Minnesota Statewide Freight Flows Study

final report

prepared for

Minnesota Department of Transportation
Office of Freight, Railroads, and Waterways

prepared by

Cambridge Systematics, Inc.

March 2000

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1.0 Introduction

The role of freight transportation in ensuring economic vitality is increasingly recognized in this era of global and interstate competition. The Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act (TEA-21) substantially increased the priority given to freight transportation by public sector planning agencies. The Minnesota Department of Transportation (Mn/DOT) has recognized the need to ensure Minnesota's competitive position in the 21st century. Through a number of efforts, Mn/DOT is working in the interests of businesses throughout Minnesota to identify potential improvements to the statewide freight transportation system. An important first step in targeting resources begins with identifying where key goods movements occur and what corridors are important to the State's economic vitality. The Minnesota Statewide Multimodal Freight Flows Study was commissioned to determine how goods move in the state and to identify key corridors where improvements might occur.

Freight movement plays a major role in the economic prosperity of the state of Minnesota. Nearly 400 million tons[1] of goods move through Minnesota each year, supporting businesses in every corner of the State. Products produced in Minnesota support consumers and industries across North America and the globe. Minnesota is a key production state that exports 50 percent more than it imports. It is the ninth largest state for outbound interstate shipments by weight,[2] following only Illinois and the large coal and oil-producing states. Ores and coal feed the large industries and cities to the east; agricultural products service food producers and human populations around the world; and manufactured components support industries on five continents. Maintaining the ability to transport goods quickly and cost-effectively is crucial to industries throughout Minnesota. These producers must also have competitive access to suppliers across North America. Millions of tons of raw materials move into the State every week, and millions more are produced within the State. Goods movement on this scale requires an extensive high-capacity transportation network capable of moving large amounts of freight quickly and cost-effectively.

Minnesota's role in the North American economy demands reliable connections to domestic and international transportation infrastructure. An extensive system of highways, rail lines, water ports, and airports facilitates goods movement within the State, as well as to and from other states. As global competition increases, maintaining the quality and capacity of this system is crucial to the economy of Minnesota. Identifying potential improvements to the freight transportation infrastructure to maintain or increase Minnesota's competitive position is an important part of maintaining future economic prosperity.

This study is intended as a significant first step down a path to more actively engage the State's business community in planning and programming activities that lead to

[1] Source: 1997 TRANSEARCH Database, Reebie Associates.

[2] Source: 1997 Commodity Flow Survey, U.S. Bureau of the Census.

transportation investments that support the economic vitality of Minnesota. The study represents an initial effort by Mn/DOT to identify logistics patterns that result in demands for transportation services (and infrastructure) by Minnesota businesses competing in a global economy. The results of this study also underscore the need to reconcile the public and private views of transportation: e.g., public infrastructure versus supply chain management; 15-year planning horizons, versus 15-minute just-in-time inventory windows.

While this study provides a better understanding of logistics patterns for existing and emerging industries in Minnesota it is limited by currently available data. Available "off-the-shelf" data sources vary both in quantity and quality in regards to transportation mode. This is a significant challenge to future freight transportation planning efforts since businesses often view their data as proprietary.

This report summarizes the findings and recommendations of this study. It is organized into the following sections:

- **Section 2.0 – Background.** A review of the study goals and related freight studies in Minnesota.
- **Section 3.0 – General Approach.** An overview of the methodological approach to this study.
- **Section 4.0 – Commodity Flows.** A comprehensive overview of freight flows in and through the state of Minnesota.
- **Section 5.0 – Logistics Profiles.** A summary of the key economic sectors and trends in Minnesota and an overview of how Minnesota shippers utilize the freight system, organized by key market sectors.
- **Section 6.0 – Modal Profiles.** A summary of Minnesota's freight transportation infrastructure by mode.
- **Section 7.0 – Key Corridors.** An overview, ranking, and performance evaluation methodology for the key intrastate and interstate freight corridors in Minnesota.
- **Section 8.0 – Recommendations.** An overview of key freight system strategies that can be undertaken to improve freight movement in the State.

2.0 Background

In the mid-1990s, the Minnesota Department of Transportation created a Freight Logistics Initiative within the department to better understand and respond to the needs of shippers in the State. Today, the Office of Freight, Railroads, and Waterways and the Metro Division's Modal Planning Section continue to work with carriers and shippers through their program activities.

In 1998, Mn/DOT established the Minnesota Freight Advisory Committee (MFAC) to solicit input directly from these sectors of the business community which rely on freight transportation for their success. The MFAC, which represents major industries and modes in the State, was created to:

- Ensure that the needs of freight are addressed in the planning, research, investment, and operations of Minnesota's transportation system;
- Establish guidelines to measure and manage the State's freight transportation needs; and
- Represent the needs and requirements of freight transportation to the public, elected officials, and other public entities.

At its first meeting in November 1998, the MFAC was asked to rank potential projects related to freight mobility for consideration by Mn/DOT. A strategic freight flows/corridor study was ranked as the project with the greatest need and anticipated value. Increasing highway congestion, particularly in the Minneapolis/St. Paul Metro area, and limited rail and intermodal access and opportunities were cited as reasons for recommending this study. In response, Mn/DOT's Freight Investment Committee (FIC) authorized funding to move forward with this study.

The goal of this study is to provide data, recommendations, and direction regarding Minnesota freight flows to Mn/DOT and the MFAC. The findings from this study will be used to make recommendations to Mn/DOT and the MFAC to improve freight transportation access and productivity in the state of Minnesota. The objectives of this study are to:

- Quantify the volume of major freight flows in the State by mode and corridor. The companion Interregional Corridors (IRC) Study will be used to complement the analysis of highway freight flows.
- Identify freight movements by type for major freight corridors (long haul, short haul, extra regional, local distribution traffic, high value, low density, low value, high density, etc.).
- Identify origins and destinations of the freight flows by mode to and from major regional centers in the State.

- Evaluate critical freight transportation planning, infrastructure, and policy issues and identify those policy questions in need of additional research, analysis, and evaluation by Mn/DOT.

- Provide freight flow data, freight transportation system performance measures, and recommendations to support and compliment the IRC Study.

2.1 Interregional Corridors Study

The statewide multimodal freight flows study was conducted in coordination with the Interregional Corridors (IRC) Study. The IRC Study was commissioned by Mn/DOT to address concerns over the efficiency of the existing and future highway system and its ability to link key economic centers in the State. While the 1994 State Transportation Plan supports investments that enhance safety and timely travel between activity centers (regional trade centers), it defined the Interregional Corridor System as the entire 5,200-mile principal arterial system. Designating all principal arterial miles as the interregional system has made it difficult for Mn/DOT to focus on the key transportation corridors throughout the State. In addition, previous plans did not provide guidance on how these corridors should perform. The result has been a lack of attention on some major corridors and some inconsistencies among Mn/DOT districts on how corridors are managed.

As a result, Mn/DOT initiated the IRC Study to identify important economic corridors in the State. The goal of the Interregional Corridor System is to maintain safe, timely, and efficient transportation services between regional centers. Providing good transportation service to the main activity centers will improve or maintain productivity, reduce transportation costs, and support the interdependence among different areas of the State and between Minnesota and other states and countries.

The IRC identified the key highway corridors over which freight moves in the State by truck. By working closely with the IRC project team and drawing upon the IRC findings, the Freight Flows Study associates key freight flows with interregional corridors, providing Mn/DOT with a better understanding of the important freight highway corridors.

2.2 Other Related Studies

In addition to the resources of the Office of Freight, Railroads, & Waterways, the MFAC, and the IRC study team, several studies have been completed in the past several years that contribute to the understanding of freight movement in Minnesota. The last statewide freight flow study was completed in 1990 by Mn/DOT. Since that time, regional studies have been completed with more detailed commodity flow information, including origin and destination data. The 1997 Freight Movement Study by the Duluth-Superior Metropolitan Interstate Committee provided details regarding the region surrounding Duluth and Superior, Wisconsin. A similar study has recently been completed by the Arrowhead

Regional Development Commission. These studies help provide an understanding of the unique character of freight movement in the Duluth area, where millions of tons of ore, coal, and grain move between rail cars and waterborne vessels. This area is responsible for a significant percentage of total freight movement by tons in the state of Minnesota.

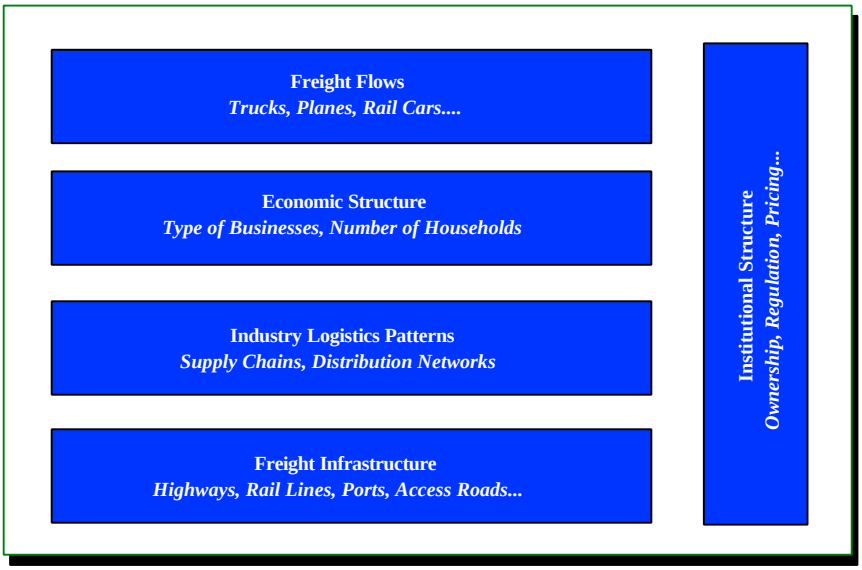
Another important study, the Northwest Minnesota Freight Flow Study, was completed for Mn/DOT in 1998. This report analyzes the large amount of seasonal agricultural commodity movements on local roads. Local agriculture and timber movements are a very large part of total freight volume in Minnesota, but these are the most difficult freight flows to quantify and track.

Other useful studies that contributed to this report included the Minnesota Intermodal Railroad Terminal Feasibility Study (MIRTS), the Minnesota State Rail Plan, and the Minnesota Statewide Transportation Plan, all prepared by Mn/DOT; and the Minnesota Statewide Air Cargo Study, prepared for Mn/DOT. A full list of resources can be found in Appendix A.

3.0 General Approach

For planning purposes, it is useful to think of the freight transportation system as comprising five major components, as follows (see Figure 3.1):

Figure 3.1 Analytical Framework



- **Freight Flows.** The principal element of any freight study, and the key part of this study, is an understanding of freight flows. The economic structure of a region, the logistics patterns of its industries, and the available infrastructure determine the flow of trucks, rail cars, and airplanes. It is important to understand the volume and value of goods flowing through the freight system, as well as their origins, destinations, and other shipment characteristics. With an understanding of freight flows and the freight transportation network, it is possible to trace vehicle movement patterns through the freight transportation system. These traffic flows can be analyzed to identify bottlenecks and opportunities for improvement. These flows are discussed in Section 4.0.

- **Economic Structure.** The economic structure of a state or metropolitan area – that is, the types of businesses and industry in an area and the number and types of jobs and households they support – is the key determinant of the type and volume of freight that will move through a region. As a region's economy grows, shifts, or shrinks, so will the demand for freight transportation. Freight planning begins with an economic profile of the industries in the region; an understanding of which industries generate freight; and a sense of how those industries are likely to change over time. Minnesota's economic structure is reviewed in Section 7.0.

- **Industry Logistics Patterns.** The logistics strategies of businesses and industry – very generally, the decisions about where to buy and sell goods – determine freight flows. Each business has a unique logistics pattern that is determined by factors such as the location of suppliers and markets, transportation costs, and economic and safety regulations. Effective freight planning requires an understanding of how changing global competition, logistics strategies, and technologies will affect businesses and their use of transportation services. Key industry logistics patterns in Minnesota are discussed in Section 7.0.

- **Infrastructure.** Freight transportation infrastructure includes highways, rail lines, rivers, freight terminals, ports, warehouses, and airports. These are the physical facilities over which goods flow. Special attention is given to intermodal facilities such as airports, railyards, and other terminals. These critical nodes in transportation and logistics systems often determine the overall effectiveness of these systems. Freight planning requires not only the identification of the location of these facilities, but also an assessment of their condition. This assessment is presented in Section 6.0.

- **Institutional Framework.** The final element of the freight transportation system is its institutional structure – how the region finances, manages, and regulates its transportation system. Federal economic deregulation of the trucking, rail, and air transportation industries in the late 1970s and early 1980s triggered major changes in ownership and operation within the freight transportation industries. These changes have led to significant shifts in industry logistics patterns and more efficient freight flows. It is important to understand the regulations governing goods movement today because they will serve as parameters for future changes in goods movement. Regulatory and institutional issues are discussed for key industries in Section 5.0 and for each modal network in Section 6.0.

4.0 Commodity Flows

The primary goal of this study and this report is to document freight flows in the state of Minnesota. Freight flows are a quantitative description of the movement of goods between defined origins and destinations by any mode of transportation. An analysis of freight flows is useful for determining important transportation corridors, principal goods markets, potential for modal diversion, congested traffic lanes, corridor improvement needs, port and terminal improvement needs, and many other freight transportation planning objectives. In response to the desires of the MFAC and other stakeholders in Minnesota, Mn/DOT commissioned the Statewide Multimodal Freight Flows Study to help identify improvements and needed strategies that will benefit the economic competitiveness of businesses across the State.

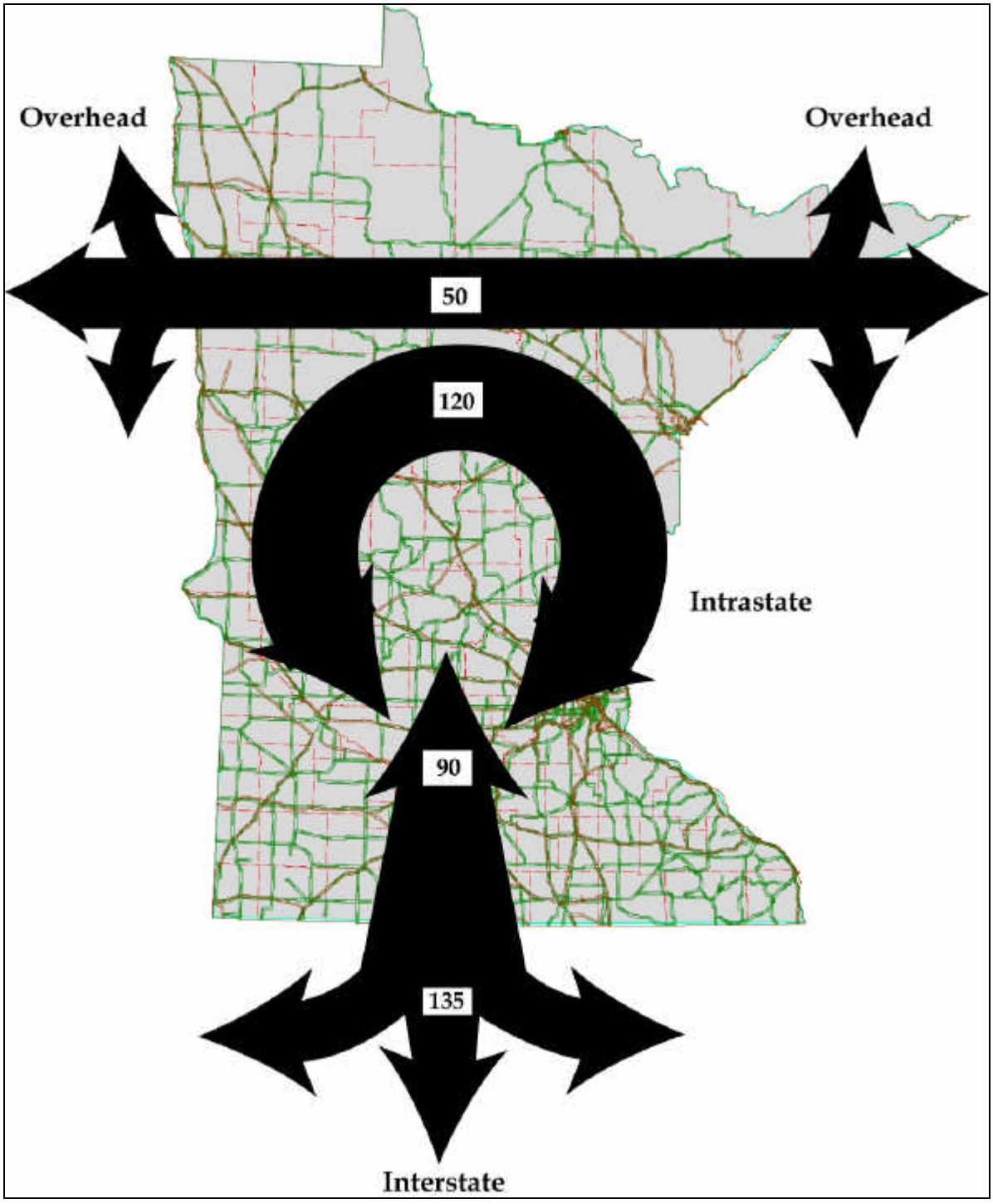
4.1 Overview

The amount of goods moving in Minnesota is tremendous. Nearly 400 million tons of commodities moved to, from, within and across the state of Minnesota in 1997. This represents approximately $350 billion worth of goods. Out of 395 million tons, 135 million tons were shipped out of the State, 90 million tons were shipped into the State, 120 million tons moved only within the State, and 50 million tons traveled through the State without stopping (see Figure 4.1). This volume of goods was comprised of large amounts of bulk commodities produced in and shipped through the State. Over 90 million tons of iron ore, 60 million tons of coal, and nearly 40 million tons of grain make up nearly half of the freight moving in Minnesota by weight.

It is also important to consider the value of goods moved. The same three bulk goods were valued at under $10 billion. However, lower tonnage consumer goods, which totaled only 18 million tons in 1997, accounted for over half ($150 billion) of the $295 billion worth of freight originating and/or terminating in the State. While consumer goods may not require as much transportation infrastructure for their distribution as do bulk goods, Minnesota's bulk products are essential inputs to the manufacture of these consumer goods throughout North America and the globe.

Minnesota is the ninth largest U.S. state for outbound domestic tons, according to the 1997 CFS. This high volume of low-value goods necessitates a well-maintained, high-capacity freight network. Minnesota's multimodal freight system needs constant upkeep and improvement to maintain the State's competitive position in the global marketplace.

Figure 4.1 Total Freight Flows Associated with Minnesota



4.2 Methodology

In order to develop an adequate understanding of freight flows in Minnesota, several data elements were necessary:

- **Total commodity flows in Minnesota.** The total quantity of freight by weight and value moving into, out of, and within the State during the year of 1997, the year for which the most recent data were available.

- **Disaggregation of total commodity flows by internal region.** The state of Minnesota was subdivided into eight regions for this analysis. These regions correspond to the Area Transportation Partnerships (ATP) shown in Figure 4.2.[1] Due to the interdependency of Duluth and Superior, Wisconsin, Douglas County in Wisconsin, which includes Superior, was added as a ninth internal region. Very little freight moves through Superior without moving through Duluth as well.

- **Detailed list of commodities.** Commodity flows are described by the specific goods being moved. The Standard Transportation Commodity Classification (STCC) codes were used at the three-digit level of detail to disaggregate commodity flows by type.[2]

- **Mode splits for all commodities.** Commodity movements were further disaggregated by the mode of transportation – air, rail, truck, and water.

- **External origins and destinations of the freight flows.** The North American origins and destinations of the State's commodity flows are important for estimating the length of haul and identifying major markets and corridors for each commodity and mode of transportation.

Data Sources

There are several federal data sources that provide commodity flow information. They include the Commodity Flow Survey (CFS) from the U.S. Bureau of the Census, the Transborder Surface Freight data from the Federal Railroad Administration (FRA), the Waterborne Commerce of the United States (WCUS) data from the U.S. Army Corps of Engineers (USACE), and the Carload Waybill Sample data from the Interstate Commerce Commission. Each source has a different level of modal or geographic coverage at different levels of

[1] ATPs are the Northeast (#1), Northwest (#2), Central (#3), West Central (#4), Metro (#5), Southeast (#6), South Central (#7), and Southwest (#8).

[2] The Standard Transportation Commodity Classifications were developed in the early 1960s by the American Association of Railroads (AAR) to analyze commodity movements by rail only. The STCC continues to be used by the AAR as a tariff mechanism. It has been adopted as the commodity classification system for all modes by several commodity reporting databases, including the 1993 Commodity Flow Survey of the U.S. Census Bureau. STCC codes go to the four-digit level but at decreasing levels of accuracy. The three-digit level provides for over 200 different commodity groupings.

disaggregation. The quality of disaggregated data is restricted by limited sampling or restrictions on the use of proprietary data. Therefore, combining these sources to paint a complete picture of commodity flows for all modes at the desired level of geographic coverage is difficult.

Figure 4.2 Minnesota Commodity Flow Regions

Reebie and Associates, Inc. was identified as having commodity flow data that has been compiled to closely match much of the data needs defined above. These data are based on

many of the data sources mentioned above as well as surveys conducted by Reebie. A detailed description of Reebie's TRANSEARCH database, including a list of STCC codes, is provided in Appendix B.

Data Analysis

The data prepared by Reebie provided the 1997 commodity flows for this analysis. The data attributes are as follows:

- **Weight and Value**. Inbound and outbound 1997 annual freight tonnage and dollar value for the state of Minnesota and each ATP;
- **Commodities**. Commodities at the three-digit STCC level of detail;
- **Modes**. Mode split information for truck, rail, water, and air;
- **Internal Regions**. Intrastate movements within the State, including trips originating and terminating within the same or different ATP; and
- **External Regions**. Distribution of inbound and outbound movements by North American region.

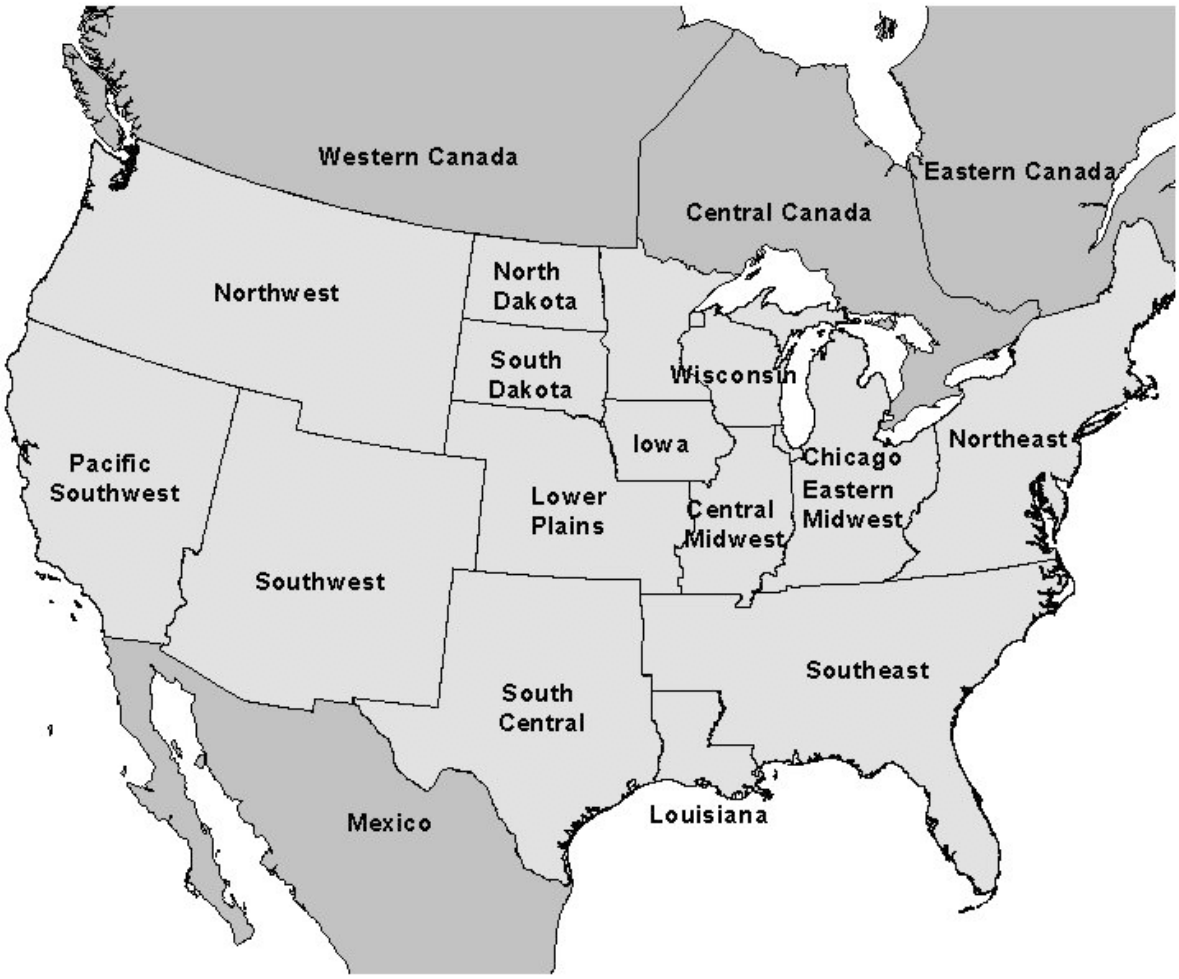
North America was divided into 19 external regions as shown in Figure 4.3. This division was made by relating large clusters of commodity flows to the major modal corridors (highway, rail, and water) serving Minnesota, thereby enabling Mn/DOT to relate major commodity flows to infrastructure needs. Thus, regions close to Minnesota are disaggregated into relatively small units (Individual states or even metropolitan areas) while more distant regions are generally aggregated into large units of multiple states since all shipments between the region and Minnesota will follow a similar path.

There are several limitations to the Reebie data, as follows:

- **Overseas Trade**. The data include all overseas trade with the State that goes through any port-of-entry (gateway) in North America outside of Minnesota. For example, mini-land bridge traffic from Asia is included in the interregional freight flows from the Northwest and Pacific Southwest regions. The data also include the domestic half of overseas trade through Minnesota ports of entry. However, Reebie's TRANSEARCH dataset does not include information for overseas origin/destination pairs. Continuing the example, Reebie has no data for the trans-Pacific movement of the Asian traffic. Therefore, no overseas import/export data are provided for ports of entry. While goods moving overseas from Minnesota are captured as they move to a port, the overseas move out of the port is not captured. This mostly understates overseas air freight through Minneapolis-St. Paul International Airport and direct overseas commerce through Minnesota ports, particularly Duluth/Superior.
- **Non-Manufactured Products**. The dataset is based on information about shippers and transportation providers in North America. Where an establishment exists that ships freight, Reebie reports the commodity flow information. However, many bulk com-

modities and agricultural products are mined or harvested and do not begin their movement at a particular facility. Most heavy bulk materials such as iron ore travel only a short distance to a consolidation facility, processing plant, or transportation terminal. Reebie captures shipments from these facilities; however, the originating movement to that facility from the mine, farm or forest goes unrecorded. This is particularly relevant in Minnesota for timber and field crops, where trucks move millions of tons of trees, grain, and sugar beets to mills, grain elevators, and processing plants. While most of these movements are short-distance on local roads, they have an impact on many local communities. Subsection 4.8 below estimates these local commodity flows. Future agricultural trends may force many grain movements to travel longer distance on heavily-traveled county and state roads. This issue is considered further in Sections 5.2 and 6.2.

Figure 4.3 North American Commodity Flow Regions



- **Commodity Flows Versus Total Tonnage.** Reebie data capture the total amount of goods shipped from establishments and transportation facilities throughout North America. It is important to note that this is not the same as the total amount of goods produced. Most materials are processed and distributed before final delivery. While a

single ton of a raw material may move to a packaging plant and then a distribution facility before arriving at the consumer, the movement of that ton may represent three or more commodity "flows." The movement to the processing plant is one flow by one mode; the movement to the distribution facility is another flow by the same or a different mode; and the movement to the consumer is yet another flow. In terms of goods movement analysis, it is important to distinguish the amount of materials handled by each separate movement in the supply chain.

4.3 Minnesota Freight Flow Summary

According to Reebie TRANSEARCH data, 338 million tons of freight originated and/or terminated in Minnesota during 1997. This corresponds to $296 billion. (An additional 50 million tons passed through the State with an approximate value of $50 billion.) Forty-seven percent, or 159 million tons, moved by rail; 32 percent, or 108 million tons, moved by truck; 21 percent, or 71 million tons, moved by water; and under 400,000 tons moved by air (see Figure 4.4). While trucks carried only 32 percent of the freight by weight, they moved 85 percent of the value, or $252 billion. Rail carried only $35 billion in value; water carried $7.6 billion; and air carried $4.4 billion worth of freight.

A complete table of commodity flows by tons for all commodities combined is provided in Appendix C. The top 20 commodities by tons and weight are listed in Tables D.1 and D.2 of Appendix D[3] for all modes. The detailed commodity flow analysis is organized by the following types of commodity flows:

- **Total Interstate Flows** – Over 220 million tons or $170 billion worth of freight moves between the state of Minnesota and other regions within North America;

- **Total Freight Flows within Minnesota Regions** – Each of nine regions within Minnesota (including Superior, Wisconsin) contributes to this total volume of interstate freight in addition to generating 120 million tons or $130 billion worth of intrastate freight;

- **Total Modal Flows** – Interstate and intrastate freight flow characteristics are disaggregated by mode; and

- **Commodity Flows of Key Commodities** – Iron ore, coal and grain play a significant role in the freight transportation system of Minnesota, and data for these commodities are disaggregated.

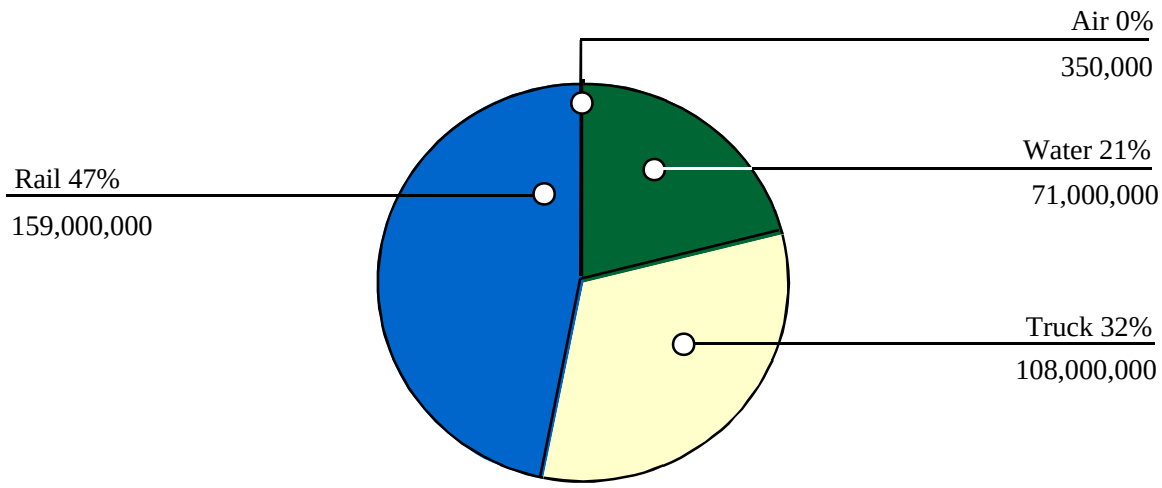
[3] Many of the figures referred to in this section have been placed in Appendix D for the sake of text flow.

4.4 Total Interstate Flows

Figure 4.5 shows the total commodity flows from Minnesota. One hundred thirty-four million tons move out of the State and 87 million tons move into the State.

Figure 4.4 Total Freight by Mode

Tons



Dollars

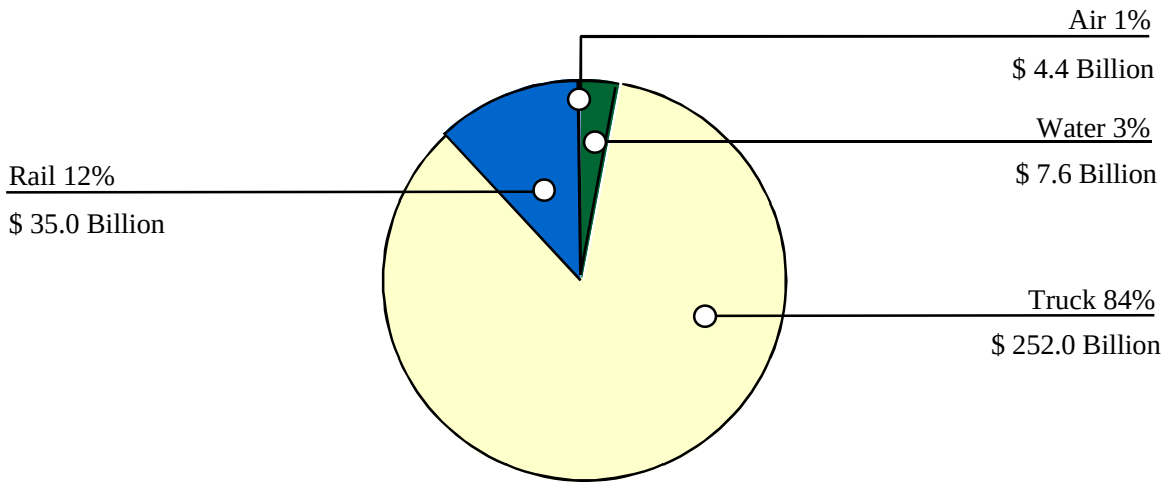
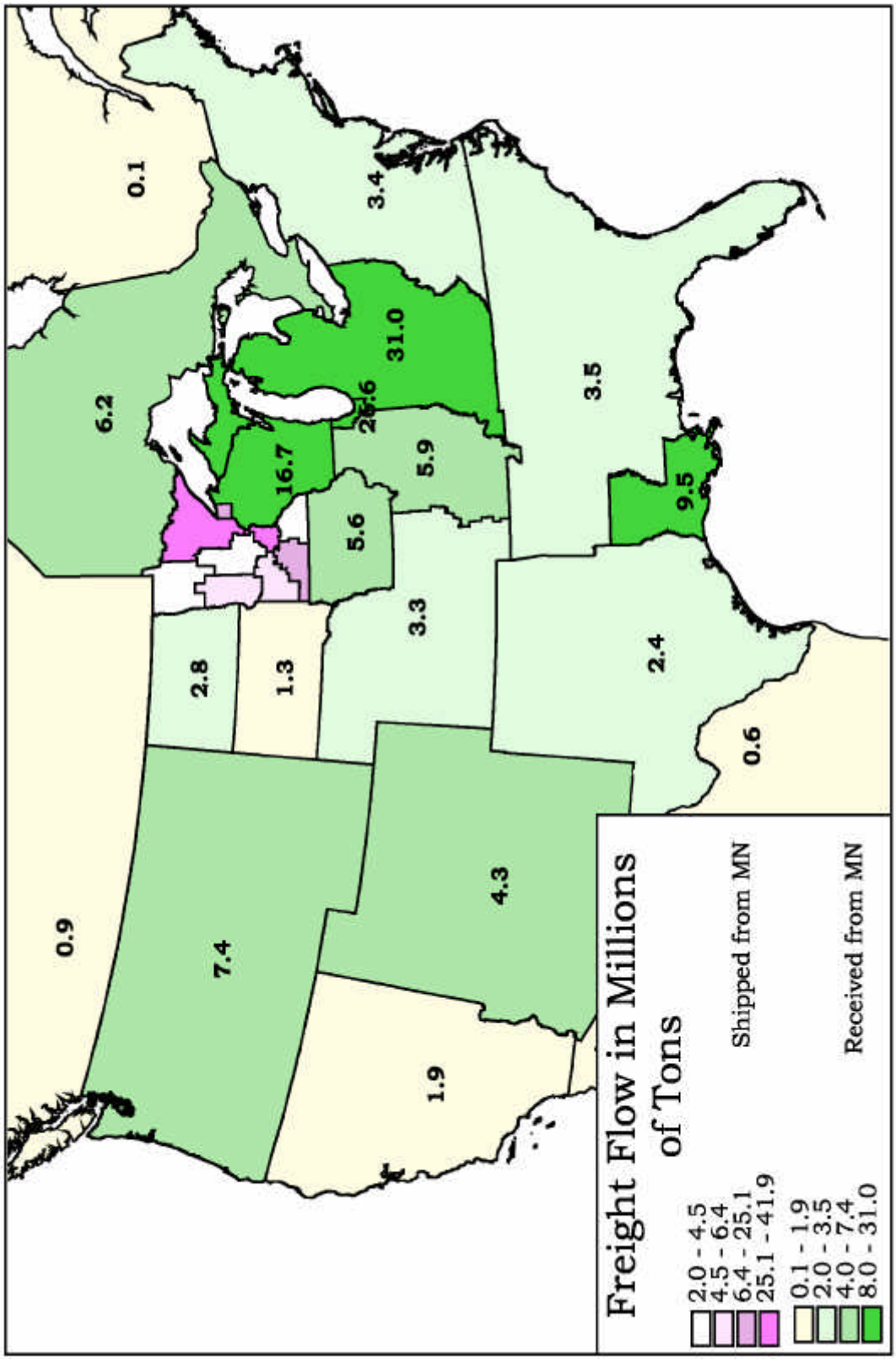


Figure 4.5 Total Interstate Commodity Flows by Weight from Minnesota



Outbound Flows

By Weight

The Eastern Midwest (31 million tons), Chicago (27 million tons), Wisconsin (17 million tons), and Louisiana (10 million tons) are the top four interstate destinations for freight originating in Minnesota. Northeast Minnesota (ATP 1) generates half (29 million tons) of the freight bound for the Eastern Midwest and Chicago, and nearly all of this tonnage is iron ore, presumably shipped by water to steel mills on the Great Lakes (i.e., northern Indiana). Northeast Minnesota and the Metro region (ATP 5) together are responsible for generating 86 million tons of freight, or about 65 percent of all outbound freight.

The bulk of material being shipped to Wisconsin comes from the Metro region (ATP 5). However, the majority (8 of 11 million tons) is coal that has been transshipped through the Metro region from the Northwest (i.e., Wyoming). A similar transshipment occurs to Louisiana. Eight out of 10 million tons shipped to Louisiana originates in the Metro region, but nearly all of this is waterborne grain and mill shipments that originate in the agricultural regions across the Upper Plains. As a result, nearly half (16 out of 38 million tons) of the interstate freight originating in the Metro region can be attributed to coal and grain transshipments.

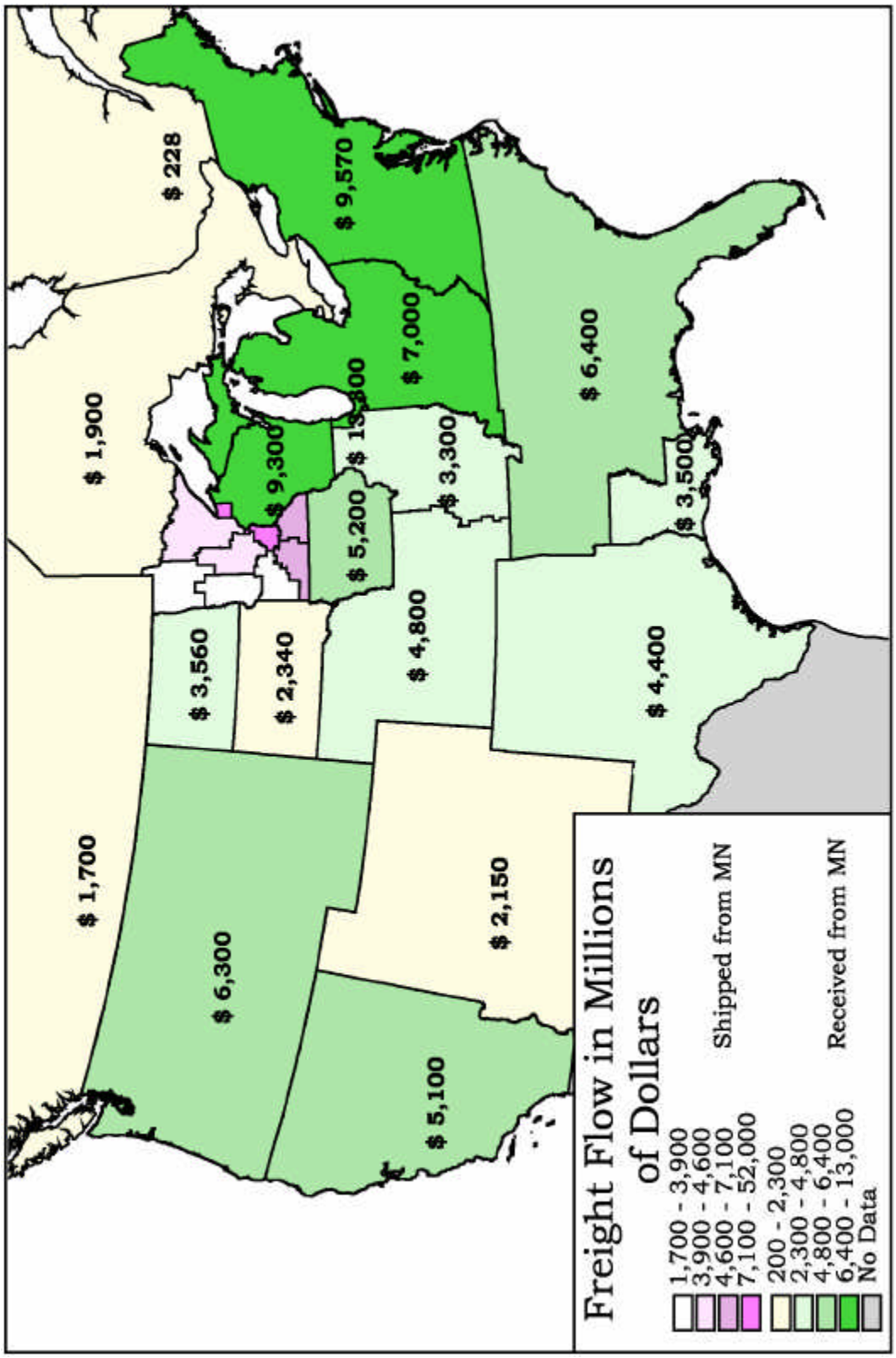
The six surrounding regions receive only 25 percent (34 of 134 million tons) of outbound interstate freight. Regions within an approximate 500-mile radius (the six adjacent regions plus the Lower Plains, Central Midwest, Chicago, and Eastern Midwest) receive 75 percent (101 million tons) of freight from Minnesota annually. The remaining 33 million tons, or 25 percent of interstate outbound freight, is shipped more than 500 miles from Minnesota. Clearly, Minnesota relies on long-distance transportation connections for three-quarters of its outbound freight. As a comparison, over three-quarters (85 out of 110 million tons) of the freight departing the New York metropolitan area remains within an approximate 250-mile radius.[4] In order to accommodate this long-distance transportation, rail is used by many Minnesota shippers. Rail carries the majority of outbound tonnage to eight of 19 external regions for an overall outbound interstate mode share of 35 percent. Four of these regions are beyond 500 miles (the Northwest, Southwest, South Central and Mexico.) The rail share to the Northwest is nearly 90 percent. This movement consists almost entirely of overseas grain shipments from Southwest and West Central Minnesota through Pacific Ocean ports.

By Value

Figure 4.6 shows the total outbound interstate commodity flows. It is important to note that while Minnesota ships much more freight by weight than it receives, the value of outbound freight is only $86 billion versus $86 billion inbound. The value per ton of Minnesota's major outbound commodities – iron ore, coal, and grain – is much lower than the value per ton of most inbound goods. Forty-five million tons of outbound iron ore corresponds

[4] Cambridge Systematics, Cross-Harbor Freight Movement Major Investment Study, prepared for the New York City Economic Development Commission, January 1999.

Figure 4.6 Total Interstate Commodity Flows by Value from Minnesota



to only $1.3 billion in value. Minnesota ships only 3.5 million tons of warehouse, distribution and freight-all-kinds (FAK) goods (typically associated with consumer products); however this amount represents the highest valued outbound commodities at $30 billion. Printed matter and meat or poultry follow at $3.5 billion and $3.4 billion, respectively.

The top four markets for Minnesota goods ranked by value are Chicago ($13 billion), the East Coast ($10 billion), Wisconsin ($9 billion), and the Eastern Midwest ($7 billion). Trucks carry the majority of this freight by value, especially to Wisconsin ($8.5 billion) and the East Coast ($9 billion). The only outbound markets where trucks do not carry the majority of goods by value are the Northwest, where rail carries over $4 billion worth of goods en route to Asia, and Louisiana, where water shipments are over $2.5 billion.

Modal Splits

The percentage of all outbound Minnesota shipments carried by each mode of transportation is shown in Figure D.1.[5]

- Out of 134 million tons, water carries the largest amount at 61 million tons. Three commodities – iron ore (31 million tons), coal (13 million tons), and grain (7 million tons) – represent over 80 percent of these waterborne shipments.

- Rail carries the second highest amount of outbound tonnage at 47 million tons. Again, iron ore (9 million tons), coal (10 million tons), and grain (15 million tons) represent the top three commodities and the largest share of outbound rail goods at 72 percent combined.

- Trucks move only 19 percent (25 million tons) of all outbound tonnage. Paving materials (3 million tons), warehouse and distribution products (2.6 million tons), and meat or poultry (2 million tons) are the top three commodities. However, these commodities represent only 30 percent of goods moved by truck, revealing the diversity of truck shipments.

- The air mode split for outbound freight shipments is less than one percent at 123,000 tons. According to Reebie, the top three outbound commodities are mail (56,000 tons), construction equipment (11,000 tons), and general machinery (7,000 tons).[6]

[5]Reebie does not capture pipeline shipments for U.S. and Mexican origins and destinations, hereby understating the total tonnage of freight. Canadian origins and destinations in Reebie's TRANSEARCH data do include pipeline shipments as part of total shipments; however, the only region external to Minnesota that is affected is western Canada which ships approximately 13 million tons of goods by pipeline to Minnesota. This data is not included in the discussion but does appear as part of total shipments.

[6]Reebie does not capture overseas air freight.

Inbound Flows

By Weight

Figure 4.7 shows inbound interstate flows. Eighty-seven million tons of goods move into Minnesota each year from other locations in North America. Over 40 percent (37 million tons) originates in the northwestern U.S. Of this amount, 95 percent (35 million tons) are coal shipments from Wyoming. The next three largest originating regions are North Dakota (8 million tons), the Eastern Midwest, and Iowa (7 million tons each). Over three-quarters of all inbound freight is destined for the Metro region (ATP 5) and Northeast Minnesota (ATP 1); nearly half of all inbound interstate tonnage (40 million tons) arrives in the Metro region, and Northeast Minnesota receives 28 million tons.

The six regions adjacent to Minnesota ship 33 percent (29 million tons) of the total inbound freight flows. Regions within 500 miles ship 48 million tons. Only 11 percent (10 million tons) of inbound freight originates over 500 miles from Minnesota.

By Value

Figure 4.8 shows inbound flows by value. The value of inbound shipments, which are primarily inputs to production and consumer products, nearly matches the value of outbound goods. Warehouse, distribution, and freight-all-kinds (FAK)[7] products represent over $34 billion of inbound interstate commodity flows. An additional $5 billion of goods are drayed from railheads into the State. Over $7 billion of motor vehicles and equipment were delivered to Minnesota in 1997 as well. Nearly a third of all inbound goods by value travel over 500 miles to the State. While Wisconsin ($15 billion), Iowa ($12 billion), and the Upper Midwest ($10 billion) are the three largest origins, nearly $9 billion worth of goods comes from the Southeast.

Modal Splits

- Due in large part to coal shipments from Wyoming, rail carries the greatest amount of goods to Minnesota (62 percent or 54 million tons. See Figure A12.). After coal, grain is the next largest inbound commodity at 12 percent or seven million tons inbound. The third largest inbound rail commodity is industrial chemicals (2 million tons), which come primarily from the South Central region.

- Trucks are responsible for 30 percent (26 million tons) of inbound freight. The top three commodities represent only 30 percent of truck tonnage. These are warehousing and distribution goods (3.5 million tons), concrete (3 million tons), and grain products (1.5 million tons).

[7] FAK is a railroad designation used primarily for containerized freight. While containers can carry many commodities, they are frequently used for higher value consumer products and inputs to production.

Figure 4.7 Total Interstate Commodity Flows by Weight to Minnesota

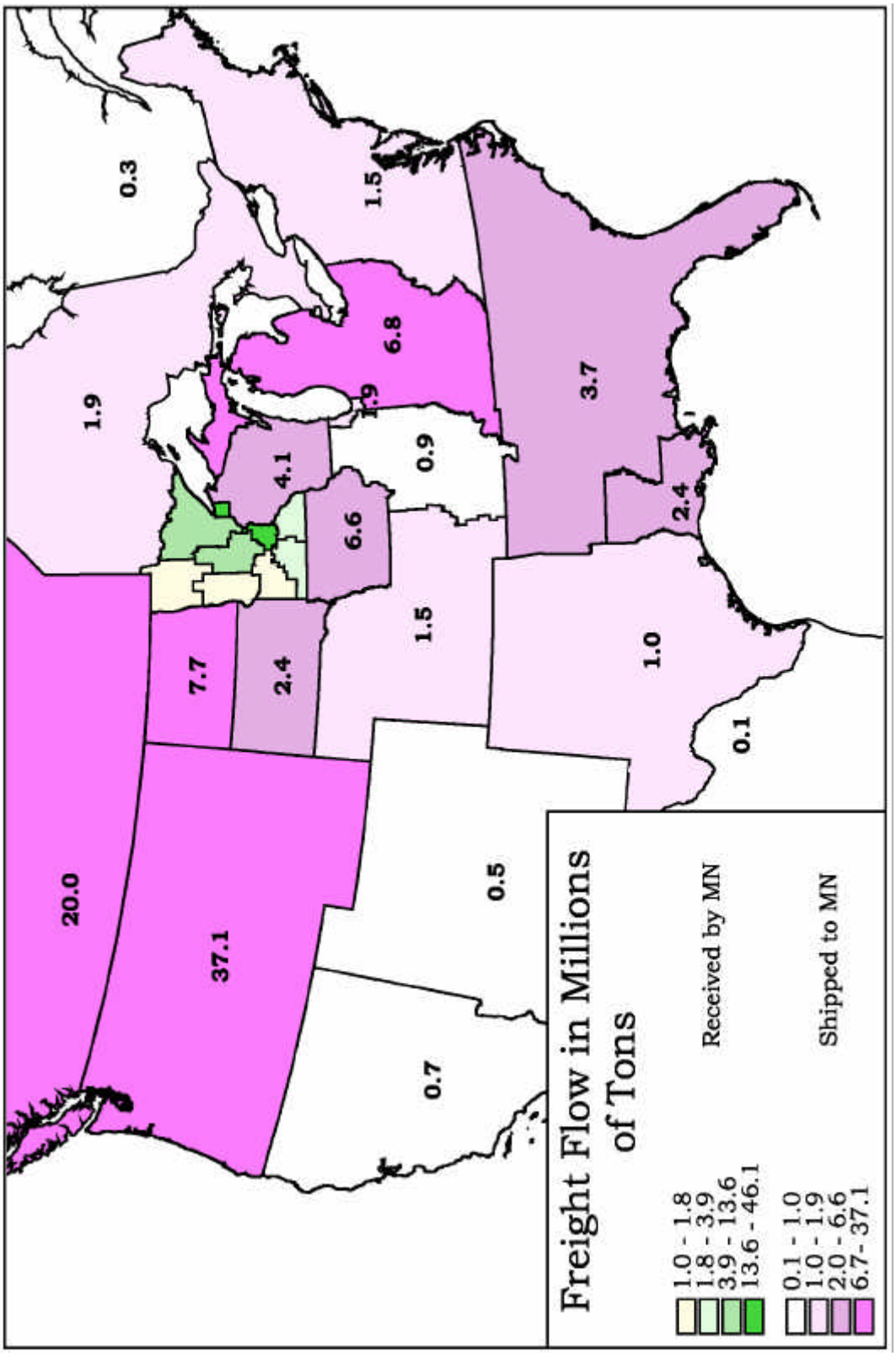
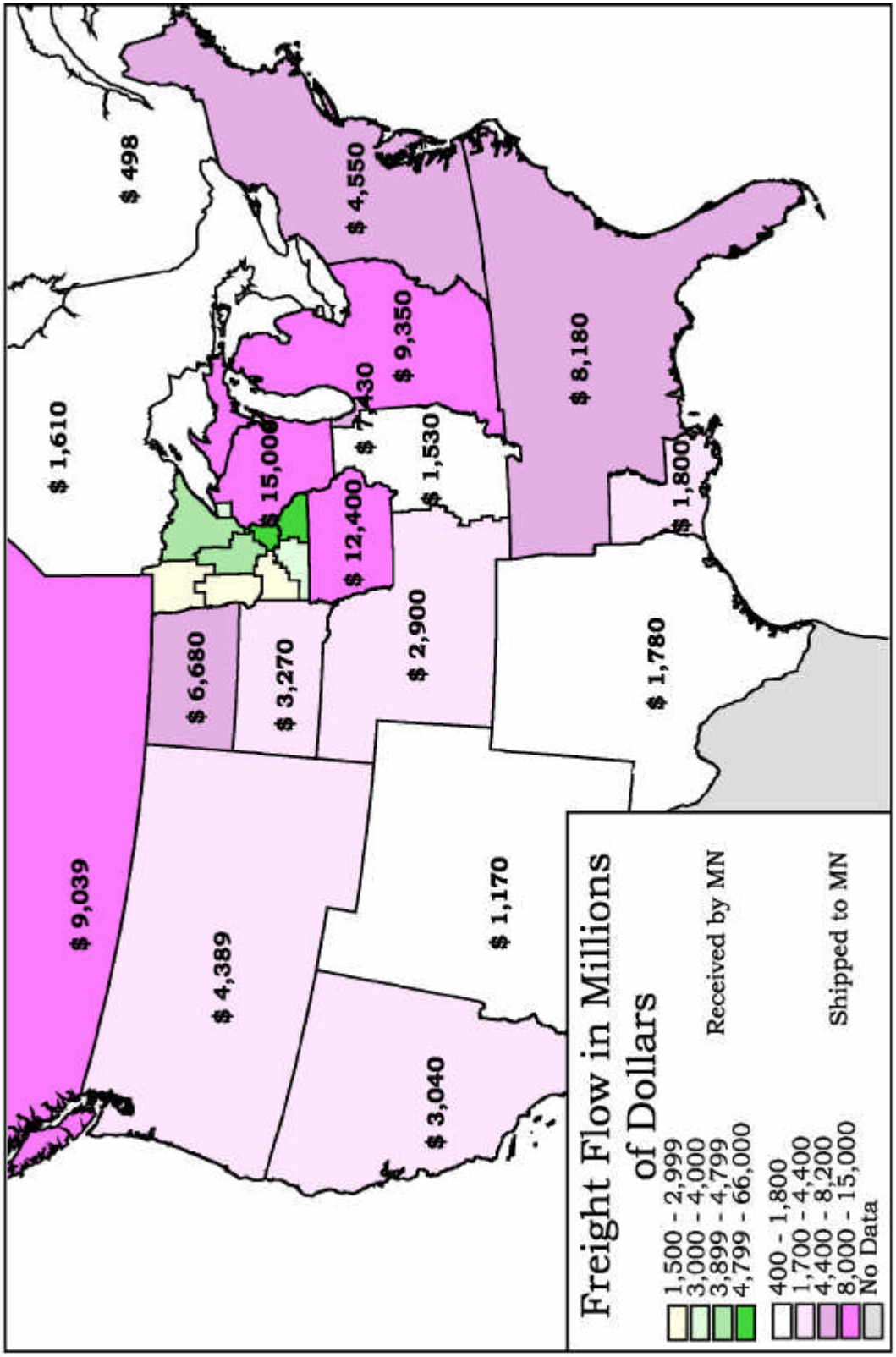


Figure 4.8 Total Interstate Commodity Flows by Value to Minnesota



- Waterborne vessels carry eight percent (7 million tons) of inbound commodities. Gravel and stone shipments up the Mississippi River account for nearly three million tons. Agricultural chemicals represent just under 25 percent (1.1 million tons) of inbound water shipments.

- Air is the only mode that brings in more freight to Minnesota than is shipped out. Of 227,000 inbound tons, nearly half (106,000 tons) is mail. Motor vehicle equipment (10,000 tons) and drugs (8,200 tons) are the next largest inbound commodities, followed closely by office and computing machinery (8,000 tons).

4.5 Freight Flows Within Minnesota Regions

Figure 4.9 estimates the total amount of freight moving in each region of Minnesota.[8] This includes inbound and outbound interstate flows; inbound and outbound intrastate flows[9]; and intraregional flows that originate and terminate within the same region. (See Table 4.1 below or Table D.3.) This graphic indicates the relative impact each region has on Minnesota's freight transportation infrastructure. Maps of interstate flows to and from these regions can be found on Figures D.3 and D.4 in Appendix D. Additional maps of intrastate flows received and shipped by each region can be found on Figures D.5 and D.6. Finally, a map of intraregional flows for each region can be found on Figure D.7. All of these maps have corresponding maps by value on Figures D.8 to D.12.

The Metro region (about 120 million tons) and Northeast Minnesota including Superior (together about 160 million tons) carry more than half of all freight (400 million tons) associated with Minnesota by weight, while the Metro region alone carries more than half of all goods by value (approximately $175 of $340 billion). Northeast Minnesota and Superior combined only handle about the same amount of freight by value ($30 billion) as either Southeast or Southern Minnesota.

Intrastate Freight Flows

As indicated earlier, 117 million tons (30 percent) of all freight with origins and destinations in Minnesota (388 million tons) both originates and terminates in Minnesota. Twenty-four million tons of this intrastate freight (21 percent) circulates without leaving the borders of Northeast Minnesota, and 20 million tons (17 percent) moves strictly within the Metro region. Typically, most intrastate freight flows that move between regions is destined for the Metro region (19 million tons). Southeast Minnesota (ATP 6) receives five million tons from other

[8] Figure D.2 and Table D.4 in Appendix D shows these regional flows by value.

[9] The amount of intrastate (or interregional) goods assigned to each region is one half of the inbound plus one half of the outbound trade for each interregional combination. These moves are evenly divided because what is outbound from one region is also inbound to another, and the entire commodity flow cannot be assigned to either region exclusively. Therefore, this freight composite is only an estimate of relative freight volumes in each region.

Figure 4.9 Total Commodity Flows by Weight for Minnesota Regions

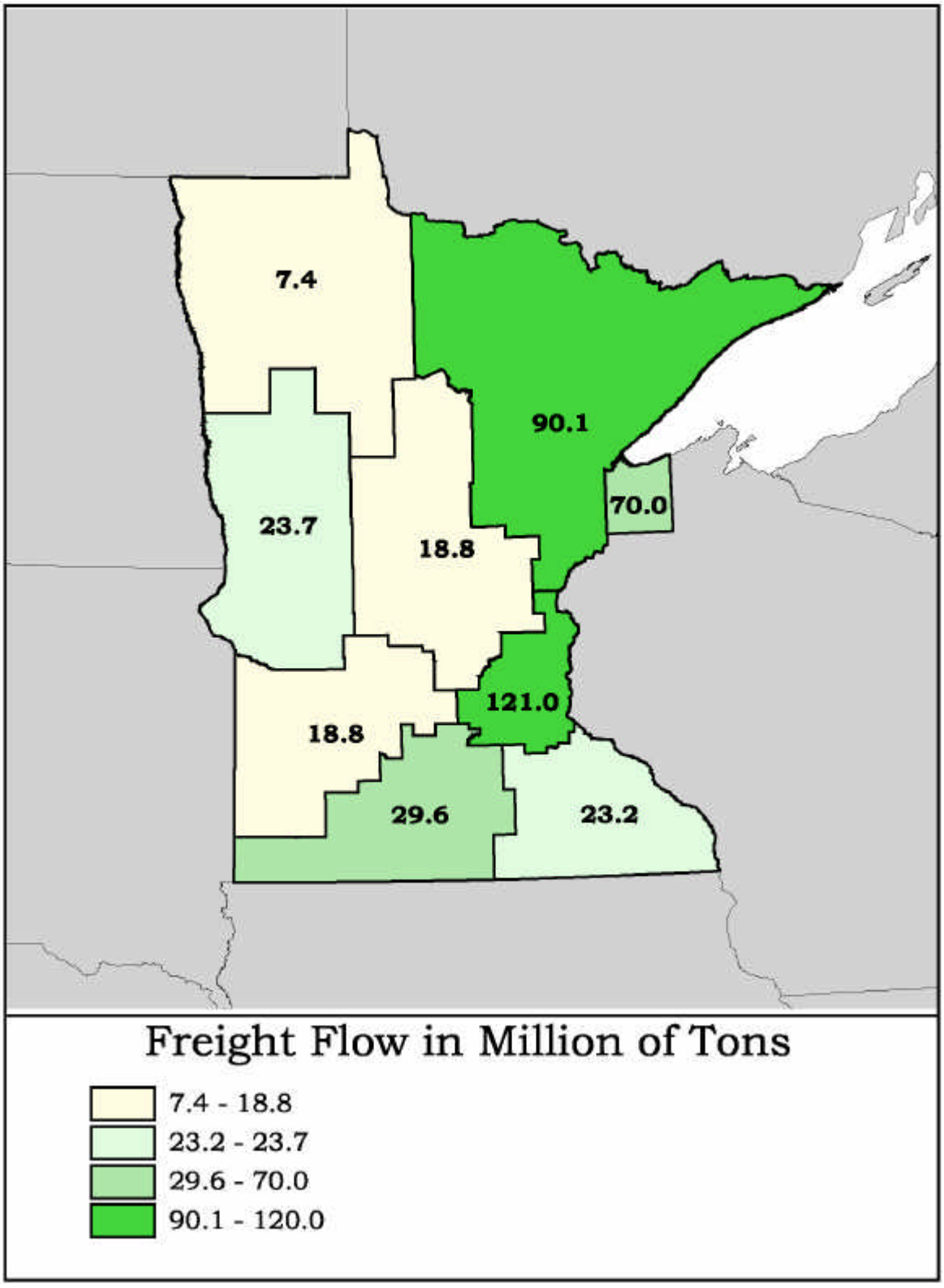


Table 4.1 Composition of Total Freight by Region*

	Total Tons	Outbound Interstate	Inbound Interstate	Intrastate	Intraregional	Overhead
ATP 1, Northeast MN	90,108,272	47%	11%	15%	26%	0%
ATP 2, Northwest MN	7,410,072	41%	13%	43%	1%	3%
ATP 3, Central MN	18,808,240	10%	57%	28%	2%	3%
ATP 4, Western MN	23,667,971	27%	6%	27%	1%	39%
ATP 5, Metro Division	121,441,273	31%	34%	12%	17%	6%
ATP 6, Southeast MN	23,199,460	19%	13%	31%	3%	34%
ATP 7, Southern MN	29,568,362	28%	6%	28%	1%	37%
ATP 8, Southwest MN	18,787,101	26%	6%	31%	1%	37%
Douglas County, WI	70,037,633	36%	25%	33%	1%	5%
TOTAL ESTIMATE	**403,028,383**	**33%**	**22%**	**22%**	**11%**	**12%**

Source: 1997 Reebie TRANSEARCH database.
*** For additional detail, see Tables D.3 and D.4 in Appendix D.**

Minnesota regions, and Central Minnesota receives 4.5 million tons. The bulk of these shipments originate in the Metro region (approximately 3 million tons to each.) Northeast Minnesota receives 3.5 million tons from the rest of the State.

4.6 Total Modal Flows

The following section summarizes freight flows by mode. This analysis helps to shed light on the particular role of each mode of transportation in Minnesota freight movement. It enables a comparison of movements by mode between specific origins and destinations in order to explain mode shares and determine the potential for modal shift.

Total Truck Flows

Figures D.13 through D.16 show the total flows by truck into and out of Minnesota by weight and value. Figure D.17 shows the top commodities that trucks carry for interstate moves. Out of 108 million tons moved by trucks, 51 million tons moves interstate (25 million tons outbound and 26 million tons inbound). The largest destinations are Wisconsin (4.5 million tons), Chicago (2.7 million tons), and the Northeast (2.4 million tons). Beyond local markets, trucks deliver long distance predominantly to the Eastern Midwest (2.2 million tons), the Northeast, the Southeast (1.5 million tons) and the Pacific Southwest (1.1 million tons). The largest origins are Iowa (5 million tons), Wisconsin (4 million tons), and North Dakota (3.5 million tons).

Total Rail Flows

Figures D.18 through D.21 show the total flows by rail into and out of Minnesota by weight and value. Figure D.22 shows the top commodities that rail carries for interstate moves. Out of 159 million tons moved by rail in Minnesota, 54 million tons moves inbound interstate and 47 million tons moves outbound. The largest destinations are Wisconsin (12 million tons), the Northwest (6.5 million tons), and the Central Midwest (5 million tons). The largest origins are the Northwest (36.5 million tons), Western Canada (4.5 million tons), and North Dakota (4 million tons).

Total Water Flows

Figures D.23 through D.26 show the total flows by water into and out of Minnesota by weight and value. Sixty-one out of 71 million tons of water freight are shipped from Minnesota to other destinations in North America. Only seven million tons is shipped to the State. About three million tons moves within the State among river and lake ports. The top four destinations are the Eastern Midwest (27 million tons), Chicago (18 million tons), Louisiana (9 million tons), and Eastern Canada (5.5 million tons.) The Eastern

Midwest (3.5 million tons) and Louisiana (2 million tons) ship three-quarters of the inbound waterborne freight.

Total Air Flows

Figures D.27 through D.30 show the total North American flows by air into and out of Minnesota by weight and value. The East Coast receives more freight than any other region at 22,000 tons. This is followed by the Eastern Midwest (17,000 tons), and the Pacific Southwest (15,500 tons). Minnesota receives more than it ships by air. Over 227,000 tons move into the State, mostly from the Southeast and Eastern Midwest where two large FedEx hubs are located.

4.7 Flows of Key Commodities

As indicated earlier, iron ore, coal, and grain represent the largest commodity flows in the state of Minnesota. Due to their importance, it is worthwhile to examine the multimodal freight flows of these bulk goods individually.

Iron Ore

The total tonnage of iron ore and taconite moving in Minnesota (94 million tons) is nearly three times as large as the next highest tonnage commodity produced in the State, field crops (36 million tons). Iron ore volumes are 50 percent larger than those of the extensive volume of coal moving to, in, and through the State (60 million tons).

Figure D.31 shows the flows of iron ore out of Minnesota. Regions within Minnesota are shaded to indicate where goods originate for outbound movements. Minnesota iron ore is produced exclusively in Northeast Minnesota and moved by rail to nearby Great Lakes ports. Over 48 million tons move by rail to the ports, with 22 million tons moving through Minnesota ports and 26 million tons moving through ports in Superior, Wisconsin. Primary waterborne destinations include the Eastern Midwest (14 million tons) and Chicago (17 million tons). Rail flows also move to these regions and the Central Midwest (together, 3.5 million tons), as well as the Southwest (3 million tons).

Coal

Nearly 35 million tons of coal move into the state of Minnesota from Wyoming, but most of it continues on to other locations throughout the Midwest. Figures D.32 and D.33 shows these movements. Regions within Minnesota are shaded to indicate where goods originate for outbound movements and where goods arrive for inbound movements. Every region within Minnesota receives coal from the Northwest. The West Central and Metro regions transship 2.5 and 8.5 million tons, respectively, by rail to Wisconsin and the

Eastern Midwest. The largest share of inbound coal (13 million tons or 37 percent) is transshipped through Superior, Wisconsin to the Eastern Midwest.

Grain

Figures D.34 and D.35 shows the distribution pattern of field crops to and from Minnesota. Again, regions within Minnesota are shaded to indicate where goods originate for outbound movements and where goods arrive for inbound movements. Grain arrives in Minnesota from the Upper Plains and Western Canada by truck and rail for processing and distribution. Thirty-six million tons of grain are shipped to Minnesota processing facilities, of which nine million tons originate in nearby regions. While 13 million of these tons remain within Minnesota, 23 million tons of product are transshipped to destinations throughout North America. Eight million tons travel down the Mississippi River to Louisiana for export. Another 5.5 million tons travel by rail to the Northwest for export to Asia. Chicago receives three million tons.

It should be reiterated that Reebie data do not capture all grain movements. (See discussion on "Data Limitations" below.)

4.8 Data Limitations: Forest Products and Field Crops

It is important to consider the contribution of local truck movements to the total flow of freight in Minnesota. Thousands of trucks carry produce from farms to processing facilities every day. A prime example is the large volume of traffic associated with the seasonal sugar beet harvest in Northwest Minnesota. In addition, many logging trucks bring hundreds of tons of cut trees to mills throughout northern Minnesota. Due to the manner in which Reebie collects data for its TRANSEARCH database, most of these freight flows are not captured. Reebie's data sources are based on interviews and surveys of what shippers send to their customers. In the case of a manufacturing shipper, raw materials typically come from another shipper in the Reebie database. However, in the case of an agricultural or forest product shipper, the raw materials are coming directly from the surrounding natural resources, not a specific shipper. While this limitation does not affect, for instance, data for a mining operation whose trucks operate directly on the property of the mine, it does affect data for shippers whose raw materials must travel many miles from the harvested fields or forest.

As a result, the total volume of freight reported in the Reebie dataset for intrastate flows is understated. For grain and forest product producers, it is conservative to assume that 100 percent of the 28 million tons of outbound processed grain traveled inbound first. In the case of grain, trucks will often travel 50 miles or more to a processing site, crossing regional and state borders in the process.

Other sources of data do exist to capture the local movement of some non-manufactured commodities. The Minnesota Timber Producers Association compiles estimates of local truck movements to lumber and paper mills in northern Minnesota. A map of these local

moves can be found on Figure D.36. Reebie captures only the products shipped from the mills or through rail and water terminals.

Other non-manufactured commodity movements in Minnesota have been estimated through models validated by truck counts and survey information. The Northwest Minnesota Freight Flows Study estimated the movement of sugar beets to processing facilities and grain to elevators in ATP 2. The study used Reebie data, MN/DOT truck counts, and survey data to calibrate a Quick Response System model for the region. Figure D.37 depicts the moves associated with Minnesota's sugar beet industry. Figure D.38 depicts local grain moves from farms in northwest Minnesota. While grain moves are not limited to this region, this methodology would be applicable to other regions where data are available. In order to develop a better understanding of local grain movements, it is recommended that similar truck volume and survey data throughout the State be collected and analyzed through a subsequent study.

4.9 Conclusions

This commodity flow analysis has provided an understanding of: what goods move in Minnesota; how they are handled; and where they go.

- Understanding the commodities that are shipped and received helps to identify the types of businesses involved in freight movement and the types of vehicles in which their goods must move.

- Understanding the different modes of transportation required by Minnesota businesses helps to determine the demand on each of Minnesota's modal freight systems. This will be discussed in detail in Section 6.0.

- Understanding where these goods move to and from helps identify Minnesota's primary internal and external markets, which helps explain the logistics requirements of the businesses moving those commodities. These requirements will be discussed in Section 7.0.

5.0 Logistics Profiles

The movement of freight is dependent on much more than the physical transportation infrastructure. It is also dependent on the service and cost requirements of the shippers and receivers that generate the demand for freight transportation services and the transportation service providers that serve this demand. Therefore, a critical component of this freight study is the analysis of the supply chains and logistics patterns of major shippers using Minnesota's infrastructure. Although no two shippers use the system in exactly the same way, this section presents the logistics profiles of the key industries operating in Minnesota. This section augments the commodity flow analysis by providing detailed illustrations of specific freight operations.

To provide the business context for companies shipping and receiving goods in Minnesota, this section begins with an overview of the Minnesota economy focusing on the implications to freight transportation.

5.1 Economic Overview

The economic summary looks at the State economy in terms of:

- **Employment**, including statistics on employment as an indicator of the overall economic health and future expectations of the State;
- **Core Industries,** exploring the four major economic sectors that particularly influence the statewide economy;
- **Competitive Advantages**, highlighting four of the State's characteristics that make it attractive to businesses; and
- **Transportation,** examining the influence of Minnesota's transportation network on the State's economic success.

From these economic insights, and the resulting estimation of demand and implications for commodity flows, agencies can develop a clearer picture of Minnesota's transportation infrastructure needs for the next 20 years.

Employment

Minnesota enjoys a well-diversified and healthy economy. The State's continued growth in manufacturing and other traditional industries, coupled with its aggressive positioning

to attract emerging industries, support the optimistic expectations of the State's economic future. Some highlights are presented below.

- The State economy employed more than 2.5 million people in 1994, and is expected to add 370,000 jobs by 2005.[1] Most of these new jobs will be in service industries (209,000 new jobs expected between 1994 and 2005); finance, insurance and real estate, and retail trade.

- Historic economic growth rates have compared very favorably with the national average. Between 1988 and 1996, Minnesota's gross state product increased by 26.5 percent, which far outpaced the comparable U.S. GDP growth of 18.3 percent.

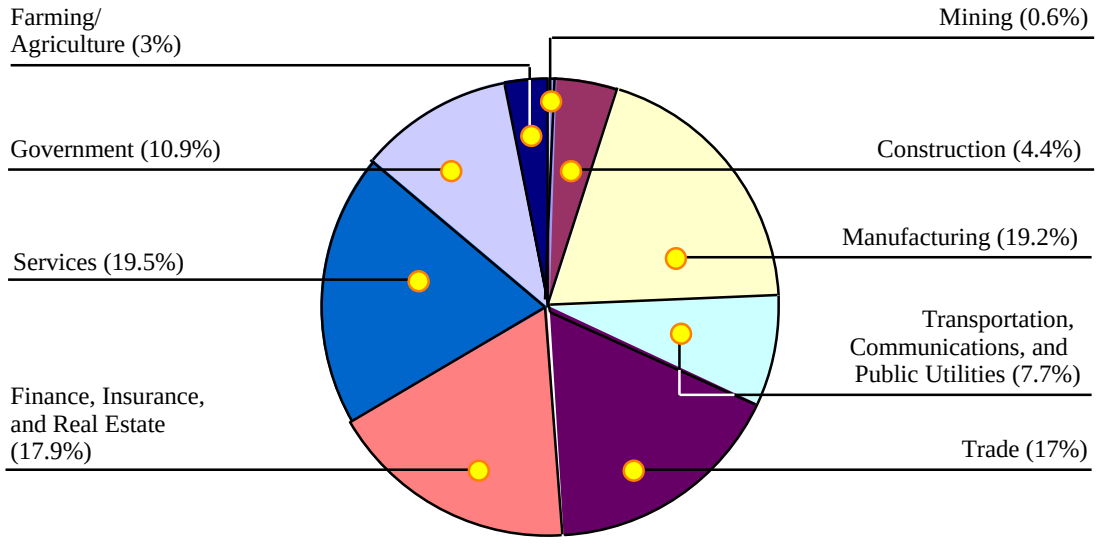
- While recent employment trends do point to a concentration of jobs in the major metropolitan areas of St. Cloud, Rochester, and particularly Minneapolis/St. Paul, 84 of the State's 87 counties have continued to experience job growth.

- Minnesota's manufacturing sector remains an important industry and is expected to grow in the face of a national decline in manufacturing.

Core Industries

Although Minnesota's economy is fairly evenly distributed across industry sectors, four industries do comprise a significantly larger portion of the Gross State Product: services; manufacturing; finance, insurance and real estate; and trade. These industries have a fundamental role in underpinning the state economy. Figure 5.1 shows the percent of Minnesota's Gross State Product (GSP) generated within each industry sector for FY 1996.

Figure 5.1 Percent of Minnesota's 1996 GSP by Industry Sector



[1] Source: Minnesota Department of Trade and Economic Development, 1999.

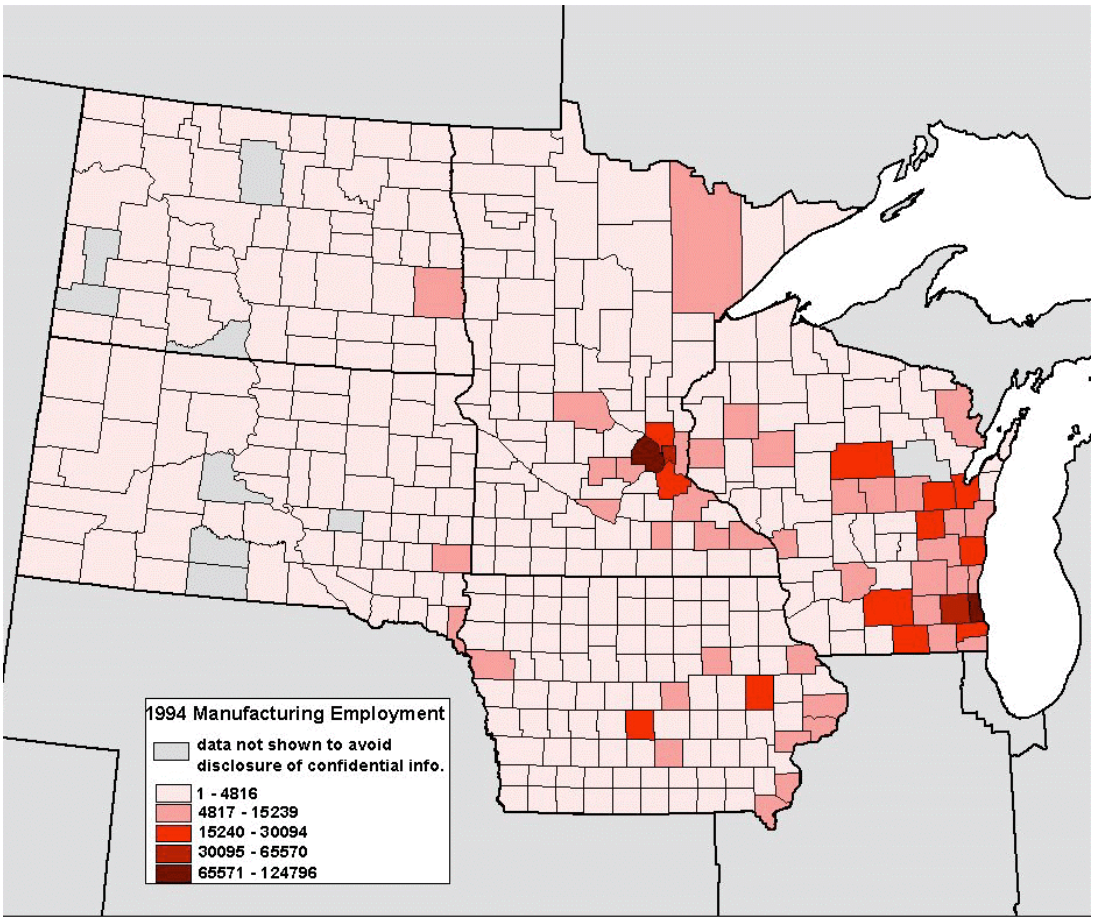
Services

In addition to being Minnesota's largest industry sector, services are the fastest growing sector of the economy. In 1996, it contributed more than $27.5 billion (19.5 percent) to the State's GSP. While services represent a significant percent of the state economy, this share is slightly below the national average of 20.2 percent. This points to a further capacity for development of the services sector in the State.

Manufacturing

Anchored by large manufacturers like Minnesota Mining and Manufacturing (3M) and General Mills, Minnesota's manufacturing sector continues to thrive in a national economy that is moving away from manufacturing. The ready proximity of raw materials, low cost of living, abundant supply of skilled labor, and extensive transportation system all make Minnesota an attractive location for manufacturers to establish operations. As a result, revenues from manufacturing comprised 19.2 percent of the State's GSP for 1996 ($27 billion), and are expected to increase roughly nine percent by 2005. Figure 5.2 shows regional manufacturing employment in 1994.

Figure 5.2 Regional Manufacturing Employment by County



Growth in the manufacturing sector is especially significant from a transportation perspective, since manufacturers are typically heavy generators of freight transportation. This generation occurs both when raw materials are shipped to processing sites and when finished products are distributed for sales.

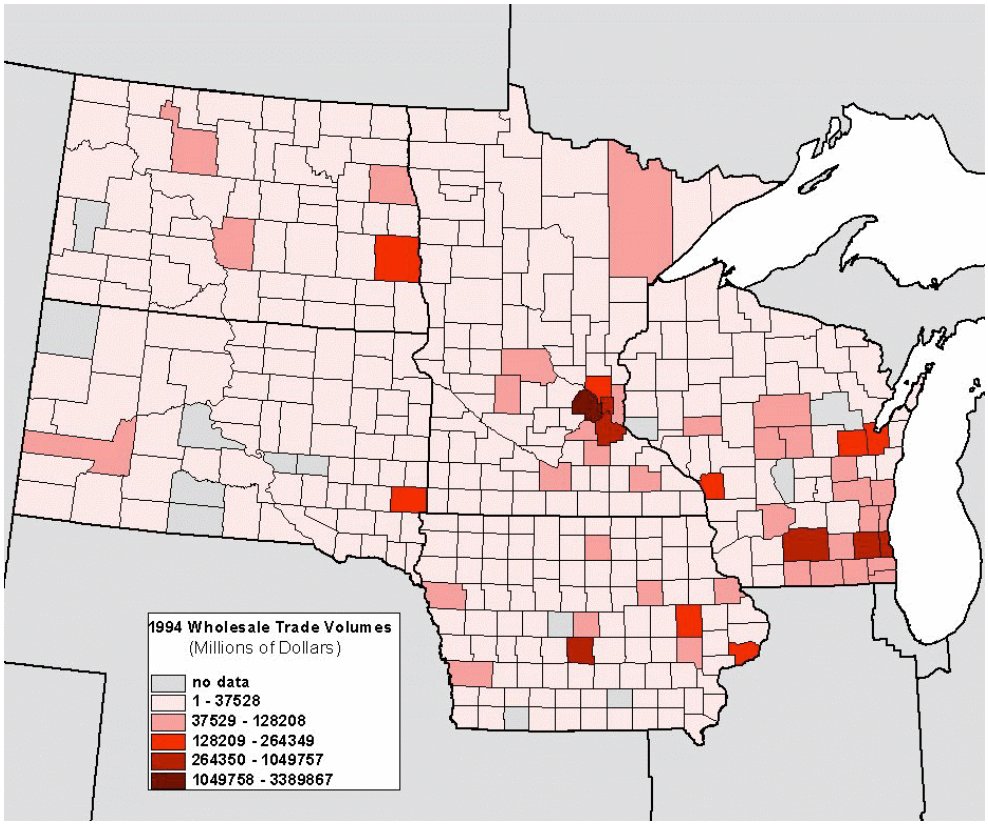
Finance, Insurance, and Real Estate

The three market sectors known collectively as finance, insurance and real estate (FIRE) comprised 17.9 percent of Minnesota's GSP in 1996. This contributed $25.4 billion to the state's economy, and represents a significant 20.1 percent employment growth from 1988. This growth was almost seven times the national FIRE growth of 3.2 percent. Forecasts predict that FIRE industries will continue to expand by 15 percent between 1994 and 2005.

Trade

The trade industry sector includes both wholesale and retail trade, with retail representing slightly more than half (51 percent) of FY 1996's trade revenues. The trade sector as a whole contributed $24.1 billion to the State's economy, accounting for 17 percent of the GSP. This is a 14.5 percent increase since 1988, and growth is expected to continue at this rate through 2005. Regional wholesale trade is depicted in Figure 5.3.

Figure 5.3 Wholesale Trade Volume by County



Minnesota's Competitive Advantages

The economic vitality that Minnesota enjoys can be attributed to a series of natural and policy-generated competitive advantages that make the State an attractive place to conduct business. These advantages allow Minnesota-based firms to procure materials easily, keep costs down, and serve large markets from fewer sites. Often, these criteria are the deciding factors in a company's decision to locate within a particular state.

- The State's **central geographic location** between the East and West Coasts allows it to serve a large number of markets effectively. This includes markets in the Midwest and Chicago served by truck and other highway modes; and more distant markets across the U.S. and Canada served by either air or rail depending on the commodity transported. For manufacturing and catalogue retail companies, this central location makes Minnesota a highly desirable state in which to operate.

- For manufacturing firms, the State's **proximity to agriculture, mining, and other raw materials** provides an inexpensive, reliable, and abundant resource that aids their profitability and stability. This natural competitive advantage was responsible for the initial development of companies like 3M and General Mills.

- Minnesota's **extensive and modally diverse transportation system** allows companies to both procure raw materials efficiently, and to distribute finished products quickly and cost-effectively. Although limited intermodal connections constrain the maximum potential of the State's transportation network (see Section 6.0), companies located in Minnesota have an array of transportation choices. Effective ground and air transportation allows Minnesota to take full advantage of its central location. Reliable rail and barge service ensures that abundant raw materials reach plants and warehouses when they are needed.

Transportation

Minnesota's transportation network plays an integral part in maintaining the State's competitive economic advantages. Whether it is a bulk cargo ship of grain traveling the Great Lakes, a trainload of coal bound for St. Cloud, packaged cereals traveling by truck to supermarkets in the Midwest, or merchandise flying out of Minneapolis to the East Coast – Minnesota's economy is linked to the State's ability to move goods.

Fortunately, Minnesota has a relatively robust transportation network. There is already an extensive network of railways, highways, waterways, and airports able to serve freight demand. The problem, ironically, is that the transportation network is so successful at promoting economic growth that increased demand is threatening to exceed existing capacity. As economic prosperity increases commodity output and draws more residents to the State (particularly the major urban areas), greater numbers of trucks, trains, boats, and planes are needed to satisfy freight demand. Already, airports and highways in the densely populated Twin Cities area are feeling the tightening constraints of these capacity limitations.

Increased congestion threatens to undermine the competitive advantages that have fueled Minnesota's economic success over the past decade. Competition for increasingly limited transportation capacity drives up the cost of goods, which in turn increases the cost of living. The same is true of retailers using the transportation network to take advantage of Minnesota's central location to reach consumers outside of the State.

The challenge for Minnesota's transportation community is to balance intermodal policy, operational strategy, and strategic infrastructure investment to ensure adequate transportation capacity for economic growth. With adequate planning, Minnesota's transportation network will continue to act as a competitive advantage well into the next millennium.

5.2 Logistics Overview

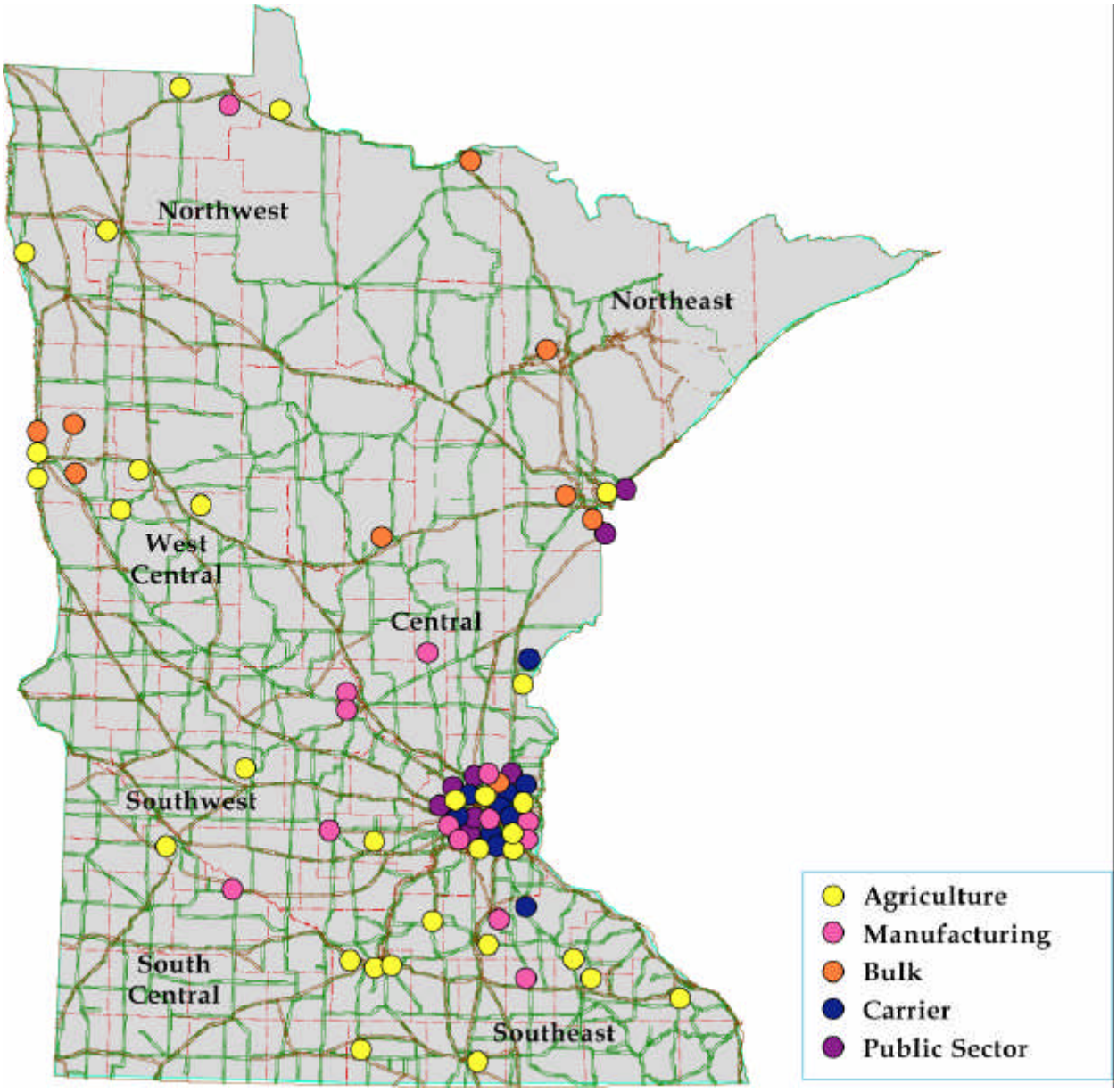
The shippers and receivers using Minnesota's freight transportation system dictate what moves, how it moves, where it moves, and how quickly it moves. Understanding the needs and behavior of these stakeholders is critical in understanding freight movements. This study analyzed the logistics patterns of shippers in major market sectors and service providers from every mode of transportation to develop a thorough understanding of the factors contributing to the existing freight flows in Minnesota. Over 50 in-person and telephone interviews were conducted in support of this study (30 in-person and 23 via telephone). A full list of interviewees is provided in Appendix E. Table 5.1 breaks the interviewees down by type. Interviewee facility locations are depicted in Figure 5.4.

Table 5.1 Description of Interviewees

Type of Interviewee	Number of Interviews
Shippers	**30**
Agriculture	12
Manufacturing	10
Bulk / Paper	8
Service Providers	**18**
Motor carriers	11
Railroads	5
Airlines	2
Public Sector Agencies	**5**

The remainder of this section describes the general logistics patterns of the major industries operating in Minnesota, including: agriculture and food processing; bulk materials production; traditional manufacturing; high-tech manufacturing; and wholesale and retail trade.

Figure 5.4 Interview Locations



5.3 Agriculture and Food Processing

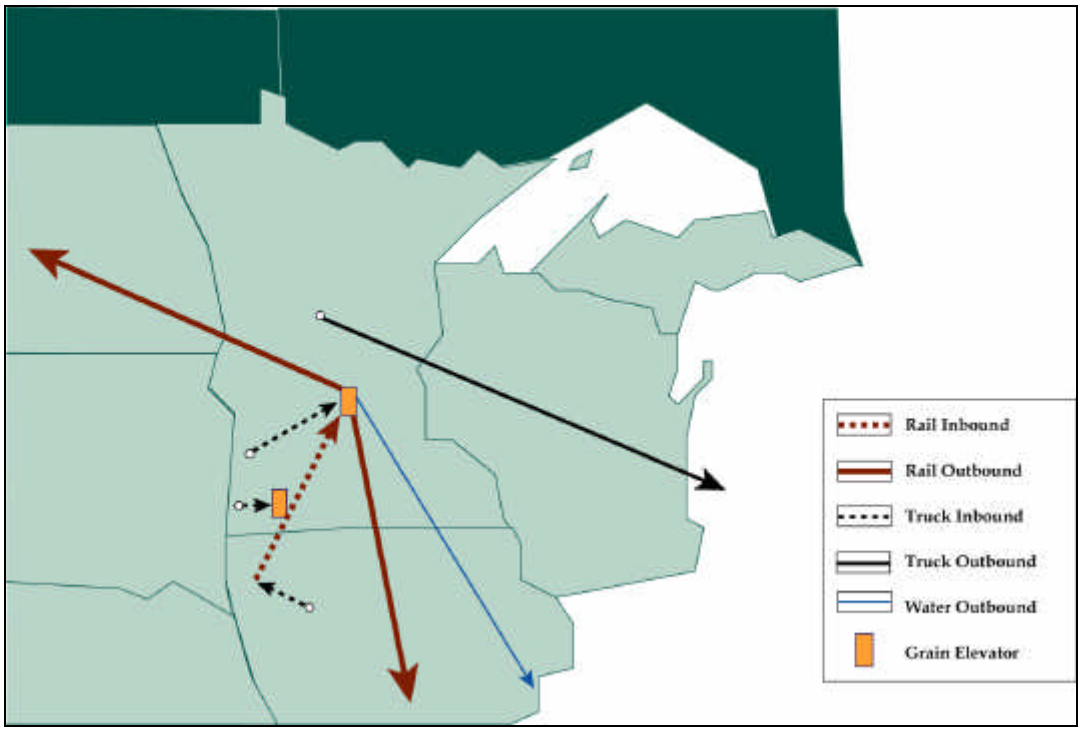
Overview

Over 35 million tons of field crops, primarily grain and sugar beets, move in Minnesota annually. Figures D.34 and D.35 in Appendix D depict the movement of field crops to and from Minnesota. The State also produces a large amount of dairy and meat products.

Figures D.39 and D.40 depict the movement of meat and poultry products to and from Minnesota.

Agriculture is a major component of the Minnesota economy. This industry includes the harvesting, processing, packaging, and distribution of products. In the spring farms import commodities such as fertilizers. These products are typically delivered in bulk by railcar (where possible), truck and barge. At the time of harvest, field crops are collected by truck and delivered in bulk to storage facilities such as grain elevators or processing plants. These movements tend to be short-haul bulk shipments unless the processing facility is located far away, and then rail is used where possible. These commodities consist of fields crops (i.e., grain), dairy products, and feed. The goods may then be processed and delivered to a customer or a more refined processing facility. These tend to be longer moves involving truckload, barge, or rail shipments. Figure 5.5 shows a sample agricultural distribution diagram for field crops.

Figure 5.5 Sample Agricultural Distribution Pattern



The seasonality of these products puts enormous pressure on all aspects of the business, making transportation services and delivery windows very important. Specialized equipment such as refrigerated units are often required to protect against spoiled or damaged goods. The limited harvest seasons also can strain highway load limits. Local weight restrictions and posted roads during the spring thaws are all regular obstacles to these shipments.

Agricultural-based firms often own and operate multiple facilities, both within and outside of the State. These firms often try to generate economies of scale by centralizing their

processing functions. Many large food (and ethanol) processors are located in Minnesota to be close to sources of raw materials and to reduce transportation costs. However, transportation expenses are a greater percent of the value of the goods when they are in the unprocessed, low-value condition.

Agricultural firms often have large private fleets to pick-up and distribute their goods to processing plants and storage facilities within a 250-mile radius. Rural elevators play an important role in the collection and distribution of rural products. Railroads are used heavily for the transport of raw products or semi-finished goods for long-distance delivery to processing centers and customers. There is also major use of the rural highway system for access to plants and facilities by farmers delivering product as well as regional farmers picking up product. There is a heavy reliance on the regional and local highway systems for delivery of products to regional collection points in Minnesota for further distribution.

The increased use of genetic engineering is expected to dramatically impact the logistics patterns and service requirements in the future. As products become more specialized, it is projected that there will be a need for the products to be segregated and delineated. For example, a customer purchasing grain will need to know its characteristics, which will become more varied with several types of genetically-engineered varieties from which to choose. This also will be important for labeling products for retail customers, some of whom may reject genetically-engineered products.

Issues and Impediments

Several impediments to the effective transport of agricultural products were identified.

- The discrepancies of truck size and weight regulations from state to state and between the U.S. and Canada create less than an optimal transportation environment. Standardizing these regulations would be desirable from the shipper's perspective.

- There is concern about the existing capacity of the lock and dam system on the Mississippi River and Great Lakes and the implications of the larger river tows anticipated in the future.

- There are a large number of bridges in the state of Minnesota that need to be replaced, as they have exceeded their life expectancy.

- There is a good network of two-lane highways, but continued maintenance is required due to heavy truck volumes.

- There needs to be an emphasis on short-line retention and upgrading of track. Short-line railroad tracks need rehabilitation due to pressure by Class I railroads to have railcars with 286,000 pound load capacity. Currently, many of the short lines do not have tracks capable of regularly carrying more than 263,000 pound railcars. If the short lines are unable to run and connect with the Class I's, then the elevators will have higher cost pressures. The farmer sees an $.08 to $.10 savings per bushel by hauling to a short-line access point instead of trucking, and it avoids wear and tear on the highways. However, Class I railroads will be able to offer lower rates at the

286,000 pound capacity, encouraging larger truck moves to the Class I elevators. The greater use of long unit trains has already encouraged this shift. (This issue is discussed in greater detail in Section 6.0 below.)

5.4 Bulk Material Production

Overview

Bulk materials are high-weight, low-cost commodities that typically are used as inputs to other production processes. Bulk materials represent the majority of freight by tons moved in Minnesota. Iron ore, coal, and concrete alone account for 50 percent (170 million tons) of all goods moving in the State. (See Figures D.31 through D.33 in Appendix D for the interstate flows of iron ore and coal.) An additional 35 million tons of agricultural field crops (grain) move annually. Over two-thirds of all goods moved in Minnesota are bulk-related commodities, and the vast majority of these goods are moving out of the State to markets around the globe. With the exception of bituminous coal produced in Wyoming that accounts for 60 million tons of bulk goods moves in Minnesota, most of the bulk commodities by tons are produced in the State (iron ore and field crops). As a result of this massive volume of bulk materials, many of Minnesota's shippers and carriers specialize in the logistics of bulk commodity movement. The study interviewed over a dozen shippers and carriers who handled bulk materials almost exclusively.

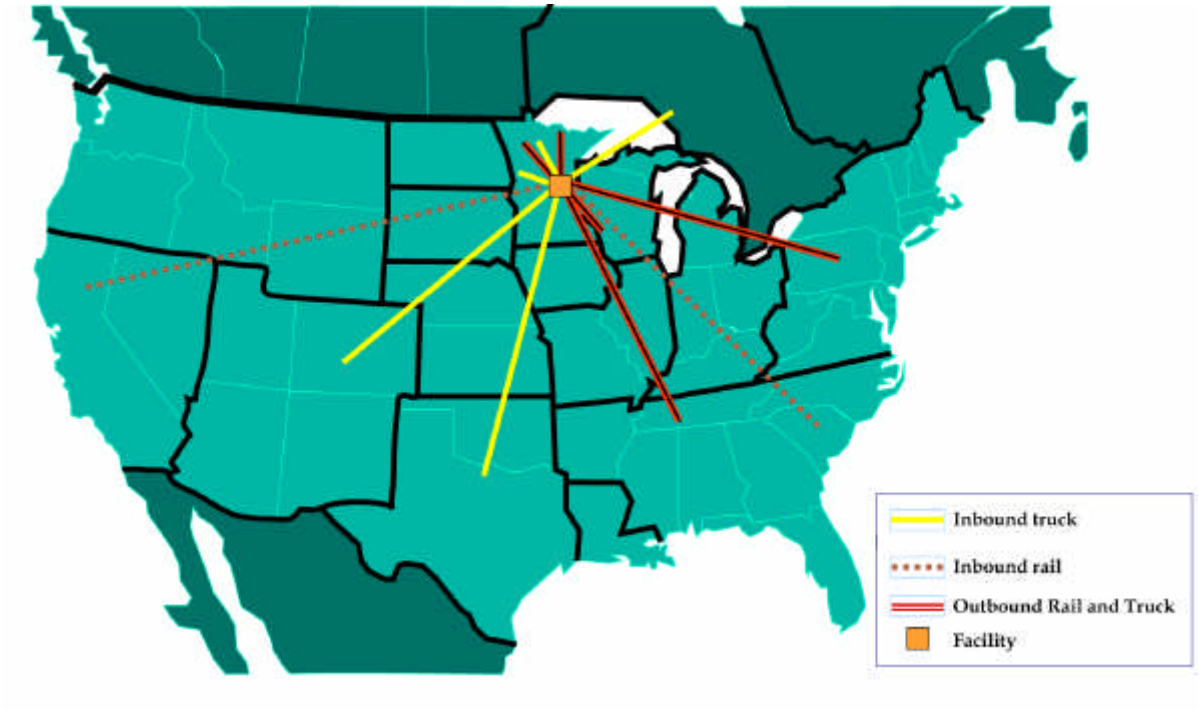
Shippers who handle bulk materials are typically mines, paper mills, grain terminals, refineries, and chemical plants. Northeast Minnesota is home to several large taconite mines that ship over 90 million tons of taconite pellets and iron ore each year for steel mills in Canada and the Midwest. Most of this ore leaves the region on barges from four Great Lakes ports. The Port of Duluth/Superior also ships a large amount of grain that arrives at terminals by truck and rail from agricultural shippers across Minnesota and North Dakota. The Port also transships over 10 million tons of coal arriving from the Powder Basin in Wyoming.

Agricultural shippers throughout the State and the Upper Plains also ship large quantities of grain down the Mississippi River to Louisiana for international export. Terminals on the upper Mississippi are designed to handle millions of tons of grain transferred to barges each year. These shippers also typically require a significant amount of inbound bulk movements in the form of fertilizer, limestone, and other chemicals. These commodities usually arrive by railcar.

Forest products are another significant bulk commodity shipped out of Minnesota. The Northeast and Northwest regions of Minnesota are home to many large paper mills that process thousands of cords of lumber every day. Finished products are typically paper rolls, pallets of paper products, or raw pulp. These shippers typically require bulk shipments of chemicals and clays to support their paper and pulp production processes. Some produce many of these inputs within their own facilities while others receive railcar shipments from suppliers located across the nation.

A typical distribution pattern for a bulk shipper in Minnesota is shown in Figure 5.6. This shipper receives local raw materials for processing by truck as well as specialized bulk commodities by rail from more distant markets. Some long-distance products arrive by truck as well. These goods are processed with the local raw materials and distributed to domestic and international markets primarily by truck. Most bulk shippers try to reduce their production costs by using cheaper forms of transportation, including water and rail.

Figure 5.6 Sample Bulk Distribution Pattern



Issues and Impediments

- The first issue is the reliability of railroad service. As discussed earlier, rail service is very important in the movement of heavy, low-value goods. Trucking goods typically is not cost-effective. Therefore, bulk shippers are very sensitive to the quality of rail service.

- A second issue was the icing of waterways during the winter months. For shippers that rely on water transportation, this time of year results in missed shipments, delays, or costly modal substitutions.

- Lastly, the issue of back haul was raised. Many bulk shippers do not have back haul opportunities. A mine has huge outbound volumes and almost nothing coming inbound. This situation limits the economies of scale and can create cost disadvantages when negotiating transportation services.

5.5 Traditional Manufacturing

Overview

The logistics patterns of manufacturing plants can vary significantly, however, they all require transportation service to receive inbound shipments of raw materials and/or components and produce outbound shipments of finished products or components. Inbound movements consist of raw materials, such as grains or chemicals, and semi-processed components, such as electronics. Outbound shipments consist of finished consumer products being distributed for consumption, or semi-processed materials being shipped to another processing facility. There are varying transportation requirements based on the commodity being moved and the plant's operational characteristics.

For example, for some inbound moves, plants can accommodate rail carloads of materials and they may have an on-site inventory that allows them some flexibility in the receipt of goods. Others may only need a truckload of product every day, but rely on that truck meeting a pre-set delivery window as small as one hour. In today's market, just-in-time delivery has become a mainstream service requirement as companies continue to improve the efficiency of their operations. For outbound movements, there are also differences. Some finished consumer products are being shipped directly to retail locations with strict delivery windows. Other components are shipped to another plant for assembly and also have strict delivery windows. All of these moves can use rail, air, or truck depending on the best service fit. It should also be recognized that many manufacturing plants have chosen to focus on their core competency, manufacturing. In these cases, they have out-sourced their transportation and distribution functions to a third party.

The types of facilities contacted for this study consisted of manufacturing plants and distribution centers. Most were located in the Metro area and in Central and Northwest Minnesota. The products consisted of transportation equipment and parts, recreational vehicles, building materials and trailer homes, and household and industrial appliances. The key markets served by these facilities consisted of: Eastern Canada, Colorado, Florida, Illinois, Iowa, Maryland, Nebraska, North Dakota, Ohio, South Dakota, Tennessee, Texas, Washington, and Wisconsin. The dominant modes of transportation were truck, rail intermodal (trailer or container on flat car, or TOFC/COFC), and traditional rail carload. The following illustrates the diversities among the different operations:

- Whether supplies and raw materials are shipped inbound via rail car is entirely dependent on the type of manufacturing conducted. The heavier the part, product or commodity in relationship to its value, the more likely it is that it will be shipped inbound via rail car. For example, in the automotive industry inbound volumes are evenly split between truck and rail, with 50 to 60 rail cars per day. In contrast, manufacturers of white goods, such as home appliances, use rail service on a limited basis for containerized parts imported from Europe to the Metro area. These are then routed by truck for final delivery to the plant.

- In the white goods industry, motor carriers deliver finished product to national and regional customers and distribution centers. This results in 15,000-20,000 truck moves for some companies per year outbound.

- The railroad plays a large role in delivery of product to distribution points around the U.S. for the automotive industry, supplemented by motor carrier delivery within an eight-state region.

- The firms interviewed have between 30 and 50 distribution centers throughout the U.S. to service their customers. One company indicated that it would reduce the number of distribution centers to five or 10 to create economies of scale to improve its ability to use rail freight. Another firm said that it will be increasing its volume of truck moves since it is eliminating the distribution centers and focusing on deliveries direct to the stores on a Just-in-Time (JIT) or "kanban" system.

- With today's global economy, firms are experiencing growth in international sales. This trend is causing shippers to pay closer attention to the transportation services they have available. They are becoming more concerned about their access to economic and efficient intermodal delivery systems and ocean containers for their products.

Issues and Impediments

Overall, the firms interviewed rate their level of satisfaction with the transportation infrastructure in Minnesota favorably. The following details some of the specific issues identified.

Highway Infrastructure

- Road construction, accidents, and weather combined often cause logistics personnel to adjust deliveries "on the fly";

- There is congestion in and around the metro areas in the State including St. Cloud, Minneapolis-St. Paul and others;

- Seasonal road restrictions have an adverse impact on firms located in northern Minnesota, especially those dependent on S.R. 11 and U.S. 59, which are restricted in the spring;

- U.S. 59 should have wider shoulders similar to those for U.S. 2 to allow oversized loads to move more easily; and

- There is concern about the condition and maintenance of the highways in northern Minnesota.

Rail Infrastructure

- The rail industry must become more competitive with motor carriers. Rail should handle more of the State's cargo to keep trucks off the highways.

- Something should be done about the pinch point in the rail system in St. Paul. Trains must slow down on the track near Kellogg Boulevard due to the reduction in the number of rail tracks from two to one at Chestnut Street.

- The at-grade rail crossing at West 7th Street causes congestion and should be addressed.

Regulatory

- Inconsistent motor carrier regulations among the states within the Upper Plains region impede the ability of some firms to efficiently transport their goods to distribution centers and customers. While Minnesota is a leading state for the development of intelligent transportation systems (ITS) for commercial vehicle operations (CVO) and the implementation of the Commercial Vehicle Information System and Networks (CVISN), some neighboring states are not as sophisticated.

- Some shippers would like to see motor carrier enforcement conducted via a terminal-based mechanism, similar to an International Standards Organization pre-audit procedure as opposed to stopping trucks at the roadside for weight enforcement activities.

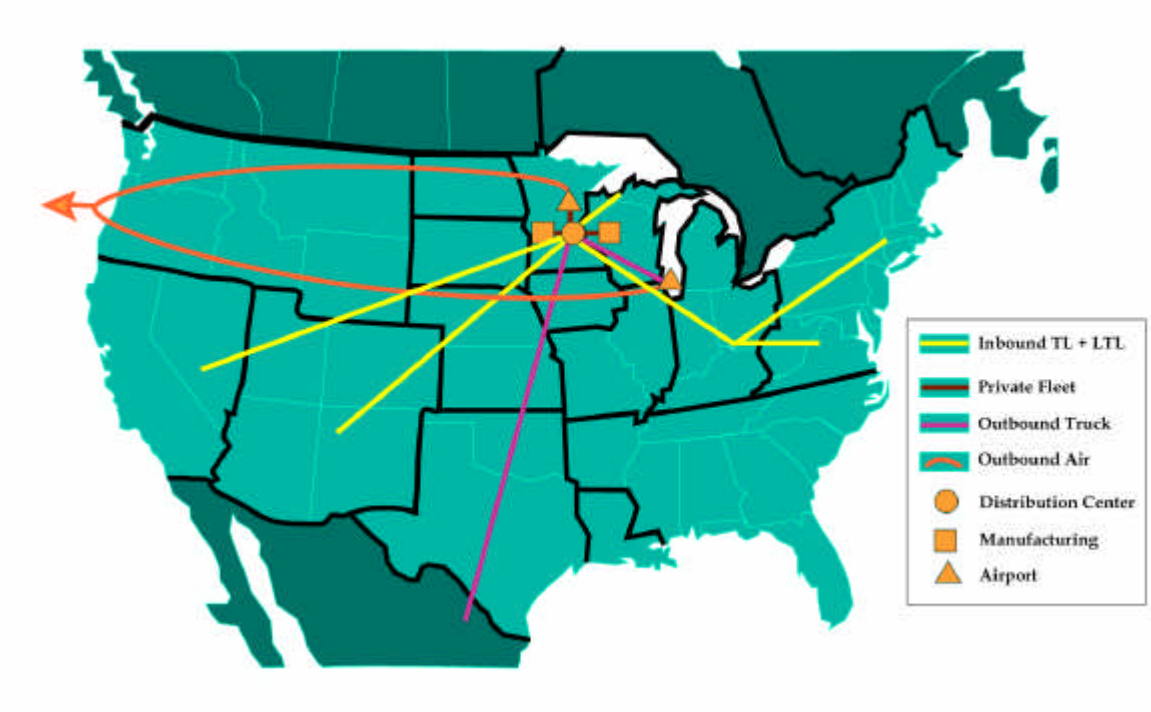
5.6 High-Technology Manufacturing

Overview

The logistics patterns of high-tech manufacturing plants are different from those of traditional manufacturing. They typically involve smaller shipments, smaller delivery windows, and higher value components and products. These characteristics require that the transportation services provided must be reliable. The cost of the service is also less critical given that the value of the products is so much greater such that the percent of the product cost associated with transportation is still small. As a result, air and truck are the dominant modes used by firms of this kind.

The inbound and outbound logistics of high-tech firms tend to rely on the global transportation infrastructure. Computer components may be brought in from Korea for use in the assembly of larger products. The finished products are often specialized or customized products and thus the distribution network must be able to accommodate great diversity. Given the importance of the distribution channels, many firms outsource their transportation function to third-party specialists. Also, since high-tech products are often small in size, many firms make heavy use of freight consolidators and overnight couriers. A typical high-technology manufacturer's distribution patterns are depicted on Figure 5.7.

Figure 5.7 Sample High-Technology Manufacturing Distribution Pattern



For this study, manufacturing plants and distribution centers were interviewed. They tended to be located in the Twin Cities area and in Northwest and Southeast Minnesota. Their key customer markets were located in Colorado, Chicago, Georgia, the Far East (Hong Kong, China, Japan, Thailand, Singapore), Latin America, and South America. They relied primarily on motor carriers, freight airlines, freight consolidators / integrators, and overnight couriers (such as Federal Express and DHL). The types of products included medical supplies and products; pharmaceuticals; and computer parts and components. The following describes the characteristics of operations of this type:

- Computer components and supply companies along with medical supply and product firms ship the majority of supplies and raw materials inbound via motor carrier, while a smaller volume is shipped inbound via courier express. (Computer equipment flows by value are shown in Figures D.41 and D.42.)

- Pharmaceutical and some computer component firms use ocean containers and intermodal rail truck service to bring in their raw materials from international origins such as Belgium and Japan.

- High-tech, pharmaceutical and medical customers require daily deliveries.

- Their customer base is worldwide. This results in multimodal moves with initial pick-up and final delivery via truck, and the airline as the international carrier. Air freight and courier or integrator firms deliver the majority of outbound shipments to domestic and international customers, with limited volumes being shipped directly by motor carrier to customers and distribution centers in the U.S.

- Many of these firms use their own as well as third-party JIT hub warehouses to serve customers. They have JIT distribution hubs located throughout the world. This is a change from the traditional centralized distribution center system.

- The use of "just-in-time" delivery is continuing to dominate the market. Transportation service providers are being asked to provide JIT deliveries to manufacturing plants as well as JIT pickups of finished products at the plants for delivery to retail or distribution centers. These firms rank the importance of the scheduling of receipt and delivery of trucks very highly.

- Many of the products are fragile and have special storage and handling requirements, including sterile or clean handling and packaging, and refrigeration.

- Transportation costs are very important since these firms ship and receive products globally.

- The manufacturing processes involving chemicals and heavy metals often generate controlled and/or hazardous waste. The disposal of these waste products requires a specialized logistics function, whether they send the product in state or out of state. The volumes of these types of shipments vary by company.

- There is little difference between the rural firms and the Metro firms when it comes to demands placed on their carriers for punctuality, transit times, and service.

- There are many high-tech firms in rural areas. This is a result of the locations picked by the company founders as well as several important business attraction/retention factors. These factors consist of a highly educated workforce, lower labor costs, low turnover in personnel (almost nonexistent), and specialized facilities that are already in place. These factors have offset any actual or perceived higher transportation costs for the shipment and receipt of goods. One major limitation for future expansions is the limited workforce (unemployment rates of two percent or so in many rural communities).

- International airfreight gateways, such as Miami, are being used for worldwide consolidations of cargo from the U.S. to foreign destinations. Miami has among the highest cargo volume, greatest number of direct all-cargo and combi-carrier flights originating and arriving at an airport in the U.S. Increasing direct connections to these gateways from Minnesota would be extremely beneficial.

Issues and Impediments

Some interviewees believed that the strength of the infrastructure in Minnesota is the fact that it is well maintained. However, several issues were identified:

- Shippers cannot always find transportation service providers that meet their service requirements. One shipper developed its own truck fleet for local and statewide deliveries because there wasn't a for-hire carrier who could satisfy its service and delivery needs for the right price.

- U.S. 7 is in need of significant modifications to improve the traffic flow and safety. Specific improvement recommendations included the development of more right and left turn lanes, and to straighten road where possible. Users consider this highway to be dangerous especially as the rural economy grows.

- Congestion is a concern for both carriers and shippers as it impacts delivery times and windows. I-494 and I-694 in the Metro area were mentioned as congested highways.

- The Vadnais Heights corridor in the Metro area is a problem congestion area (I-694, I-494, U.S. 10).

- Winter roadway conditions are an issue in some locations. For example, on S.R. 19 in Renville County, between Franklin and Fairfax, the crews are slow to plow the roads. This makes it impossible to have 7:30 a.m. departures from the area's facilities.

- Road construction and repair in rural Minnesota affects delivery and transit times.

- Some routes, such as U.S. 59 and CSAH 3 in District 2, do not accommodate large vehicles. These routes should be upgraded.

- The existing capacity and available service at the MSP airport is insufficient. There are problems getting the planes in and out on time. The air infrastructure must grow with the firms that depend on it.

5.7 Wholesale and Retail Trade

Overview

Consumer goods consist of materials and products ready for distribution to retail locations. The firms dealing with consumer goods include specialized distribution companies, farms, and manufacturers. The important distinction that must be made is that from a logistics perspective, the emphasis for consumer goods is the final delivery to a customer or retail location. A variety of modes are used for movements of this type, again dependent on the product and the type of operation. For example, tropical flowers will be flown in to Minnesota due to the short life of a cut flower. Pharmaceuticals will be sent via LTL common carrier or via an overnight courier due to high value, time sensitivity, and light weight. Canned food from the West Coast may come by truck or intermodal rail based on the cost, service, and reliability. The commodity flows of general warehouse items are shown in Figures D.43 and D.44.

Another key characteristic of this sector is the use of warehouses and distribution centers. These consist of private facilities owned and operated by the firm or public facilities that provide storage space, and in some instances also arrange for the distribution moves. The economics of a given product also dictate the location and number of facilities. A food distributor serving grocery store chains will require regional warehouses. Some specialty

clothing items may have one large facility in the U.S. And in some cases, shipments may come directly from a plant.

For this study, retail stores and distribution centers were interviewed. These facilities are located throughout the Twin Cities area as well as in Northwest, Central and Southwest Minnesota. They serve markets throughout Minnesota, the Eastern Midwest, Chicago, the Pacific Northwest, and Los Angeles, CA. They use motor carriers, traditional rail carload, and intermodal rail for inbound and outbound moves. These firms rely heavily on for-hire motor carriers for local and regional deliveries and traditional rail for some long-haul shipments to distribution facilities. Commodities moved by these companies consist of soft products including clothing, shoes, household goods; hard goods including furniture, and appliances; and food products including dairy products and canned goods. The following describes some of the different characteristics:

- Many of these firms have between 30 and 50 distribution centers located throughout the U.S. to service their stores and customers; however, the deliveries in and near Minnesota are made within a 250-mile radius to their local stores and customers by motor carrier. In some cases, the trucks make multiple stops at stores for their deliveries.

- The retail products are sourced from outside the State to centrally located distribution centers within the Minneapolis-St. Paul, Metro area. The retail sales companies import products from other countries by ocean freight to various ocean ports, then by intermodal rail to a rail ramp in the Metro area. Domestically sourced products are shipped in to Minnesota by contract with motor carriers. However, it is assumed that the motor carriers will use either truck or truck/rail intermodal service to move the goods.

- Some of these companies manage the inventory systems of their customers, such as grocery stores, and arrange deliveries for products to retail stores in a just-in-time environment.

- There is increasing reliance on computerization to manage fleets, both private and for hire (assess fuel taxes by state, track, monitor and route the drivers, etc.).

- Some goods, such as frozen and fresh food products, are susceptible to damage and require more specialized service like refrigerated units.

- There is a seasonal variation in shipping, with peaks occurring in October, November and December for the holiday season for most goods.

- There is limited use for railcar or intermodal shipments of these goods outbound since they are time sensitive and special handling is usually required. Products such as potatoes and canned food products can be shipped in railcars or intermodal containers (for potatoes, properly vented) to distribution centers for grocery stores in the Pacific Southwest, Texas and Louisiana and other distribution facilities throughout the U.S.

- There is growth and expansion in rural and urban facilities to accommodate the growing marketplace and distribution needs of these companies.

Issues and Impediments

The strength of the region's transportation infrastructure is the clearing and maintenance of the roads. The interviewees believed that there are minimal changes needed to the existing infrastructure. The roads are relatively well-maintained and the freight transportation infrastructure is safe. However, several issues were identified.

- Minnesota does not have a main rail hub, but is not that far from Chicago. These shippers believe that Minnesota's relationship to intermodal rail transportation is weak due to the imbalance of outbound to inbound moves.

- Regulations could be changed to improve shipper operations by allowing double 48 foot tandem trailers, or triple "pup" trailers. For example in Texas, Illinois or Indiana, UPS can pull triple pups and increase truck length from 53' to 57'.

- More than one person indicated that their fleet experiences delays as a result of road maintenance and repairs. They do not receive notification on the road construction, maintenance or delays except for road restriction notices. These firms were not aware that Mn/DOT has a Web site with statewide travel information on it.

- The Minneapolis/St. Paul Metro region is congested and this area is important since most firms route the majority of their products through or into this area.

- These firms are concerned about spring road restrictions that impede their operations between March 1 and May 15. When Highways such as U.S. 59, S.R. 32 and S.R. 1 in Northwest Minnesota are under repair or reconstruction, firms will use county roads to route trucks to North Dakota including Pennington County Road 3 and Polk County Road 21. However, these alternative routes have weight restrictions in the springtime, impeding deliveries of their product to market.

- Some rural economic centers are experiencing strong economic growth contributing to increased truck traffic, plus an increased volume in through truck traffic resulting in conflicts between the towns and the processing plants, distribution centers and manufacturing facilities. One example is Park Rapids which has a large processing plant with farm trucks delivering potatoes and refrigerated trailers picking up loads for delivery to market. Increasing traffic and conflicts with passenger vehicles are a concern.

5.8 Conclusions

This overview of the Minnesota economy and the businesses moving freight within the State provides an important understanding of the demands on Minnesota's goods movement system. Improvements to transportation infrastructure in the State can affect how businesses operate, and deficiencies in the system can have adverse impacts on business and the entire multimodal freight infrastructure. From the perspective of a shipper or receiver in Minnesota, the freight system is highly multimodal; any changes in service on one mode will at the very least affect their operations on other modes, and at the worst,

they will limit the firm's ability to do business. Section 6.0 will look at the impact this demand for freight service has on Minnesota's transportation system by mode. Additional input was sought for this section from the actual modal service providers.

6.0 Modal Infrastructure Profiles

The freight system in Minnesota serves a wide variety of users and businesses with unique goods transportation requirements. The State provides good service by all modes of transportation – including air, water, rail and highway – although there are major impediments and issues within and between these modes. Each mode has a well-developed network throughout the State, and each mode interacts with at least one other mode. The network of these intermodal connections is nearly as important as the modes themselves. Understanding these modal and intermodal networks is crucial to understanding freight movement. Capacity, service, and other impediments or opportunities affect the ability of commodities to move between origin and destination. Efficient transportation networks keep transportation costs low and improve competitiveness for businesses in the state.

As part of the Minnesota Statewide Multimodal Freight Flows Study, each modal network and the key intermodal connections were analyzed to determine the supply of freight transportation services. Data sources include previous reports, existing databases and interviews conducted by study team members. (See the breakdown of interviews by type at the beginning of Section 5.0.) Summaries by truck, rail, water and air follow.

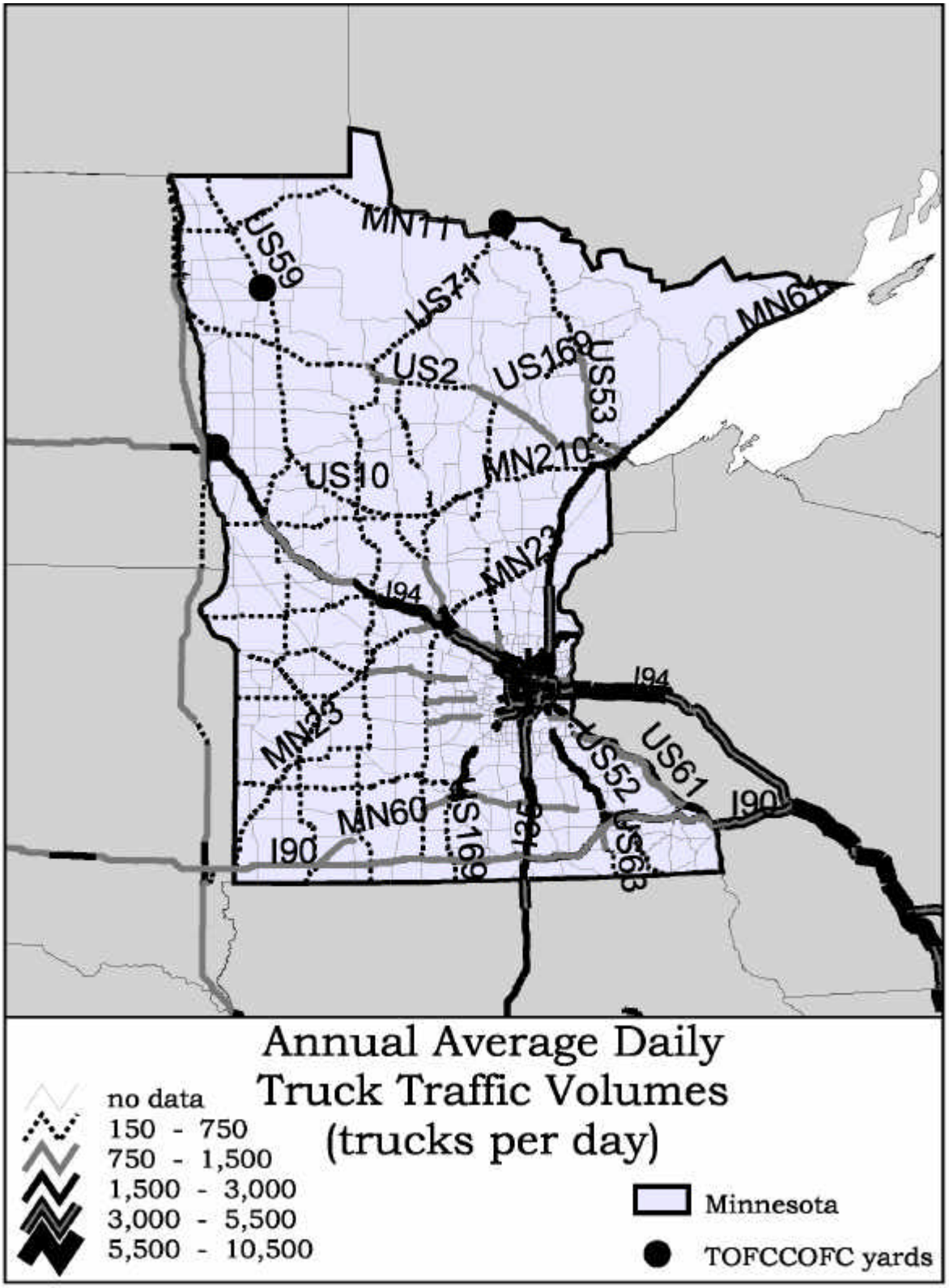
6.1 Truck

Trucking plays an important role in the freight transportation system in Minnesota. While trucks carry only a third (110 million tons) of the total freight volume by weight, they are responsible for key linkages between businesses, other modes, and customers, and carry the majority of volume by value. (Figures D.13 through D.16 show Minnesota's truck commodity flows by weight and value.) Local distribution patterns rely heavily on truck freight in the agriculture and forest product industries, and longer hauls of non-bulk goods are handled predominantly by trucks. Figure 6.1 depicts Minnesota's highway system with daily truck volumes. Facilities with greater volumes helped determine the key freight flow corridors discussed in Section 7.0.

Industry Overview

The trucking industry is not homogeneous. Trucks vary by type of motor carrier, industry segment, fleet size, clientele and freight hauled, and whether operations are interstate or intrastate. These differences significantly impact the operating characteristics of trucking companies, including the patterns of fleet vehicle moves. The movements of a carrier's fleet reveal the location of carrier facilities, origins and destinations of shipments, distribution centers, and transfer or consolidation points. Truck movements between these locations also highlight the parts of the transportation infrastructure that are used.

Figure 6.1 Truck Infrastructure/Truck Volumes



The focus of this study was to characterize the freight infrastructure and determine how it can be improved, through targeted investments, in order to enhance the efficiency and safety of moving goods in the state. One way to determine needed improvements was to identify impediments to efficient operations. Identification of trends that affect a carrier's fleet management or business practices also was important for isolating opportunities for improvement.

Types of Operations

Typically, the motor carrier industry is segmented into four categories: for-hire truckload (TL) carriers; for-hire less-than-truckload (LTL) carriers; private TL carriers; and private LTL carriers. However, the type of operation simplifies these industry segments into several broad groupings:

- **Long-haul.** Truckload carriers, both for-hire and private, operating long-haul variable-route operations, in which trucks that may be on the road for days or weeks at a time must be closely managed in order to assure that commitments to shippers can be fulfilled. Arrival and unloading times, and availability for reloading with new goods, are critical.

- **Regional.** Less-than-truckload carriers, both for-hire and private, consisting of metropolitan/regional fleets on scheduled runs along relatively fixed routes, make pickups from regular customers or plants. Typically, the shipments are taken to the carrier's transfer terminal and readied for line-haul truck operations. Once a pickup has been made, delivery time can usually be predicted with some accuracy, yet with interplant shipments, information such as confirmed pickup or transfer may be required to start production, or reschedule it. Trips are usually under 400 miles, and most fall between 50 and 200 miles.

- **Local Distribution.** Local/metropolitan fleets operate irregular, very localized routes. Government, service, local for-hire, and construction fleets are in this group. Routing and scheduling typically are done days to a week in advance. Trips are usually under 50 miles.

Key Operational Practices and Trends

One or more carriers identified the following operational practices as important trends impacting a carrier's ability to be competitive and profitable:

- **Just-in-time (JIT) delivery** – JIT delivery has resulted from lean manufacturing methods that demand small factory inventories, short delivery windows, and more frequent shipments of smaller quantities. An assembly plant, for example, only stores enough parts for a few hours of production so late deliveries cause substantial revenue losses. The motor carrier often bears these costs through shipper fines making reliability on highways and roads a critical variable. Because of the increasing integration of points in the supply chain, JIT requirements affect all facets of this chain – shipper,

distribution, warehousing, and delivery to retailers. One TL carrier noted that some of its customers take shipments directly from the truck to the production line; others use the trailer as an inventory facility. Another carrier cited frequent, and increasing, two-hour or four-hour windows for deliveries.

- **Customer service** – Capabilities such as tracking trucks and shipments, accurately predicting pickup and delivery times, and communicating progress of shipments to customers are customer service enhancements that directly affect the customer's bottom line. These services provided by the carrier can give the carrier an edge against its competitors. Production lines can be shut down if manufacturers cannot be certain that needed shipments will arrive as scheduled. Carriers that were interviewed gave examples of customer service enhancements that reduce clients' operating costs. One carrier delivers shipments to a client's retail stores at night because the shelves are restocked at late night. The same carrier constructed a warehouse near its client's manufacturing plant for managing pickups and deliveries in order to avoid using the client's facility. The facility has poor truck access, congestion on local roads is considerable, and area residents were complaining about the use of neighborhood streets by large trucks.

- **Technology applications** – All the TL carriers that were interviewed utilize advanced technology applications. Some of these applications enable the carrier to provide better customer service, such as vehicle location systems (GPS location tracking, for example) and mobile communications systems (including mobile satellite communication and mobile radios) that support truck tracking and communication between truck and dispatcher; route optimization software that determines the shortest, quickest, or most fuel-efficient route depending on the needs of the carrier/customer; and electronic data interchange (EDI) that allows the carrier and its customer to exchange dispatch, reporting, or billing information directly from computer to computer. Other technologies such as onboard computers and vehicle monitoring systems, which are used by two of the carriers, are useful primarily for motor carrier administrative, credentials, and safety management.

- **Maximization of backhauls** – To make money, a carrier must keep its trucks loaded and moving. Backhauls – picking up new loads on the way back to a terminal – are pursued as much as possible. An empty truck equates to costly, unproductive hours for the driver and the truck. Potential for backhauls varies according to the traffic lane (e.g., Chicago to Minneapolis along a major interstate system is an important backhaul route); relative demand for inbound and outbound goods (e.g., a truck delivering a shipment to a high "consumption" area finds it difficult to pick up a load for backhaul delivery to a high "production" area); and absolute imbalance between inbound and outbound freight in one locality.

Minnesota Truckload Carrier Interviews

Both truckload and less-than-truckload motor carriers were interviewed for this study. The emphasis of the interviews was on truck movements, including commodities, origins, destinations, and intermodal interfaces. Key logistics practices and impediments to efficient operations were identified by the respondents.

Overview of Truckload Carriers

The TL carriers that were interviewed have large fleets, i.e., 100 or more power units, and one terminal facility in the Twin Cities Metropolitan Region. These are for-hire carriers that operate principally in the Midwest and move freight from a shipper's facility to a regional distribution center. One company in this group transports shipments from a regional distribution center to retail outlets. Shipments consist of general freight in truckload quantities. All firms primarily use major highways in Minnesota and the region, but there is also significant use of local roads and streets.

Truckload Carrier Interviews

- One of the carriers interviewed is a very large, national carrier with one of its principal terminals located in the Twin Cities. In a typical scenario, the company's trucks bring shipments for a national firm from across the U.S. to its regional distribution center in the Twin Cities. At the distribution center, trucks are unloaded, relocated to another part of the facility, and reloaded with different freight for delivery to retail stores in Minnesota and the Midwest. From the Twin Cities, the carrier's heaviest routes are to and from the East Coast. Trucks also travel south from the Twin Cities to Texas, and then commonly to the Southeast. Destinations are regional distribution centers for large shippers on the East Coast, in the Ohio Valley, and in the Southeast. The main terminal and several other warehouses located in the Twin Cities are highly dependent on the metropolitan interstate system, especially I-35E, I-94, and I-494, and other major highways such as U.S. 52.

- Another carrier interviewed is a large, national carrier based in St. Paul with a strong Midwest regional operation using dedicated fleets. Dedicated fleets involve carrier-provided drivers, tractors, trailers, and dispatching for the client. The client pays for all of a fleet vehicle's miles. From the client's distribution center, fleet trucks make truckload deliveries to multiple retail destinations (i.e., no pickups or third-party backhauls). These operations do not follow the typical TL scenarios. For example, from a distribution center near the South Dakota and Minnesota border, a dedicated truck makes deliveries to retailers in the Twin Cities, Wisconsin, and Chicago, using the I-94 and I-90/94 systems as the major artery from the Twin Cities to Chicago. U.S. Highway 12 is the link from the border east to the Twin Cities. Frequent travel on local roads and streets is necessary in order to service retailers. The return trip from Chicago transports returned or defective merchandise. The carrier operates in Minnesota, South Dakota, North Dakota, Wisconsin, Iowa, Illinois, Nebraska, and Missouri.

- Another carrier makes pickups primarily at manufacturing plants in Minnesota and Wisconsin. For this regional carrier based about an hour south of the Twin Cities, Chicago is the major destination; it serves as the regional distribution center for many of the carrier's clientele. Hence, Minneapolis–Chicago is the major traffic lane. The carrier has terminals along the I-94–I-90/94 route between the two cities, and utilizes them to create a relay system of drivers, each driver tied to a terminal, for the entire lane. The drivers, then, are short-haul drivers – home every night. The carrier augments its regional long hauls with Twin Cities-specific operations that resemble the expected patterns of private TL carriers as described above. For example, city drivers do shuttle runs of one commodity between a client's facilities (e.g., two manufacturing plants, making short, comparatively scheduled moves).

Intermodal transfers – at least for their operations in Minnesota – are minimal among the TL carriers that were interviewed. Diversification of operations was prominent, however, and reflects a heightening of the twin pressures of customer service and competition. Warehousing, brokerage, and logistics services are among the activities being incorporated into carrier offerings to supplement the core TL activities.

Key Impediments

Warehousing, brokerage, and logistics services are just a few of the changes being made by motor carriers in the way they do business as responses to the pressures and opportunities of the global marketplace. Just-in-time manufacturing and distribution systems and increased emphasis on customer service are having major impacts on carrier operations. To reduce inventory costs, businesses are requiring carriers to provide more frequent and timely deliveries to resupply assembly lines and restock retail shelves. Carriers also are on the line to provide greater control over shipments, tracking individual packages as well as the truck.

The truckload carriers identified two major impediments to truck freight movement:

- **Urban congestion** – Urban congestion significantly impacts trucking operations because typically one-third of all truck-miles of travel occurs in large urban areas and an estimated two-thirds of that mileage is on freeways. Traffic congestion reduces carriers' ability to meet customer commitments and affects the competitiveness and profitability of carriers and their customers. Congestion also increases the risk of accidents and their associated costs to individuals and businesses.

  Carriers have responded to congestion in various ways. Operations may be shifted to non-peak periods, or to alternate routes. Another option is to incorporate real-time or near real-time congestion and traffic incident information into carrier routing and dispatching decisions. This kind of system is not currently deployed in Minnesota, although generally available traffic condition information is available through radio, television, cell phones, and the Internet. The current Minnesota systems do not address the special routing constraints of trucks, nor do they provide information about congestion conditions outside of the normal commuter shed that is needed by trucks operating at a regional scale.

  Congestion in the Twin Cities area that increases travel time and heightens safety concerns was cited by several carriers. The bottlenecks include the following locations:

  – In downtown Minneapolis, the I-94–I-35W interchange "weaves"; in Minneapolis, I-35W north and south of I-94; and in south Minneapolis, Crosstown 62 west and east of the I-35W interchanges;

  – In downtown St. Paul, I-94–I-35E interchange "weaves," and U.S. 52 (Lafayette Bridge) over the Mississippi River;

  – In St. Paul, I-494 (Mississippi River Bridge) west of the junction with U.S. 10/61; and

  – I-35W and I-35E north of the I-694 beltline.

- **Physical limitations of rural roads in northern Minnesota** – Carriers stated that the physical infrastructure in rural northern Minnesota impedes efficient freight movements. U.S. 2, which links North Dakota (at Grand Forks) with Duluth, and is the primary east-west highway in the northern one-third of the State, was given as the prime example. Much of the road is undivided, narrow (nine-feet wide), and in need of surface upgrading. Roads such as this one, it was said, were not built to handle large volumes of truck traffic. Conditions worsen in the summer, when heavy traffic of all kinds coincide with the construction season.

Minnesota Less-Than-Truckload Carrier Interviews

Less-than-truckload motor carriers also were interviewed for this study. Truck movements, including commodities, origins, destinations, and intermodal interfaces, were determined, as well as key logistics practices and key impediments to efficient operations.

Overview of Less-Than-Truckload Carriers

LTL carriers that were interviewed for the study were either medium-sized (10 to 99 power units) or large (100 or more power units) fleets operating for-hire wholly or considerably in the Midwest. These carriers have a terminal in the Metro region and move freight from a shipper's facility to a regional distribution center. One of the carriers delivers shipments from a regional distribution center to retailers and other direct consumers. Shipments consist of general commodities in less-than-truckload quantities. The primary traffic lanes are the major highways in Minnesota and the region, with considerable use of local roads and streets.

Less-Than-Truckload Carrier Interviews

- The core operation of a large, national carrier with its headquarters in the Twin Cities is industrial distribution for large retailers. The carrier's corporate facility is used as an assembly center and warehouse for shippers. Goods arrive at shippers' facilities by train, truck, or air. The carrier's trucks pick up the unsorted goods and deliver them to the carrier's facility where they are assembled into shipments. Shipments are delivered by the carrier to retail outlets throughout the U.S. on a JIT basis. Overnight deliveries are made to Minnesota, western Wisconsin, Iowa, Nebraska, South Dakota, and North Dakota; second-day deliveries are made to Montana and Wyoming. According to the carrier, the interstate system is used "almost exclusively," except that local streets are used for local pickup and delivery. (Note that LTL carriers commonly operate both local pickup and delivery and line-haul/long-haul runs, as described earlier.) Warehousing is an important function that complements the LTL distribution services, and may be short- or long-term.

Less-Than-Truckload Carrier Interviews (continued)

- One of the carriers that was interviewed provides LTL service to regional distribution centers for large national or regional firms. Its principal operations are in Canada; from its Twin Cities and Chicago terminals, it serves the eastern U.S. and Canada. The company's trucks move freight from shippers' facilities in Eastern Canada, Minnesota, and Wisconsin to distribution centers primarily on the East Coast, Atlanta, and Dallas. These distribution centers commonly are located on the fringe of large cities. These LTL destinations can be characterized as areas of consumption, where there is higher demand for inbound goods than outbound goods, and consequently, many loaded trucks travel in and create an oversupply of trucks for outbound demand. In contrast, Chicago is an area of production; consumption is comparatively lower than production, resulting in predominantly outbound truck traffic. The Twin Cities represent a balance of inbound and outbound demand. While backhaul loads are consistently pursued, inbound versus outbound considerations affect a truck's ability to secure a backhaul load. The carrier's primary traffic lanes are between the Twin Cities and Chicago; from Chicago to the East Coast and Atlanta; and from the Twin Cities to Dallas. Routes follow the interstate system as much as possible; other major roads, such as U.S. 53 from I-94 in Wisconsin through northern Minnesota to Ontario, and local roads are used as necessary.

- Another carrier operates strictly in Minnesota and western Wisconsin as a distribution carrier, delivering shipments from regional distribution centers to retailers and consumers. This small firm has a facility within an hour north of the Twin Cities. It characterizes its operations as "on-the-fly" – no regular routes and no contracts. It handles all general commodities. Ninety percent of the carrier's pickups are in the Twin Cities, with consistent clientele. Company trucks make pickups at distribution centers in the Twin Cities where shipments have been delivered by large interline carriers. The trucks return full to the facility at the end of the day, and at night the trucks are stripped and loads are reassembled by destinations. Drivers leave the facility in the morning with deliveries to retailers, schools, hospitals, and residences in Minnesota and western Wisconsin within a 200-mile radius of the terminal. Only 10 percent of the deliveries are destined for the Twin Cities. To accommodate the kinds of destinations for the freight and their locations, all roadway types are used.

- Two "straight LTL trucking" companies have diversified operations. One carrier's operations started with air freight, and air freight pickup and delivery continues to be one of the company's service divisions. Trucks make twice-daily sweeps of all air cargo facilities at the Twin Cities airport, with same-day delivery in the metropolitan area. This carrier also provides warehousing and local pickup and delivery services (TL service is provided by the carrier through a different facility not located in Minnesota). Another carrier is adding TL service to its core LTL service, utilizing owner/operators who live along the carrier's primary LTL lanes and marketing the new service to its traditional LTL shipper client base.

Less-Than-Truckload Carrier Interviews (continued)

- Intermodal transfers are an important market for one company interviewed, a firm providing warehousing, distribution, transportation, and contract logistics services. The company has a small fleet of drivers plus local carriers under contract, moving freight in LTL quantities, but trucking is considered a convenience for the distribution services and is not the core of business. The company's services are continental in scope, with emphasis from Chicago to Montana and into central Canada. Headquarters and nine facilities are located in the Twin Cities region. Truck movements are from regional distributors to other distribution centers, and utilize major highways (e.g., interstate and U.S. systems) as much as possible. Rail connections are important in the company's operations. Representative scenarios include: company trucks take shipments coming in on rail at shipper distribution centers in the Twin Cities to distributors, whose own trucks deliver the goods to retail and restaurant establishments; shippers in northern Minnesota send shipments by rail to the company's facility, which is equipped with sidings, for cross-dock to storage or to trucks, or recross-dock to rail; and company trucks pick up shipments at a St. Paul manufacturing plant for transport by rail from the company's facility to western and southern states.

Key Impediments

A number of impediments to efficient truck freight movements were identified by the LTL carriers that were interviewed for this study:

- **Urban congestion** – Congestion in the metropolitan area was cited as a major problem for trucking operations because of the travel delays it causes. The same locations were emphasized by LTL carriers that were mentioned by TL carrier:

  The LTL carriers were vocal about the impact of congestion on JIT delivery requirements. Clearly, meeting JIT deadlines is becoming increasingly difficult as congestion in the Metro region increases. As one carrier pointed out, all its LTL operations are conducted on a JIT basis, with delivery windows established and delivery times set. Peak-hour congestion can be especially deleterious when deliveries are expected during a narrow window in the morning, or pickups are allowed only from 2:00 to 4:00 p.m. Planning for delays and lower speeds is part of a carrier's business practices, but it increases operating costs and lowers profit margins. Missing a delivery window outright frequently results in shipper-imposed penalties on the carrier.

  The IRC study pointed to the importance of the I-494/I-694 beltline as a metropolitan area bypass (in terms of interregional travel), distributing trips around the area and connecting the interregional corridors to each other. The system was identified as an important truck route by carrier respondents (note that it is used by trucks to reroute around the St. Paul I-35E restricted highway; see the discussion below). The study also affirmed the congestion that plagues the I-494/I-694 ring, and noted that it will continue to function marginally, even after it is upgraded to a six-lane freeway.

- **Physical limitations of rural roads** – Carriers that moves goods to retailers and consumers in rural areas identified numerous state highways that are either poorly maintained or not built to accommodate large trucks (e.g., Highway 70 from I-35 to Grantsburg, Wisconsin; Highway 73 from Hibbing to Moose Lake; and Highway 371 north from Little Falls). Local roads and residential streets provide further examples of roadways that are decidedly not "truck-friendly," a situation which is worsening as dock-to-residence deliveries also increase.

- **Restricted highways** – The problems caused by banning trucks on a portion of I-35E near downtown St. Paul were described by several carriers. Much rerouting is necessitated, and this is extremely time-consuming, whether rerouting is to city streets or around the city on the I-494/I-694 beltline; hazardous because of the mingling of large trucks and cars on local streets; and problematical for drivers unfamiliar with the area and route options.

- **Parking** – Truck parking is a growing problem in and around the Twin Cities. JIT deliveries in the morning accentuate the need to park trucks overnight in the vicinity of the metropolitan area, but available parking is almost nonexistent. Some carriers that bring shipments to Minneapolis from Chicago on I-94 for a JIT delivery early in the morning must stay overnight in Hudson, Wisconsin, due to the lack of proper facilities closer to the city.

- **Residential access and unloading** – Changes in business practices and routing as a result of electronic merchandise orders submitted through the Internet have increased the amount of dock-to-residence deliveries. Until recently, the operations of one of the carriers that were interviewed were almost exclusively dock-to-dock. Now goods are delivered directly to residences from distribution centers (albeit after loads are reassembled by destinations). Unnavigable driveways and inaccessible homes as well as unloading on lawns and doorsteps (when large merchandise such as appliances are involved) are growing problems for LTL drivers.

Additional Impediments/Issues for Trucking

- Spring load restrictions were raised numerous times as an issue, primarily in regard to the local roadway system. Complaints were received that some trucks were avoiding scale checks on main routes at border crossing areas in Northwest Minnesota.

- Statutory load limits are also an issue in terms of moving goods. At 80,000 pounds, Minnesota has one of the lower weight limits in the Upper Plains (i.e., North Dakota authorizes up to 110,000 pounds). This can result in logistical issues and extra costs. One example that was relayed at one of the meetings was for the movement of large pulp processing equipment. This equipment came into the Duluth port and was destined for western Canada. Due to different weight and hauling requirements the equipment had to be unloaded with cranes and reloaded on different trucks at the border.

- Truckers can either be paid based on a per-mile basis and/or based on the load (so much from getting goods from point A to point B). There is significant competition in

the trucking industry and there is substantial pressure to keep costs low. The speed and length of route are both important to truckers. Truckers by law can only drive so many hours per day and have to keep a log-book of their time. In terms of travel, the trucking industry was mostly concerned about the following:

- The number of signals and stops reduces ability to move goods efficiently.
- Congestion in and around the Twin Cities Metropolitan area is reducing the ability to move goods during peak travel times. Companies regularly plan for delays and lower speeds during the peak hours. However, these can increase costs. Some companies have tried to relocate distribution facilities to better serve customers and reduce delays.
- More rest areas on main routes for truckers that need to break or rest.
- The number of small towns is incompatible with through traffic.
- Many firms would like to see higher speed limits (55 mph) in rural areas with little traffic.

Minnesota Trucking Trends and Market Forces

- Competition is forcing businesses to cut costs. One such cost-saving measure is to reduce inventory costs. Inventory reductions have increased pressure to deliver materials and parts on a quick and reliable basis. Transportation is one of many components that are looked at carefully in locating manufacturing facilities. Congestion, labor costs, distance from markets and other concerns that impact trucking in Minnesota directly affect a manufacturer's decision to locate in the State.

- Trucks are more cost-effective for moving goods short distances (up to 400 miles). Rail service becomes more competitive for longer distances and at greater economies of scale. For this reason, Chicago is the freight capital of the upper Midwest area. Many goods are trucked into or out of Chicago because that is where most of the goods area shipped by rail. In addition, because Chicago has many more international flights and has much more heavy air freight service (making air-freight more cost-effective), many goods are flown in and out of Chicago.

- Parcel delivery services have grown significantly. More customers want dependable services that can track packages from start to finish. Federal Express is one of the leaders in this industry. Some of these companies have located distribution facilities outside of the Metro region and are servicing it from the perimeter, as opposed to from urban locations.

- Much of the regional freight and mail is moved overnight between main distribution centers and regional facilities. For example, distribution may go from Twin Cities to Bemidji to Fargo. While congestion is not generally an issue for these movements, the roadway conditions including ice, snow, visibility, and safety are important. Companies indicated that wider shoulders, turn lanes, and good maintenance (plowing) are important to them and the services that they provide.

- Class I railroads pushing their grain service at 286,000 pound, 100-car unit train elevators has caused consolidation of rural elevators. This in turn has required that farmers truck commodities further to market. The average distance has increased from approximately seven miles to 40 miles over the last 30 years. In addition, the number of on-farm private storage facilities is increasing. Farmers want more flexibility to hold and sell commodities based on overall market prices. Many farmers watch market prices and world markets on a daily basis and can sell products quickly over the Internet. With this flexibility they also must be able to then deliver their commodities quickly at all times of the year.

- New uses for agricultural products are increasing. For example, corn is being used for making fuel additives. These new value added products are, in some areas, changing the commodity flows to more local destinations for local processing – encouraging new local truck moves.

6.2 Rail

The rail freight transportation network in Minnesota is extremely well developed. Figure 6.2 displays this network as it relates to surrounding states. There are approximately 4,650 miles of rail lines in Minnesota. These lines are split among four major Class I railroads and their subsidiaries, six Class II railroads, and 12 Class III railroads. (See Figure 6.3.) All of these firms play a vital role in Minnesota's economy through the interstate and intrastate transportation of coal, ores, grain, and other bulk commodities. Through the use of intermodal services, these railroads also compete for a share of the long-haul truckload market.

The core of Minnesota's rail network is its Class I railroads: the Burlington Northern Santa Fe (BNSF), Canadian Pacific (CP), Union Pacific (UP), and Canadian National (CN). Each of these firms is a very large corporation, both in financial (multibillion $) and in geographical scope (transcontinental).

Figure 6.2 Minnesota Rail Infrastructure

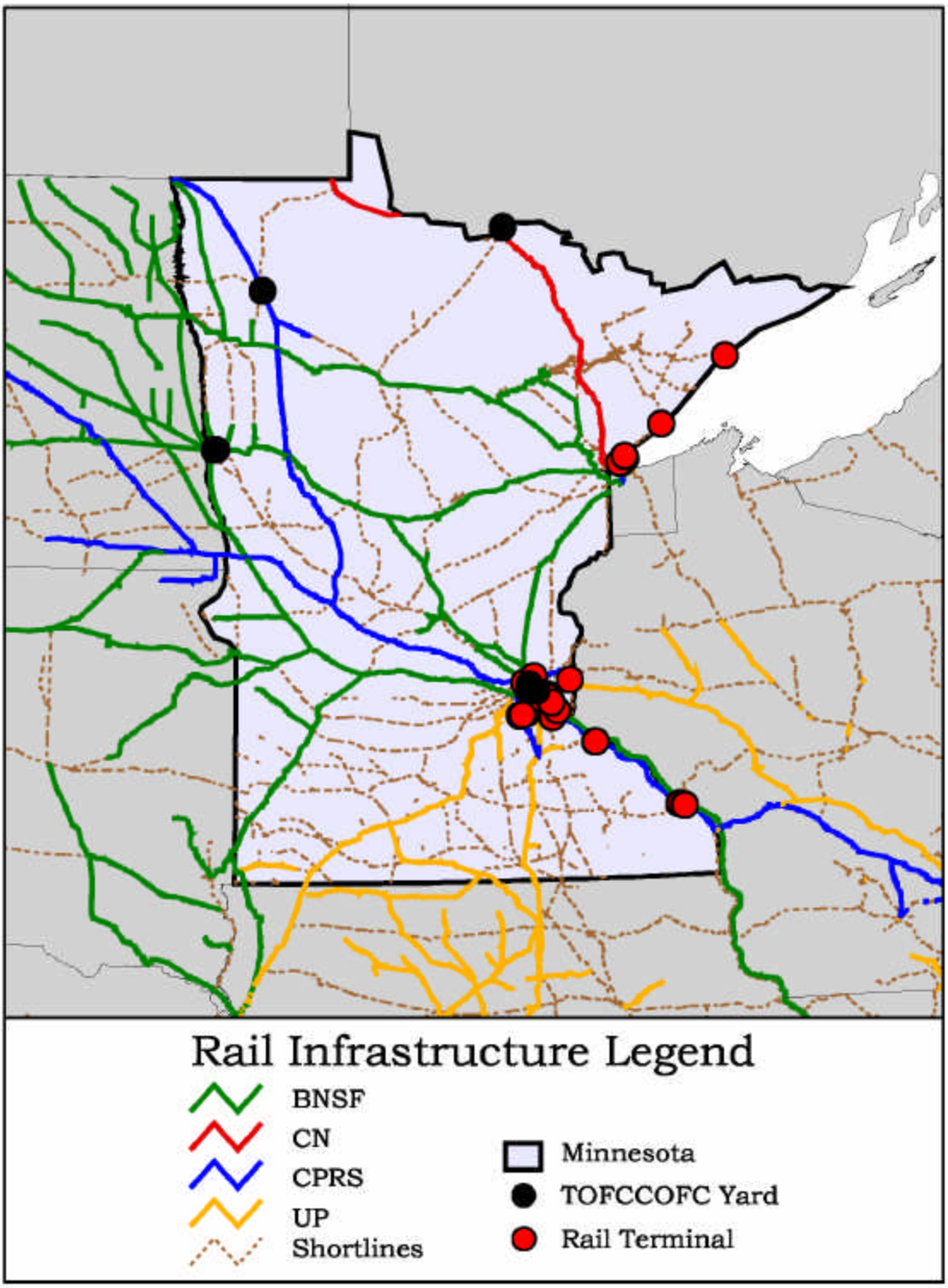
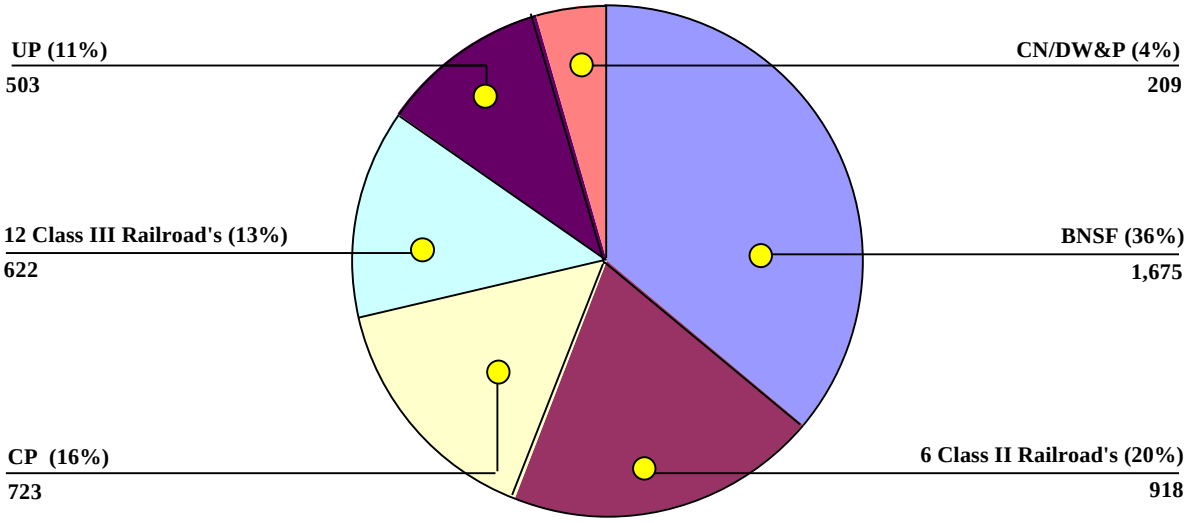


Figure 6.3 Minnesota Railroad Mileage



Industry Overview

The rail industry has a rich and colorful history which dates from the 19th century. The availability of rail transportation 100 years ago permitted the State's production economy to develop in a manner that continues to be world competitive today. Examples of this are the State's agricultural and mining business sectors.

The grain production and distribution patterns of the time largely drove the initial development of most of Minnesota's railway in the late 19th century. Because the gathering system was the horse and wagon, a very dense network of rail lines was constructed. Today, as both the rail and highway technology has changed dramatically, a network of lesser density but of the same general pattern is in place. Now as then, Chicago is the main hub of the North American railway network and strongly influences the pattern of the rail traffic moving in and through Minnesota.

The modern history of the rail industry dates to deregulation in the 1980s. Deregulation permitted the large railroads to manage their business by pricing their products competitively, abandoning unprofitable track, and developing new services. Deregulation was necessary because the regulatory environment was driving the industry toward financial collapse. Over the past 15 years large railroads have downsized, streamlined, priced, and merged their way to increased profitability. Out of necessity, this trend continues to the present. Railroads arguably are still not sufficiently profitable to generate an adequate return on invested capital. This is the industry's number one perceived problem.

Large railroads are merging to consolidate their operations and to reduce costs. As a result, the number of large railroads is declining. The entire North American continent is now served by only six large rail systems. Prior to deregulation this number exceeded 70. The most recent mergers – BNSF, UP, and the Conrail breakup – have been accompanied by major service disruptions and hardships for shippers. These problems have lead to the

current controversy over the role, responsibilities, and operating procedures of the federal regulator of rail mergers, the Surface Transportation Board.

Large railroads also improved profitability by selling or abandoning surplus or unprofitable rail lines. This led to a large and vital short-line rail industry. Nationwide, there are more than 500 small railroads. These firms operate in all 50 states, account for about one-third of all rail route miles, employ 11 percent of all rail workers, and generate about nine percent of all rail revenue. Minnesota is representative of the norm; about a third of the rail mileage in the State is operated by short lines.

Key Commodities

Rail freight in Minnesota carries nearly half of the total tonnage moving in the State. Figures D.18 through D.21 depict these flows to and from North America by weight and value. Three commodities make the bulk of this freight, and each commodity has its own unique distribution characteristics, as described below.

Coal

Minnesota railroads move approximately 45 million tons of coal into/through the state. The primary origin of the coal is the Powder River basin. (See Figures D.32 and D.33.) The largest movement of coal is to Duluth/Superior (17 million tons) where it is transloaded to lakers for delivery to various U.S. and Canadian ports. Much of the coal (16 million tons) moves to Central and Metro Minnesota and is used to generate power. Most of the remainder moves through the State for destinations in Wisconsin.

This total tonnage could more than double early in the next century. The Dakota, Minnesota, and Eastern (DM&E) Railroad is developing a new rail line that would connect the river port in Winona, Minnesota with the Powder River Basin coal field in Wyoming. This project has the commercial prospect of offering a competitive alternative to BNSF and UP. If successful, the DM&E expect to move 40-50 million tons of coal to/through Minnesota annually. This movement would place seven to 10 coal trains moving each way daily along the DM&E main line.

DM&E has obtained basic agreement from the STB that the proposed new line is feasible and in the public interest. Currently, the environmental scope process has been completed and work is in progress on a draft environmental statement. This document is scheduled for completion in early 2000. Subsequent to finalization of the environmental process, DM&E is planning on a year 2003 completion of the project. Meanwhile, the remainder of the line is being upgraded. DM&E is laying new welded rail and lengthening passing sidings. Some portions of their main line trackage are currently capable of handling 286,000 pound equipment. Upon completion of the Powder River project, all main line trackage will be able to handle 315,000 pound equipment. DM&E expects, after the main line project is completed, to upgrade various branch lines to the 286,000 pound standard.

Ore

Four railroads move approximately 44 million tons of taconite from iron mines in northern Minnesota to five piers on Lake Superior.

1. Burlington Northern Santa Fe connects Hibbing and Keewatin to Superior, WI;

2. The Duluth, Missabe, and Iron Range Railway (DMIR) connects Mt. Iron, Eveleth, Forbes, and Virginia either to docks in Duluth or to Two Harbors;

3. LTV operates a private railway connecting Hoyt Lakes and Two Harbors; and

4. Northern Mining Company operates a private line between Babbitt and Silver Bay.

Five major ore docks handle the traffic as shown in Table 6.1.

Table 6.1 Iron Ore Volumes at Minnesota's Great Lakes Ports

1997 Throughput	Location	Owner	Storage Capacity
10.7 million tons	Superior, WI	BNSF	5,625,550 tons
13.6 million tons	Two Harbors, MN	DMIR	2,600,000 tons
7.9 million tons	Taconite Harbor, MN	LTV	100,000 tons
7.1 million tons	Duluth, MN	DMIR	3,100,000 tons
5.0 million tons	Silver Bay, MN	Northshore	5,000,000 tons

Source: Iron Mining Association of Minnesota, 1997.

Grain

Grain is the third large bulk commodity moving in the state. Out of a total of 36 million tons, about 25 million tons move by rail annually. Unlike coal and ore, the movement patterns of grain are more complex, volatile, diverse, and truck competitive. (See Figures D.34 and D.35.) Ordinarily, farmers move grain by truck to a country grain elevator. There are approximately 675 country grain elevators in Minnesota. Next, grain moves by truck or rail to a regional user or to a terminal elevator. Many of these terminal elevators are located in Minnesota and handle grain from surrounding states, most importantly, North and South Dakota. The most significant rail destinations for grain moving in and through Minnesota include Duluth/Superior, the Twin Cities, and the various barge terminals on the Mississippi River. In addition, some Minnesota grain moves by rail southbound to terminal elevators on the Gulf of Mexico or westbound to terminal elevators on the Pacific. From the terminal elevators grain is then distributed to other terminal facilities as well as to customers worldwide.

This system is very competitive and competitive options are increasing. The gathering system is dense enough that the farmer may sell his grain at several competing elevators on rival rail lines. Farmers may also truck grain directly to a consumer or to a terminal elevator, thereby avoiding the railroad and country grain elevator altogether. Currently, any country elevator within 80 miles of Savage, MN is being bypassed for direct delivery to the port terminal. In addition, a farmer may be limited in the choices of country grain elevators based on the genetic characteristics of his products. Country elevators have choices and may forward grain using either rail or highway modes. Terminal elevators also enjoy these options, but in addition, they may have the option of forwarding grain by laker or barge. This level of competition is intense; as a result, Minnesota grain is competitive in the world market.

Impediments/Issues for Railroading

The Evolution of the Grain Distribution System

Currently there are several countervailing interrelated trends that are creating significant and at this time somewhat unpredictable changes in the grain distribution system. These trends include:

- The post-deregulation trend toward a grain gathering network of lesser density and fewer large country grain elevators based on the evolution and post-war availability of trucks and economies of scale in the transportation and distribution business.

- The development of the short-line rail industry and its promotion by the State as a means to reduce truck vehicle miles of travel (VMT), particularly on low-density rural highways.

- The increase in the weight carrying capacities of some railways to handle 286,000 pound loads.

- The change in the demand characteristics for grain and the associated requirement for identity preservation. Formerly, grain was the classic "textbook" example of an undifferentiated product. Today, grain is becoming a much more specialized commodity.

The Post-deregulation Trend Toward a Less Dense Grain Gathering Network

As originally developed, the grain gathering network was based on a relatively dense network of rail lines. Horses (later farm tractors) and wagons moved grain to country grain elevators that served as storage and consolidation points for loading onto individual rail cars. This system dominated until after World War II when trucks became more readily available, the highway system was dramatically improved, motor carriers became more competitive, and the regulated railroads were unable to adequately respond. As a result, motor carriers gained market share. However, burgeoning demand off-set this modal shift, and almost every farming village in the State retained at least one country grain elevator.

Rail deregulation changed the situation dramatically. Railroads were not able to offer unit train service to economically inconvenient elevators and had to abandon unprofitable sections of the railway. As railroad economics favor loading larger lots at larger country grain elevators, many elevators on branch lines lost service, many smaller elevators were consolidated with larger facilities, and a number of main lines were sold to short-line carriers. The result was a dramatic and positive post-deregulation shift in rail market share. The port of Duluth in part attributed a market share shift from 30 percent rail to 70 percent rail to the lower transportation costs associated with this trend. The drawbacks of this shift include the increased VMT associated with longer truck hauls from farms to consolidated elevators.

This trend continues to the present. BNSF has invested (and continues to invest) large amounts of capital into their grain infrastructure for the purpose of increasing overall efficiency. Their current marketing emphasis is on the "shuttle train" concept; loading 100+ units per train at a single elevator. This approach is designed to minimize the railroad's grain transportation costs. It puts competitive pressure on motor carriers, smaller country elevators, and short-line railroads. The farmers, traders, large country elevators, and larger railroads are the beneficiaries. Large elevators and railroads have reduced costs and farmers and traders switch to the resulting reduced rates. This trend also increases truck VMT on rural highways, as the larger elevators increase their gathering radius.

Promotion of Minnesota's Short-line Rail Industry

In response, the State has engaged in promotional activity for light density lines. For example, the 1994 Minnesota State Rail Plan identified the following 1994-2000 objectives:

- To assist in the revitalization of rail lines in Minnesota which show evidence of the future potential to be profitable;
- To improve rail service access for Minnesota rail users on light density lines; and
- To preserve opportunities that might exist for future rail service and other transportation, utilities, and communications uses.

These objectives have been translated into various assistance programs that have impacted the grain distribution system through the promotion of light density rail lines, many of which are used to support the grain gathering system. The program puts competitive pressure on motor carriers, country elevators on high-density lines, and railroads that operate those lines. The farmers, traders, small country elevators, and the railroads operating low-density lines are the beneficiaries. This initiative reduces truck VMT on rural highways by reducing the distance a farmer must go to deliver grain.

The "286" Issue

Led by the Class I railroads, many railroad companies are currently investing in their rail infrastructure in order to be able to increase from a 263,000-pound weight limit per car to a 286,000-pound weight limit. This situation is analogous to increasing the weight limit on the highway system. This is part of a long-term trend, and railroad weight limits are

likely to continue to increase over time. For example, the DME is planning to upgrade its coal line in Southern Minnesota to a 315,000-pound standard. Firms that are making this investment are doing so because of perceived commercial advantages in cost reductions and market gains. Almost all railroads, big or small, can handle an occasional heavy car with little or no negative impact. As rail cars are 30-year assets, the "286 issue" should be considered as a critical long-term issue for any railway that cannot afford to make the investments necessary to meet the standard. The magnitude of this issue will increase over time.

Concurrently, this issue is both significant and immediate for the grain distribution system, as the Class I railroads offer better rates on cars loaded to the heavier standard. This action is entirely consistent with the post-deregulation trend of passing lower costs on to customers. This action puts competitive pressure on light density lines that previous evaluations may have rated as profitable or potentially profitable, which may have been beneficiaries of assistance programs, and which may put Mn/DOT's loan portfolio at risk.

At present however, the issue is one of uncertain magnitude, because formal investigations to determine the cost of upgrading to the 286,000-pound standard have not yet been completed for the potentially impacted railways and grain elevators. Until these facts are known, the true seriousness of the "286 issue" will remain a matter of speculation. A second aspect of this issue is one of obtaining funds for the upgrade. In our interview, BNSF indicated a willingness to help with investment, generally with per carload incentives, for shortlines or country elevators that indicate an inability to handle the heavier cars.

Identity Preservation

Identity preservation is a leading edge trend in the grain business at this time. It results from the specific demands of the grain consumers for grains with or without specific characteristics. These characteristics may be different from the U.S. Department of Agriculture's grading standards. For example:

- Approximately five percent of the corn crop comes from hybrids that are not approved for export to the European Union (EU). At present, country grain elevators and terminals can be categorized by their willingness to accept non-EU-approved grain.

- General Mills demands oats with particular genetic characteristics for the production of Cheerios™.

- BNSF has a Mexican customer who prefers soybeans from Southern Minnesota for their specific oil content.

- The Minnesota Grain and Feed Association projects a future in which the farmer sends grain to an elevator that will dry, bag, containerize, and perform any other special process for the end user. The commercial relationship will be between the farmer and the end-user.

These requirements are customer-driven and may not be consistent with U.S. grading standards, which do not recognize genetic differences and which permit easily measurable amounts (for example three percent for U.S. No. 2 Yellow Corn) of foreign material

(primarily other grains). While these standards served well to support and organize the grain trade in the 20th century they appear to be inadequate and obsolete in the evolving 21st century environment. Concurrently, no generally accepted grading standard has been promulgated. This uncertainty regarding acceptable 21st century requirements translates into an associated uncertainty in prospective distribution methods.

The transportation implications of this trend are already showing up in the categorization of elevators and terminals as willing or unwilling to accept non-EU-approved grain. The obvious result is an immediate increase in truck VMT on rural highways.

While the ultimate result of this trend is uncertain, its general direction is not. Identity preservation means that grain will be handled in smaller lots and will not be blended to the extent that it is currently. Meanwhile, railroad's cost-driven marketing initiatives have been moving the opposite way. As the railroads respond to this demand trend, costs and rates will increase. When questioned on this point, BNSF emphasized its menu of services, ranging from single car shipments to 100-car unit trains. The railroad also emphasized that its prices would reflect appropriate volume discounts.

Any increase in rail costs will drive market share to motor carriers. In Minnesota, currently all grain within 80 miles of Savage is trucked to the port without passing through a country grain elevator. This competitive reality is based on low-cost rail unit train competition. To the extent that railroads must revert to single cars and smaller units in order to meet the lot size requirements, the competitive distance and market share will shift to trucks and away from the rail system and to some extent away from country elevators.

This trend puts competitive pressure on Class I and shortline railroads as well as on country elevators and traders who have gained margin from blending. The motor carriers appear to be the beneficiaries. This trend will increase truck VMT on rural and trunk highways. Farmers will face a more complex market with greater opportunities for individual marketing initiatives involving product and service differentiation.

Country grain elevators face the need to remake and redefine their business, particularly if they are close enough to the major terminals to be bypassed. Smaller elevators may gain from the need for more sorting, smaller lot sizes, and by providing innovative special services. Concurrently, they face the loss of the ability to gain margin from blending and the need to invest in order to modernize their facilities.

In the most extreme (and unlikely) case, identity preservation would be required from farm field to consumer anywhere in the world. Because transportation costs would increase, grain production patterns would change and grain would tend to be grown closer to the consumer. If shipment sizes decline to container sized lots, then the location of large import markets and associated available container capacity will also favor non-traditional growing areas.

The future situation is quite uncertain and there remain critical unanswered questions that will drive prospective changes in the grain distribution system:

- How much of the market will continue to be cost-driven and generic, and how much will require identity preservation?

- Will new grading standards be developed that reduce/modify the need for identity preservation?

- How will motor carriers and railroads respond to grain's new demand characteristics?

- How much will it cost to upgrade the light density rail system to the new weight standard?

Minnesota already enjoys considerable success in meeting the generic, cost-driven demand for grain, and Mn/DOT has been managing cost-driven incremental changes in Class 1, shortline, and motor carrier market share. This will likely continue to be true for the portion of the market that remains generic and cost-driven.

Changes in demand characteristics are a completely different matter. Additional services and features are being demanded for grains that could make the underlying production and distribution system obsolete. While the prospective magnitude and many of the features of these changes are unclear, the direction of their impact on the grain distribution system is not. Moving grain in smaller lots from production sites closer to consumers will drive grain transportation market share away from the rail/country elevator system and toward a system relying on motor carriers.

Intermodal Service Issues

Minnesota's rail intermodal service is relatively under-developed and incomplete. Minnesota lacks 1) good intermodal service in many long-distance traffic lanes, particularly between the Twin Cities and the Pacific southwest, 2) adequate terminal space in the Twin Cities, and 3) reasonable intermodal service in smaller communities.

- **Lack of service in many long-distance traffic lanes.** Table 6.2 illustrates the rail intermodal market share for traffic moving over 500 miles from the Twin Cities. The Intermodal Association of North America estimates that nationwide, approximately 18 percent of truckload traffic moving 500 miles or more is moving intermodally. As the economic advantage of intermodal service increases with distance, one should expect a relatively higher market share in the longer markets.

  Minnesota does enjoy good rail intermodal rail service on east/west routes between Chicago and the Pacific Northwest. BNSF and Canadian Pacific serve the Twin Cities and the Red River Valley using parallel routes. Similarly, Canadian National's parallel route transits Minnesota primarily between Duluth and International Falls. There is a terminal in International Falls but surprisingly not in Duluth/Superior. As a result, service is relatively good for international cargo moving between the Twin Cities, the Pacific Northwest, and Chicago. Service is also good for domestic cargo moving in corridors between the Twin Cities, the Northeast, the Southeast, and the Pacific Northwest. More than 90 percent of Minnesota's intermodal rail activity is moving in the Pacific Northwest-Chicago corridor, and its intermodal share is higher than the norm.

Table 6.2 Rail Intermodal Market Share

Metro Destination		Metro Origin	
Origins	**Intermodal Share (%)**	**Intermodal Share (%)**	**Destinations**
Chicago	75	46	Chicago
Northwest	46	59	Northwest
Southwest	6	4	Southwest
East Coast	3	4	East Coast
LA	3	7	LA
IL & MO	2	5	IL & MO
TX & OK	2	4	TX & OK
Southeast	2	12	Southeast
CA & NV	1	5	CA & NV

Source: 1997 Reebie TRANSEARCH database.

Other long-distance traffic lanes, particularly Minnesota to California, have much lower than the normal market shares. This indicates a relatively undeveloped intermodal opportunity. Currently, the I&M Rail Link, LLC provides a limited and relatively indirect service to Kansas City for interchange with BNSF for California traffic. Other California intermodal traffic pays an even more significant circuitry penalty and moves via Chicago. Mainly, the traffic moves all the way to California over the highway. The reasons for this limited service are probably historic. Prior to the recent mergers of BNSF and UP, the lane did not enjoy the positive economics associated with single-line service. With those mergers now complete, it would be reasonable for the railroads to revisit the opportunities associated with better service to the southwestern quadrant of the nation.

Eastern traffic lanes also appear under served, but it is common for traffic moving over the Chicago gateway to lose its identity. As a result, it is difficult to make reliable conclusions regarding this traffic.

- **Limited Terminal Capacity.** Shippers note that BNSF's hub at Midway in St. Paul is apparently operating at/near capacity with no reasonable expectation of expansion. They also report that, as a result, BNSF is de-marketing the region, i.e., raising rates to ensure a fluid operation for the remaining premium customers. BNSF indicates that approximately 125,000 lifts are being handled in Minneapolis. CP operates a smaller facility handling about 68,000 units annually. Union Pacific has no terminal presence in the Twin Cities.

- **Service in Smaller Cities.** Minnesota's smaller cities apparently do not enjoy the same level of intermodal rail service as do similar communities in Wisconsin and Iowa. Outside of the Twin Cities, only International Falls, Dilworth, and Thief River Falls have intermodal terminals. All are associated with Class I Railroads.

Concurrently, the Wisconsin Central (WC) provides service in Arcadia, Green Bay, Neenah, and Stevens Point. In addition, Iowa enjoys service in Council Bluffs, Davenport,

Dubuque, Fort Dodge, Newton, Waterloo, and West Liberty. Interviews with IAIS and WC, indicate that there is a base load customer for each facility. Maytag, for example, is the key customer for the Newton facility, while Amana fills the same role in West Liberty.

This study conducted several shipper interviews and examined population, manufacturing, employment, and wholesale trade volume in the five-state region. An analysis of that data indicates that small intermodal terminals may be viable in St. Cloud and Rochester/Mankato/Owatonna. Another way to illustrate this issue is to consider Frigidaire's inbound and outbound distribution pattern. It likely has enough cargo moving to far distant distribution centers to be an "anchor" customer for a small intermodal terminal. This would be new business for BNSF, and a St. Cloud terminal would also relieve volume pressure on BNSF's Midway terminal.

The BNSF-CN Merger

While this study was in progress, the Burlington Northern Santa Fe and Canadian National Railway announced their plan to merge their operations through a new company, North American Railways, Inc. If approved, this combination would create the largest rail system in North America, with 50,000 route miles, serving eight Canadian provinces and 32 states in the western and central United States, employing 67,000 people, and generating revenues of about $12.5 billion. This combined revenue would represent approximately one-third of all rail revenue generated in North America. CN and BNSF will file a joint application seeking STB approval of the rail combination as soon as practicable after March 20, 2000, and they are seeking a 365-day review process.

In Minnesota the new carrier will:

- Operate approximately 40 percent of the rail route miles in the State;
- Operate parallel main lines in northern Minnesota and southern Ontario/Manitoba; and
- Most significantly impact Duluth, which is the only city in the State served by both railroads.

More specifics regarding service route and impacts will become available when the formal merger documents are filed. Of particular interest will be the level of diversion of freight from the UP and CP systems as well as the shortlines and the associated economic impact on those carriers.

Beyond the merger as presently identified, there is a possibility that the current merger will trigger another round of rail mergers that could lead to a situation in which there are two main rail systems in North America. Such a possibility was identified by the Presidents of four large railroads in an open letter that was published in the Wall Street Journal on January 11, 2000. In that letter they agreed with the Surface Transportation Board and recommend that "the future structure of the railroad industry should be discussed now, before the BNSF/CN merger goes forward." How this process will evolve is unclear at this time.

In Minnesota, the ultimate picture could look like two very large competing North American rail systems with the BNSF and CN/IC combination followed by a combination of Union

and Canadian Pacific railways, both of which have an Eastern partner. The real gain for Minnesota in this scenario would be the reduction in the gateway barrier at Chicago as well as the associated improvement in access to Eastern consuming markets.

In contrast, many large shippers been seriously disadvantaged by the large rail mergers of the 1990s; and are lobbying for a more radical restructuring of the rail industry. In any case, the BNSF-CN merger process will be an important event with long-term consequences. Mn/DOT should decide what kind of prospective rail system it wants and then begin intervening in the process toward that end.

6.3 Water[1]

Waterborne commerce carries a significant percentage of the total freight moved through Minnesota by weight. Over 70 million (20 percent) of 340 million tons (not including overhead) moved through the State travels by water via Great Lakes or Mississippi River ports. Five million tons of grain, 40 million tons of iron ore, and 16 million tons of coal depart the Great Lakes ports of Duluth and the North Shore of Minnesota bound for other Great Lake states and international markets. Seven to nine million tons of grain are transported down the Mississippi River, primarily for export to overseas destinations through Louisiana at the Gulf of Mexico (see Figures D.23 through D.26). Minnesota's unique water freight connections enable the State to compete on the global market with high-volume/low-value bulk commodities produced by extensive agriculture and mining industries employing thousands of workers statewide.

Minnesota Ports

Minnesota is home to nine Great Lake and Mississippi River ports. These are depicted in Figure 6.4 along with the volumes on their respective waterways. The lake ports are Duluth/Superior, Two Harbors, Silver Bay, and Taconite Bay. With the exception of Duluth, all of these ports exclusively handle iron ore (taconite) shipments from mines in Northeast Minnesota. Most of the taconite goes to Indiana, Ohio, and Pennsylvania.

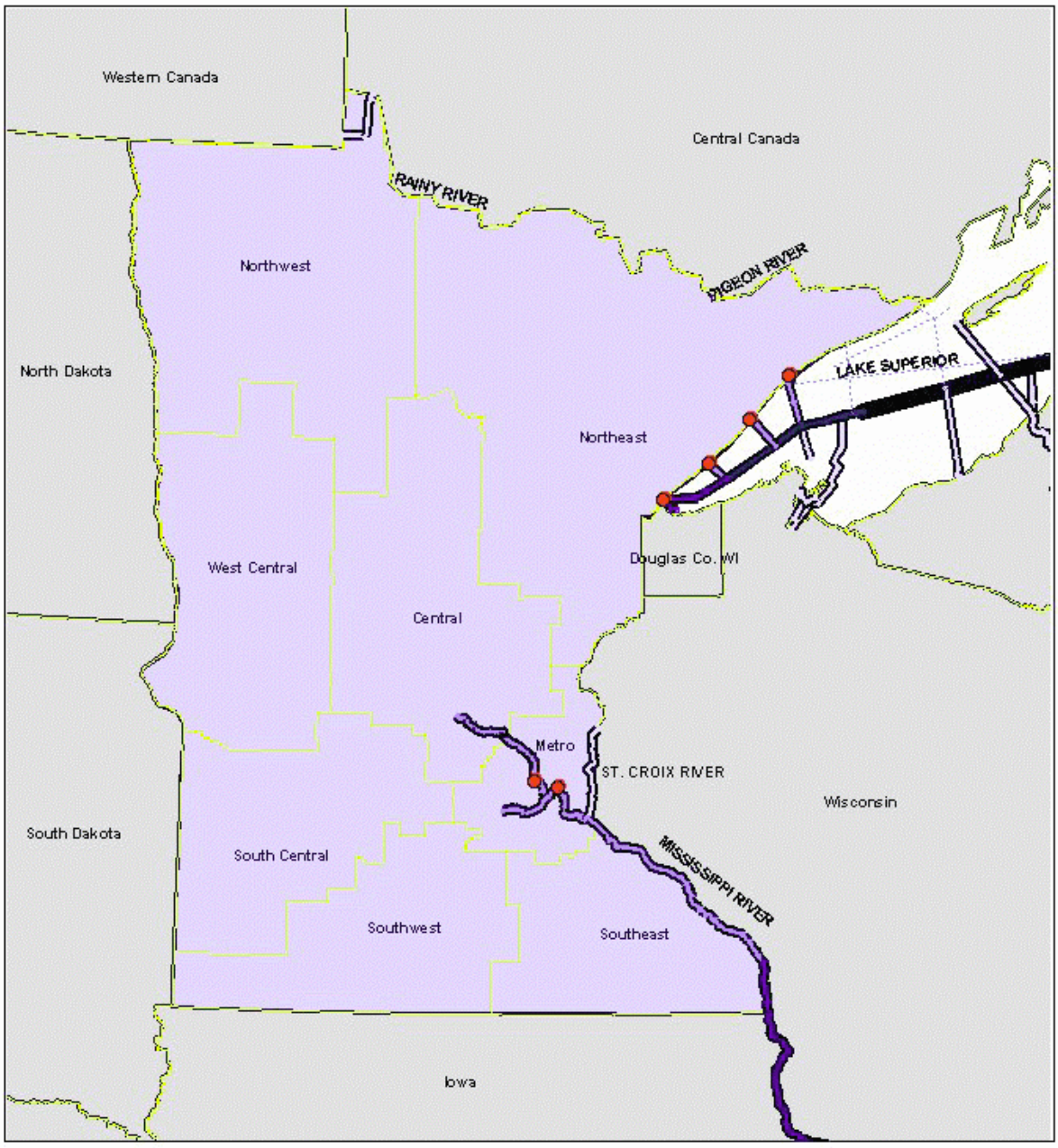
[1] Sources for this subsection:

Interview with the Duluth Port Authority; Interview with Dick Lambert from Mn/DOT's waterways section.

River Transportation in Minnesota, Department of Transportation Ports and Waterways Section, St. Paul, 1993.

Great Lakes Transportation in Minnesota, Department of Transportation Ports and Waterways Section, St. Paul, 1994.

Figure 6.4 Port and Waterway Freight Volumes



Duluth/Superior handles most of the agricultural and coal shipments. Agricultural products come into the port from the northern half of the State and the Dakotas. These are distributed domestically and internationally. Duluth/Superior is the highest ranked Great Lake Port in terms of total tonnage and grain movement. It is ranked 17th in total tonnage among all United States ports. In 1993, 28.3 million metric tons of goods were distributed domestically and 9.1 million metric tons were distributed internationally. In 1998, 11.2 million metric tons of goods were distributed internationally and 27.4 million metric tons were distributed domestically.

Minnesota's Mississippi River ports are located in Minneapolis, St. Paul, Savage, Red Wing, and Winona. Grain represents about half of all commodities handled by Minnesota's river ports. Minnesota's Mississippi River grain shipments account for approximately seven percent of the nation's total grain export. A total of 42 active river terminal facilities handle this grain, as well as coal, sand, gravel, cement, fertilizers, petroleum, salt, scrap, and steel.

While tonnage at Minnesota ports has been relatively consistent over the past few years, most river terminals are expected to see an increase in total tonnage and subsequently an increase in the number of trucks carrying commodities to and from those terminals. Meanwhile, barge lines are consolidating in order to remain competitive. The number of shipping options are reducing for Minnesota shippers, but thus far, rates have been kept fairly low due to water and rail competition.

Problems and Impediments

Several issues limit the overall capacity and service of waterborne commerce through the state of Minnesota. These are summarized below.

Physical and Infrastructure

- There is a long haul for exporting goods internationally. It is 2,300 miles to the Atlantic Ocean and 1,800 miles to the Gulf of Mexico. Therefore, waterborne commodities typically cannot be time dependent or sensitive to long en route times.

- Lock and dam infrastructure is old and in need of repairs and upgrading. Delays are caused by long waits at locks.

- There are 26 locks between St. Paul and St. Louis. Twenty-three of the 26 locks are only 600-feet long, which slows barge movement. Most barge tows have to be broken up so that they can pass through. This can slow traffic by two hours. This congestion adds roughly $35 million a year in shipping costs.

- The width of 15 Great Lakes and St. Lawrence Seaway lock chambers is 80 feet, which is quite narrow when compared to the typical width of most ocean-going vessels, and many locks are too short for these vessels. However, Canadian vessel operators, which operate the majority of Great Lakes ships, have lobbied to maintain these smaller facilities to prevent foreign flag ships from traveling beyond the ocean ports in the St. Lawrence Seaway. Goods must be switched to the barge operators to get through the locks and canals to inland markets like Minnesota. Thirteen of the 16 Great Lakes and St. Lawrence Seaway locks are controlled by Canada.

- The lock on the St. Lawrence Seaway and the Welland canal limit the size of vessel that can enter the Great Lakes. A large percentage of ocean ships are too large for the locking system giving access to the Great Lakes.

Regulatory and Institutional

- The federal lock and dam infrastructure is maintained by the U.S. Army Corps of Engineers and safety is handled by the Coast Guard. As a result, the State has little influence over much of the movement of goods on waterways. The federal government sets the hours that the locks operate (24 hours per day for eight to 10 months per year). The U.S. Congress has the power to decide if there is not enough tonnage to make it worth the expense to keep a lock open.

- In 1986, the U.S. Congress passed the Water Resources Development Act of 1986 with a provision instituting user fees at all U.S. deep-draft ports. The fees were in the form of a .04 percent tax on the value of the cargo carried. The fees were used to pay 40 percent of the dredging and other operations and maintenance services the federal government had previously provided at no charge. The federal government would continue to pay the remaining 60 percent of operations and maintenance costs. In 1990, Congress passed the budget reconciliation bill which raised the ad valorum tax from .04 percent to .125 percent. Since .04 percent represented 40 percent of O&M costs for the harbors, a three-fold increase occurred. The tax now represents 125 percent of O&M costs. Many carriers and shippers complain that this is an unfair income source for the government that is hurting Minnesota's waterborne commerce. In 1998, the U.S. Supreme Court ruled the *export* tax part of this charge as unconstitutional. The industry is waiting to see whether there will be similar ruling on the *import* part of the tax. The Administration has introduced a new "user fee" that would double the existing tax. So far the Congress has not accepted this proposal.

- The 1904 Cargo Preference Act (government impelled cargo) limits shipping in the Great Lakes area by non-U.S.-flag ships. This act requires that all military cargoes be transported in U.S.-flag vessels. Because of the law and the absence of U.S.-flag service, the Great Lakes historically have been awarded less than one percent of military cargo slated for overseas shipment despite the large amount of military cargo that is generated in the Great Lakes region. It also poses a problem for vessels carrying USDA and AID cargoes. There is a three-year waiting period for ships to carry government impelled cargo once becoming a U.S.-flagged carrier.

Other Impediments

- Weather-related constraints on the length of the shipping season (winter ice) prohibits some vessel operators from using the Great Lakes.

- The city of Minneapolis and the Metropolitan Council are evaluating what are the best and highest uses of key parts of the region's riverfront. One area of investigation is the relative value of commercial navigation on the Minneapolis Upper Harbor area versus riverfront amenities. This could change how goods flow to and from Minneapolis. If commercial navigation is closed, the highway network would have to be utilized to transport two million tons of aggregate and other commodities from St. Paul River terminals that currently travel by water directly to their Minneapolis destination. This would significantly increase the number of trucks on local roads.

6.4 Air[2]

Air transportation provides a vital link to distant suppliers and markets for many of Minnesota's businesses. Airports throughout the State provide connections to locations across the globe, with direct service overseas through Minneapolis-St. Paul International Airport (MSP). Due to the relatively high cost per pound of air transportation as compared to other modes, air freight generally carries high-value items that require short delivery times. As a result, about 400,000 tons of Minnesota's freight move by air each year. Of this total, 350,000 tons travel between Minnesota and airports in North America. This amount represents under one percent of the State's total North American freight by weight, but over four billion of total freight value (slightly more than one percent. See Figures D.27 through D.30.).

Nearly all air freight involves a truck movement to load or receive the cargo. Typically, this truck move is short-haul and time sensitive. Good landside access to air cargo facilities is important. Adequate cargo facilities are necessary to stage cargo and load aircraft. Air freight is carried by two primary methods: belly or combination freight and dedicated service. Belly/combination freight is loaded in the cargo holds of passenger aircraft. Northwest Airlines (NWA) is the primary passenger and belly freight carrier in Minnesota because MSP is a main NWA hub. Dedicated service involves freight-only aircraft operated by carriers such as Federal Express and Airborne Express.

Providers of air freight services fall into three categories: passenger airlines, integrators, and freight forwarders. Northwest is the dominant passenger airline carrying belly and combination freight in Minnesota to and from domestic and international airports. Freight forwarders arrange cargo space for their customers with belly/combination freight operators and dedicated providers. These organizations handle approximately 80 percent of international deliveries to and from Minnesota. FedEx is currently an integrator (provides door-to-door dedicated service). Other major integrators include BAX, UPS, Airbourne, DHL, and Emery. These companies handle mostly domestic freight (60 percent market share according to FAA report on Air Freight). Integrated (express) air freight carriers are challenging traditional air freight carriers in the international markets. The current international express freight market share stands at just above six percent. That market share is expected to continue growing to 40 percent by 2017. International express air freight mirrors the domestic express freight growth pattern somewhat. Domestic express freight is expected to continue to grow at an average of 6.4 percent per year, while international air freight is expected to grow at about 6.1 percent per year. Some of the integrators have been purchasing freight forwarding companies to gain

[2] Sources for this subsection:

Interview with and written comments from Dick Theisen, Duane Haukebo and Dan McDowell of Mn/DOT Aeronautics.

Minneapolis-St. Paul International Airport Air Cargo Feasibility Study, Cargo Marketing Group, Brewster, MA, 1997.

Minnesota Statewide Air Cargo Study, TAMS Consultants, Inc., Chicago, 1999.

international expertise and market connections. Some of the major passenger airlines have countered with forming alliances with freight forwarding companies.

Air Freight Services in Minnesota

There are 24 airports in the State with freight service. These are depicted in Figure 6.5. There are three tiers of service available in the State: major service facilities, local and regional service facilities, and on-demand facilities. The major air cargo service facilities are located in Duluth, Minneapolis/St. Paul (MSP), and Rochester. Northwest Airlines is the dominant freight carrier at MSP. A number of providers service MSP and Duluth. Federal Express opened a hub facility in Rochester in 1996 to avoid growing landside access problems at MSP.

Local and regional air cargo service facilities are located throughout the State. These facilities provide scheduled or regular service with smaller turboprop or propeller aircraft that connect to larger national and international hubs. Typically, a large or regular customer has prompted the provider to deliver direct service to these smaller markets. There are 15 local or regional air cargo facilities located at airports in Alexandria, Bemidji, Brainerd, Detroit Lakes, Eveleth-Virginia, Fairmont, Fergus Falls, Grand Rapids, Chisholm-Hibbing, International Falls, Mankato, Marshall, St. Cloud, Thief River Falls, and Winona.

On-demand air cargo service is provided to additional locations by special arrangement with a customer. These airports can handle cargo operations, but air freight is typically trucked to other airports. This service can be found in six airports in Minnesota: Anoka, Baudette, Morris, Roseau, St. Paul Downtown, and Worthington.

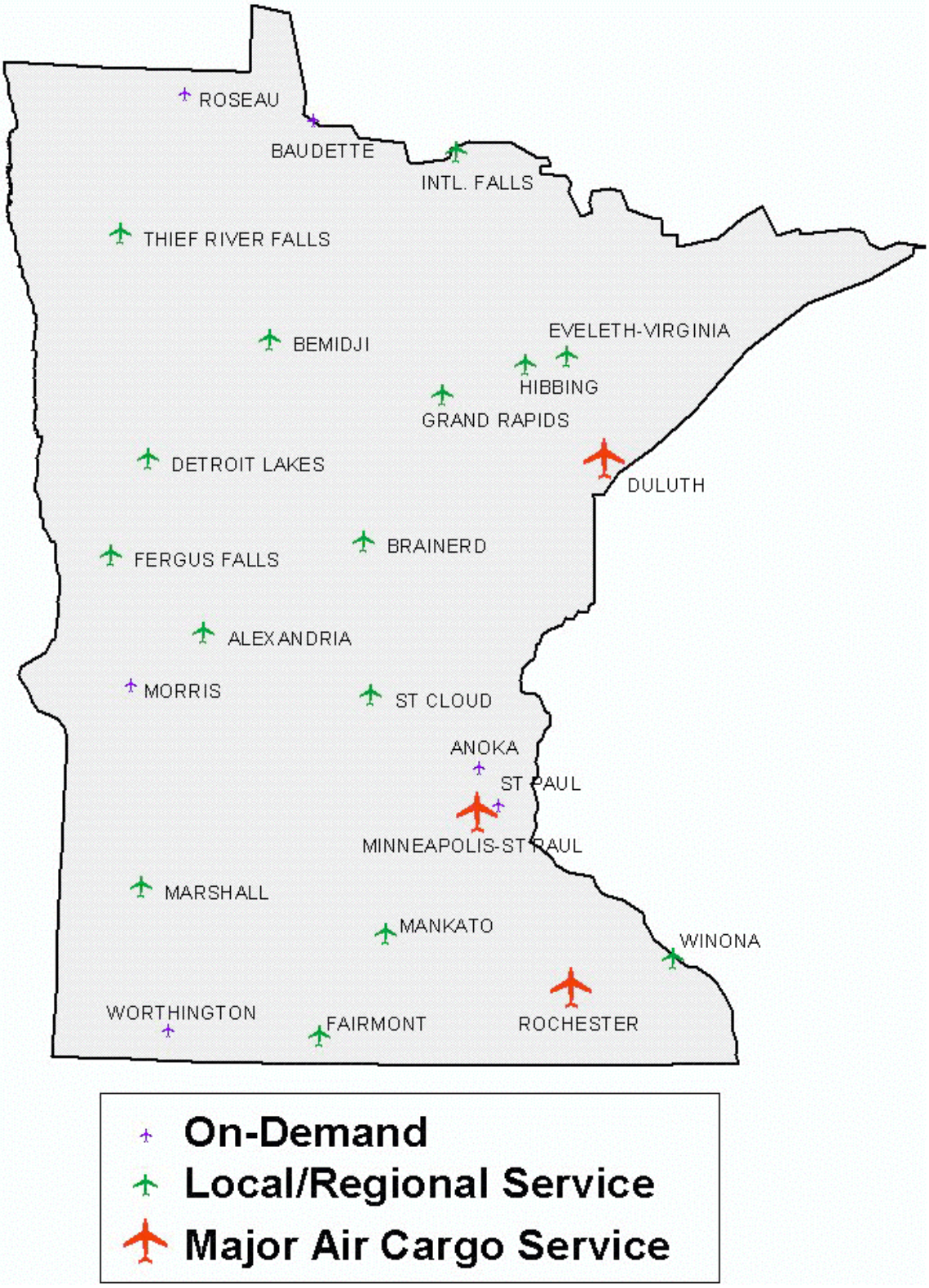
Origins and Destinations

Minnesota's airports provide connections to every market in the world. Overall, the State is a net exporter to North America and the rest of the globe. However, most air tonnage moves in to the State (227,000 tons from North America), with 123,000 tons moving outbound. Clearly, Minnesota's manufacturers depend on timely delivery of high-value products. Some of the key points regarding Minnesota's air freight connections are highlighted below.

- The State's largest dedicated integrator, Federal Express, has cargo facilities in Minneapolis and Rochester with pick-up and delivery services at several local and regional airports in the State. Most goods are trucked to these facilities and then shipped to their hub facilities in Memphis, TN and Salt Lake City, UT. United Parcel Service (UPS) has facilities at MSP and pick-up and delivery service at Bemidji and Thief River Falls. Goods are transported to their hub centers in Louisville, KY and Oakland, CA. Both of these major carriers anticipate that overseas shipments will increase in the future.

- It is estimated that 90 percent of the international air cargo moving in the Minneapolis/St. Paul market is flown into or out of other international airports. For example, many goods are trucked from Minnesota to Chicago and flown out of Chicago's O'Hare Airport.

Figure 6.5 Freight Airports in Minnesota



- Ninety percent of Minnesota's air cargo international export markets are located in the Asia-Pacific rim countries and Europe. One million pounds per week are shipped to Europe, and slightly over one million pounds per week are shipped to Asia and the Pacific rim. Only 200,000 pounds are shipped to other international destinations.

Problems and Impediments

Several issues affect the expansion of air freight service in Minnesota. As air freight volumes increase worldwide every year, Minnesota's air freight system will need to expand in order to remain competitive. Some of the impediments to expansion are discussed below.

- Landside congestion at the Minneapolis/St. Paul airport is becoming severe. It is difficult to get in and out of the airport. This hurts carriers such as Federal Express and UPS which are sensitive to the timing of deliveries for overnight service. Federal Express is exploring the possibility of opening a facility in St. Cloud in addition to its Rochester and MSP facilities because of congestion in the Twin Cities.

- While airside congestion is typically not a factor for air freight carriers, which operate during off-peak passenger-traffic periods, the increase in air transportation is slowly widening the hours of peak operation. Noise abatement restrictions between 10:00 p.m. and 6:00 a.m. at MSP will expose air freight carriers to airside congestion in the future, further limiting the growth potential of air freight operations at MSP.

- Significant economies of scale affect operations out of Minnesota due to the proximity of the large air freight operations in Chicago. Minnesota has limited international flights when compared with Chicago and significantly lower air cargo service volumes.

- Space in the bellies of international flights out of MSP is often full because of significant passenger loads and the associated baggage. In addition, the number of international flights is limited as compared to other major hub airports. NWA flies most of these routes because MSP is one of their main hubs. Therefore, NWA operates most of the freight gates at MSP. Other airlines have had a difficult time competing in this market. They have chosen to funnel traffic by truck to feed their own hub systems through other airports such as Chicago. This situation will be remedied with the planned airport improvements at MSP. New landside freight facilities will be complete in three years that will be operated by MAC for independent freight-hauling companies. A new runway is also planned.

- The perception of general aviation airports is that they do not handle cargo. This is a misconception. Half of the air freight airports in the State are considered general aviation airports. There is a push to have them identified as commercial airports by modifying the current definition of a commercial facility.

Market Forces

The growth of air freight transportation worldwide has forced providers to expand their operations in nearly every market they serve. These changes will continue to require improvements to Minnesota's air freight infrastructure for several years.

- The air cargo market is anticipated to grow significantly over the next 20 years. In 1998, 295,000 tons of air cargo passed through the State. By 2020, that number is expected to grow to 1,321,000. The overseas market in particular is predicted to grow substantially.

- MSP has approximately 90 to 93 percent of the air cargo business in the State. It is the air cargo hub for Minnesota, the Upper Peninsula of Michigan, Western Wisconsin, Northern Iowa, and most of North Dakota. The Rochester Airport is the second largest center. By 2020 these two facilities are anticipated to have 97 percent of the air cargo business.

6.5 Conclusions

This section has provided an overview of the infrastructure and issues facing each mode of freight transportation in Minnesota. Shippers and receivers in the State depend regularly on one or more of these modes. Minnesota has a strong network of truck, rail, water, and air infrastructure. Global competition necessitates that this infrastructure is maintained and improved in order to keep the State economically competitive. The State must consider ways to strategically focus limited resources on its freight infrastructure.

This report has provided an understanding of the elements leading to the identification of important goods movements corridors in Minnesota. These elements include: how goods are moving in Minnesota; the requirements of freight shippers and receivers and the issues that they face; and the use of the multimodal freight infrastructure and the issues that it faces. Based on these findings, Section 7.0 identifies the key goods movement corridors for Minnesota. These corridors should be one of Mn/DOT's focus freight planning and programming efforts. By directing resources at key multimodal freight corridors, the State can improve access to important markets and avoid unfocused single-mode improvements. Several methods and best practices for analyzing these corridors in detail are also discussed in Section 7.0.

7.0 Key Corridors

An important outcome of the Minnesota Statewide Freight Flows Study is the identification, analysis, and comparison of key Minnesota freight movement corridors. Determining the relative significance of goods movement corridors that are important to Minnesota's economy can help to prioritize freight system improvement needs and strategies. The study identified six key interstate multimodal corridors and several intrastate (interregional) corridors; assigned commodity flows to each corridor (not including through traffic); correlated the truck movements to the companion Interregional Corridors Study (IRC); and ranked these corridors according to the weight and value of shipments. The study also has provided a framework for evaluating the performance of the infrastructure in these corridors relative to freight movement to provide a foundation for future project evaluation.

7.1 Interstate Corridors

Methodology

Identifying key commodity flow corridors was an objective at the beginning of this study. Commodity flow data is not publicly available for most corridor facilities, including highways, rail lines, air routes, and waterways. While originating and terminating information for most commodities by weight, value and mode is available from a number of sources, there is no source that associates these freight generators with the actual en-route (corridor) facilities used. The routes freight takes can only be estimated based on point data and models. For instance, truck surveys can be conducted at toll facilities or at weigh stations to identify part of the route a shipment moves on, but such surveys have not been conducted in Minnesota. The Carload Waybill Sample has specific route and commodity flow information for Class I railroads, but the data is not publicly available at that level of detail. Therefore, localized models have been developed to estimate the routes freight moves on, such as those for the Northwest Minnesota Freight Flows Study (see Section 4.8). Reebie Associates, under contract to the Federal Highway Administration, is developing an Intermodal Visual Freight Database that assigns truck commodity flows to highways based on a national highway shortest-path model developed by the Oak Ridge National Laboratories. While still under development, this system has simulated commodity flows on actual facilities well. Similar methods could be developed in the future for rail, air and water corridors as well.

In order to identify interstate goods movement corridors for this study, the original definition of external regions (Figure 4.3) took into account the major truck, rail and water corridors connecting Minnesota to the rest of North America. These regions enabled a distinction of nearby North American market areas, those within 500 miles, and those over 500 miles, while associating each market area with a primary multi-modal corridor that

served it. The nineteen external markets were grouped along six primary corridors. These corridors are the Northwest corridor; Southwest corridor; South corridor; Southeast corridor; East corridor; and Northeast corridor. Table 7.1 identifies these corridors and the modal facilities used for access to the markets on the corridor. These facilities were identified as part of the modal profiles developed for Section 6.0.

Table 7.1 Sample Major Facilities Serving Key Commodity Flow Corridors

Corridor	Highway	Rail Line	Waterway	External Air Hub
Northwest	I-94, I-90, U.S. 2, U.S. 212	BNSF CP – Soo Line	N / A	Seattle, Chicago
Southwest	I-90, I-35, SR 60	BNSF – Chicago UP – Kansas City	N / A	Sioux Falls, Memphis, Chicago
South	I-35, U.S. 63, SR 60	BNSF – Chicago UP – Kansas City	Mississippi River	Chicago, Memphis
Southeast	I-94, I-90	BNSF – Chicago	Mississippi River	Memphis, Louisville, Indianapolis, Chicago
East	I-94, I-90, U.S. 53, SR 36, SR 8	BNSF – Chicago CP	Great Lakes	Chicago, Indianapolis, Louisville, Philadelphia
Northeast	SR 61	CN	Great Lakes	N / A

Identification of the six corridors and their associated facilities was validated by data from interviews, known vehicle volumes, the available facilities, and previous studies. This included: highway, rail, air and water interview data from the interviews conducted for this study; average daily commercial truck volumes from the Highway Performance Monitoring System (HPMS) in 1997; rail volumes reported by the Bureau of Transportation Statistics from the 1995 Carload Waybill Statistics; waterway volumes from the U.S. Army Corps of Engineers; and air corridors identified by the Minnesota Statewide Air Cargo Study, prepared for Mn / DOT in 1998.

A separate modeling analysis was performed to validate the truck corridor volumes. The Reebie truck commodity flows to and from North American regions were converted to daily truck volumes and compared to known Heavy Commercial Average Daily Traffic (HCADT) volumes at the points where the interstate commodity flow corridors crossed the Minnesota state borders. The methodology and the results of this process are described in Appendix F.

Findings

Figures 7.1 and 7.2 show each interstate corridor with its corresponding commodity flow by weight. Table 7.2 below compares the total weight and value moving on each interstate corridor. Table D.5 in Appendix D provides a detailed modal breakout of weight and value for each corridor (Figures D.45 and D.46 show the corridor flows by value).

Table 7.2 Interstate Corridor Comparison

	Tons		Dollars	
East	92,646,266	42%	$74,507,540,972	43%
Northwest	62,230,560	28%	$21,146,796,093	12%
South	21,274,216	10%	$31,558,688,229	18%
Southeast	25,989,453	12%	$27,648,508,064	16%
Southwest	11,176,855	5%	$17,839,752,184	10%
Northeast	7,990,428	4%	$153,330,522	0%
TOTAL	**221,307,779**		**$172,854,616,064**	

In terms of weight and value, the East corridor is by far the most significant freight corridor for Minnesota's economy. Ninety-three out of 221 million interstate tons move along the East corridor. This represents $66 billion out of the $170 billion total value of interstate shipments. The primary modal facilities in the East corridor are I-94 east of St. Paul, the Burlington Northern Santa Fe (BNSF) and Canadian Pacific (CP) railroads to Chicago, and the Great Lakes waterways out of Duluth/Superior. Nearly three-quarters of the value in either direction is carried by trucks. However, water carries over half of the weight, of which 45 million tons are outbound shipments across the Great Lakes. Iron ore therefore represents the largest commodity by weight, with warehouse, distribution and FAK consumer goods representing the greatest by value.

In terms of weight, the second ranking corridor is the Northwest corridor (62 million tons), of which 51 million tons are inbound. Outbound moves on the Southeast corridor (19 million tons) actually exceed outbound moves on the Northwest corridor (11 million tons). In terms of value, the South and Southeast corridors tie for second at approximately $31 billion each. In all corridors, trucks carry the majority of the value.

It should be noted that modal routes for each corridor are not exclusive to that corridor. The Southeast and the East use I-94 as well as the BNSF mainline; the South and the Southeast both use the Mississippi River; and rail service to the Southwest, South, Southeast, and East may actually be on the same rail line out of Minnesota (See Table 7.1). While the final destination of goods varies by corridor, in many cases, routing options are the same. This is an important point to consider for infrastructure planning. Improvements along one modal route may serve many freight markets, depending on the mode and the commodity being shipped.

Figure 7.1 Top Inbound Interstate Commodity Flow Corridors by Weight

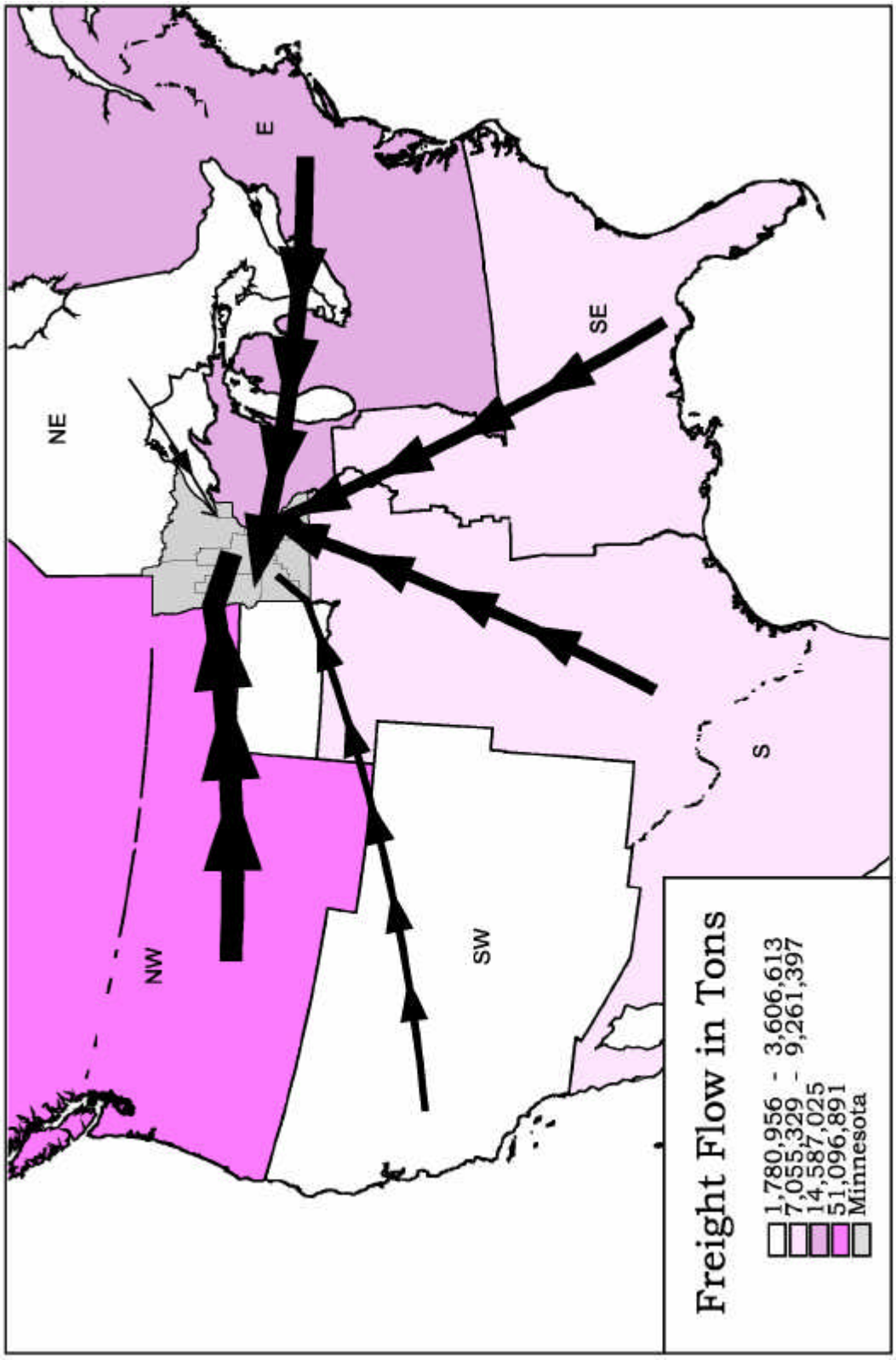
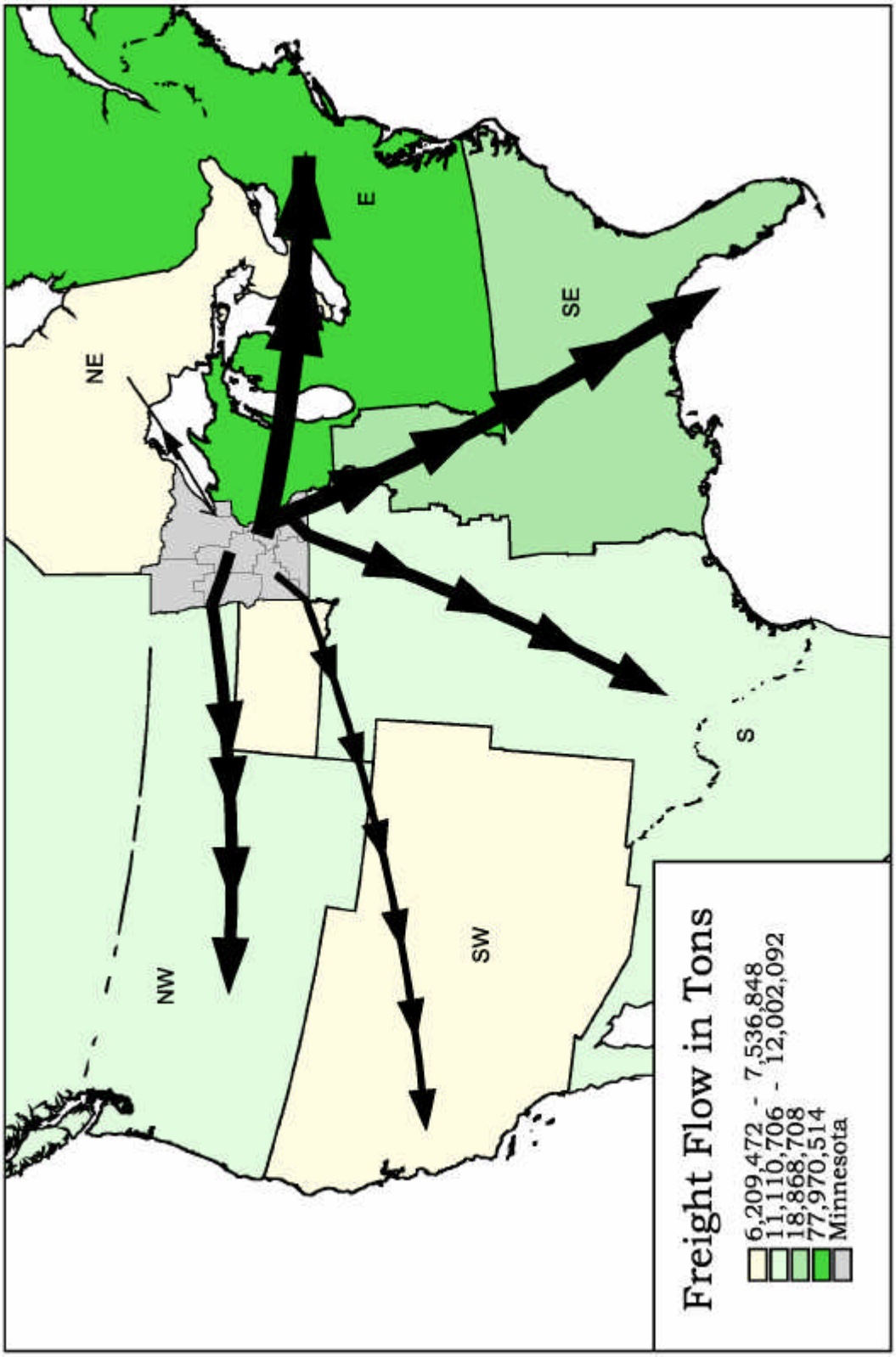


Figure 7.2 Top Outbound Interstate Commodity Flow Corridors by Weight



7.2 Intrastate Corridors

Methodology

Identifying key intrastate (interregional) commodity flow corridors is an important part of understanding how goods move within Minnesota. Determining the primary regions for freight generation and consumption helps Mn/DOT prioritize the multimodal facilities that connect these regions. As with interstate corridors, certain intrastate corridor facilities can be associated with where freight is generated and consumed. However, there are a great number of freight users scattered across Minnesota. A detailed modeling effort for all of these origins and destinations was not possible within the scope of this study, so freight users had to be aggregated into the principle freight generating regions of the State. It was agreed that Minnesota's ATPs were appropriate (see Figure 4.2). Unfortunately, it was not possible to associate intrastate flows with specific facilities at this level of detail. Major rail lines and highways connect each region, but there are many other local facilities that carry much of the intrastate freight as well. Therefore, this analysis only identifies the primary intrastate commodity flow corridors. In an attempt to focus planning efforts, likely intrastate corridor highway facilities have been identified from those determined to be interregional corridors in the companion IRC study.

Findings

In terms of the commodity flows identified by this study within the state of Minnesota, there are as many intrastate corridors as there are unique one-way pair combinations of the nine internal regions (72); however the primary corridors are associated with goods movement to and from the Metro region, Northeast Minnesota, and Southeast Minnesota. Figures 7.3 and 7.4 show the largest intrastate commodity flows. The Northeast internal region and Douglas County (WI) exchange more intrastate freight (27 million tons) than any other interregional pair by far, due to shipments to terminals in Superior, Wisconsin, as well as the overall interdependency of the Ports of Duluth and Superior. While the connection between Duluth and Superior is not a long corridor, the importance of the port district is evident. The Metro region and Southeast Minnesota exchange the next greatest intrastate weight at seven million tons. The top three interregional corridors by value are between the Metro region and Southeast Minnesota, Southern Minnesota and Central Minnesota (at approximately $12 billion apiece).

Due to the variability of identifying specific intrastate corridor facilities, the analysis only attempted to associate intrastate highway flows with the interregional corridors identified by the IRC study. In general, the primary intrastate flows are well served by many of Minnesota's highways. In order to focus attention on facilities that may be threatening efficient goods movement, the "at-risk" IRCs were compared to the top commodity flow corridors. At-risk corridors were defined as those having "current or anticipated performance deficiencies" and/or "a medium to high signal proliferation risk." Figure 7.5 depicts the top nine commodity flow corridors and the IRC "at-risk" facilities likely to be associated with these flows. These are listed in Table 7.3 below. While other highways move this intrastate freight, these facilities should attract more attention in any freight planning efforts. It

should be emphasized that this is a preliminary ranking for sketch planning purposes only. A more detailed surveying and modeling study would identify specific facilities. It also should be noted that this level of detail is limited to truck infrastructure; rail, water and air infrastructure have not been analyzed to the same level of detail of the IRC study. This procedure does establish a methodology for future freight system analysis.

Figure 7.3 Top Intrastate Commodity Flow Corridors by Weight

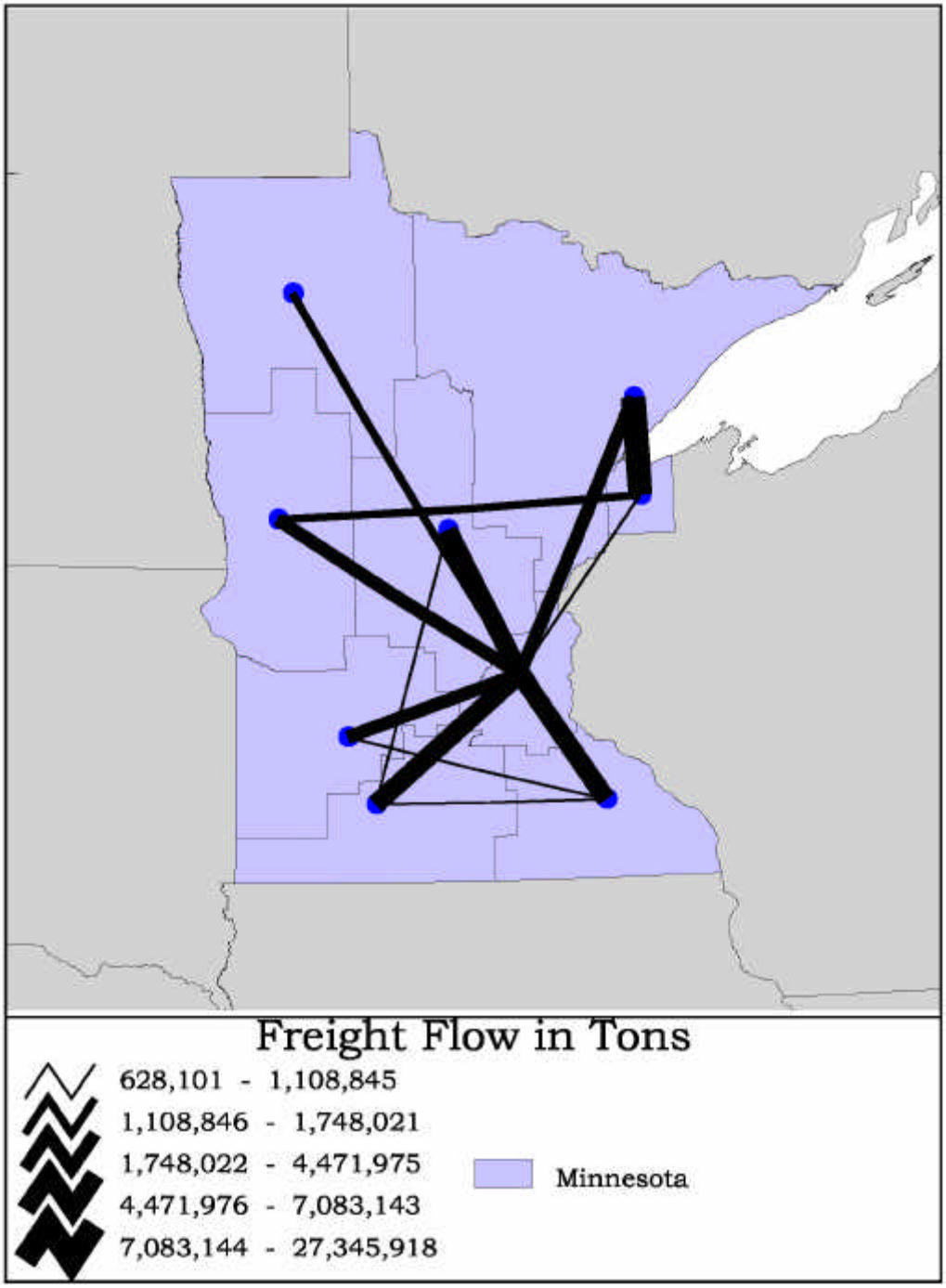


Figure 7.4 Top Intrastate Commodity Flow Corridors by Value

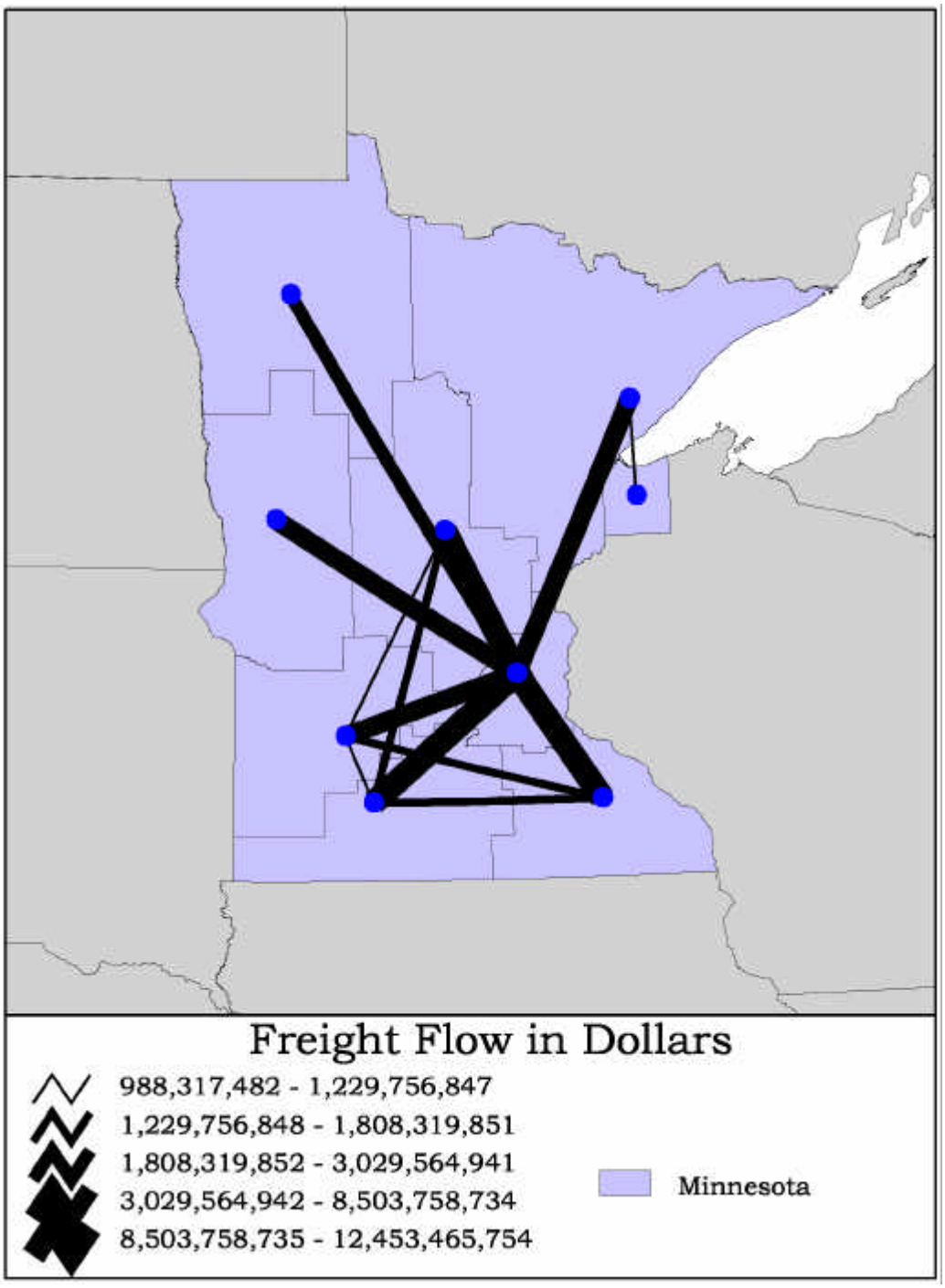


Figure 7.5 IRC At-Risk and Top Commodity Flow Corridors

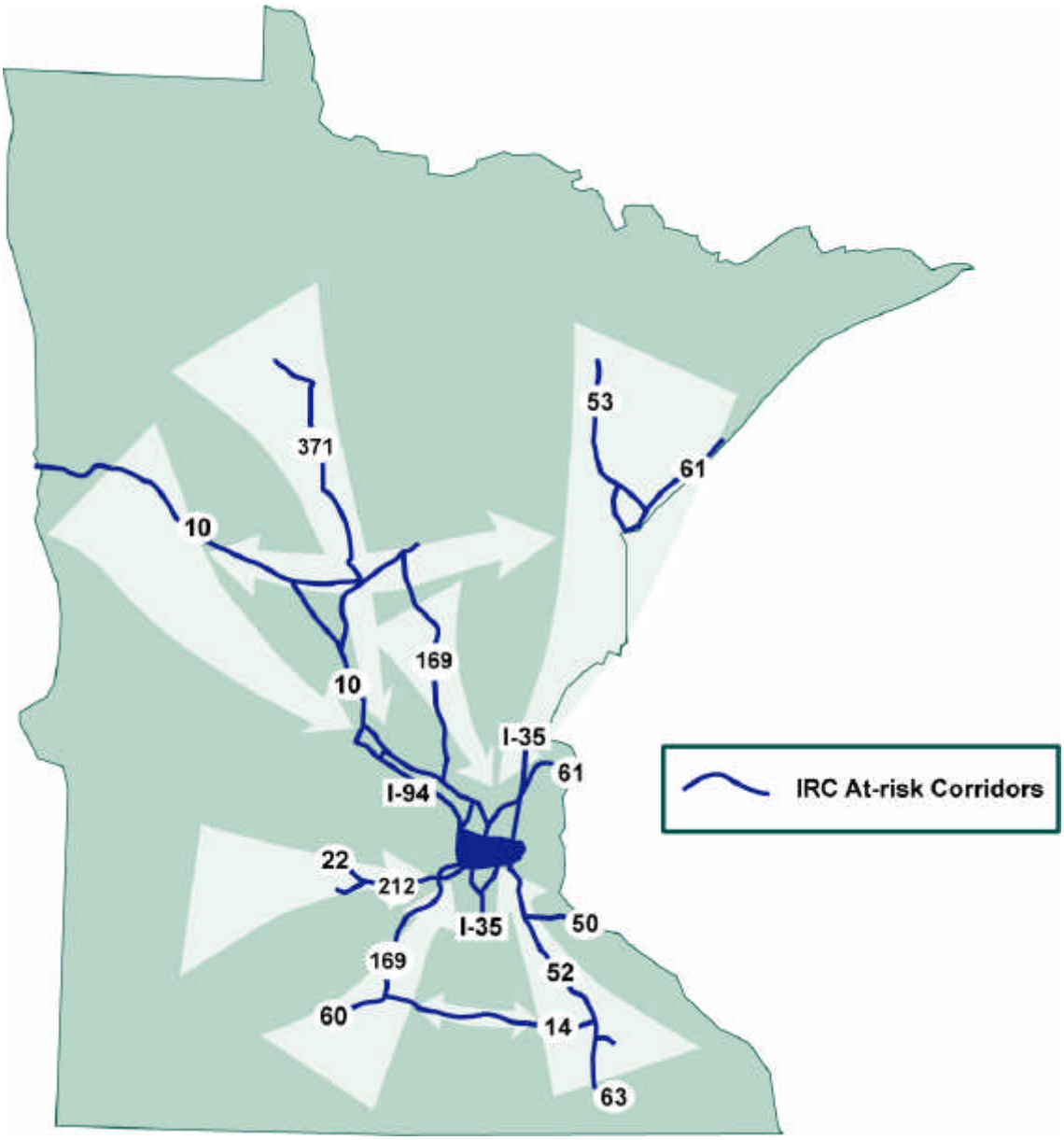


Table 7.3 Intrastate Commodity Flow Corridors and Associated "At-Risk" IRC Facilities

Corridor	Facilities
West Central – Metro	SR 10, Moorhead – Minneapolis I-94, St. Cloud – Minneapolis
Northwest – Metro	SR 371, Bemidji – Little Falls
Northeast – Metro	SR 53, Virginia – Duluth SR 61, Two Harbors – Duluth
Central – Metro	SR 10, Little Falls – Minneapolis I-94, St. Cloud – Minneapolis SR 371, Brainerd – Little Falls SR 169, Brainerd – Minneapolis
Southeast – Metro	I-35, Northfield – Minneapolis SR 52, Rochester – Minneapolis SR 50, Red Wing – Hampton SR 63, Spring Valley – Rochester
South Central – Metro	I-35, Northfield – Minneapolis SR 169, Mankato – Minneapolis SR 60, Madelia – Mankato
Southwest – Metro	SR 22, Hutchinson – Glencoe SR 212, Brownton – Minneapolis
West Central – Northeast	SR 10, Moorhead – Motley SR 210, Motley – Hassman
South Central – Southeast	SR 14, Mankato - Rochester

IRC Findings

The Interregional Corridor Study considered a wide variety of truck transportation movements throughout the State. As part of the study, numerous meetings were held with local officials, businesses, and agencies. Based on these interviews and analysis of traffic-related data, many high-volume truck routes were also identified. The highest heavy commercial vehicle volumes (HCADT) follow the interstate system and a number of the main trunk highways that link larger regional centers. The highest volume HCADT routes are as follows:

- I-94 from Fargo / Moorhead to the Metro area;
- I-94 from the Metro area to the Wisconsin border;
- I-35 from the beltway to the Iowa border;
- I-35 from the Metro area to Duluth;

- I-90 from South Dakota border to Wisconsin border;
- TH 10 from I-35 to Big Lake;
- TH 10 from Clearwater to Little Falls;
- TH 52 from Metro area to Rochester;
- TH 169 from Metro area to TH 15 south of Mankato;
- TH 169 from Metro area to TH 10 in Anoka;
- TH 8 from I-35 to Wisconsin border;
- TH 36 from Metro area to Stillwater;
- TH 12 from Metro area to Delano; and
- TH 212 from Metro area to Chaska.

These routes should also be considered important intrastate corridors.

Non-IRC routes were evaluated as potential truck routes within the Metro Area. This study identified several non-IRC routes that had a high HCADT count relative to other major facilities (see Table 7.4.) The majority of facilities ranged from 1,300 to 3,000 HCADT. TH 13 had a range of 3,350 to 6,600; therefore this facility was identified as a heavy truck route. The review of truck volumes did not include the I-494/694 ring facility or other Interstate routes. These local routes are not intraregional corridors but should be considered important facilities for freight planning efforts.[1]

Table 7.4 Non-IRC Routes with Higher Commercial Vehicle Counts

Route	From	To	AADT	HCADT	Percent HCADT
TH 10/61	North of Hastings	I-494 Newport	23,000 to 50,000	1,175 to 2,650	5.2%
TH 10/61	I-494 Newport	I-94 St. Paul	28,000 to 31,500	1,550 to 1,600	5.3%
TH 55	Jct. 55/52 Inver Grove	I-494 Mendota	13,000 to 15,600	1,100 to 1,375	8.7%
TH 13*	TH 77 Burnsville	I-35 Burnsville	21,000 to 32,000	800 to 1,050	3.5%
TH 13	I-35 Burnsville	Savage Grain Terminals	46,000 to 54,000	3,350 to 6,600	10.0%
TH 5	TH 41 Chanhassen	I-494 Eden Prairie	28,000 to 56,000	1,250 to 1,800	3.6%
TH 62	I-494 Eden Prairie	TH 169	39,000 to 41,500	1,100 to 1,150	2.8%
TH 62	TH 169	TH 100 Edina	95,000	2,400	2.5%
TH 62	TH 100 Edina	I-35 Richfield	88,000 to 98,000	2,300 to 2,500	2.6%
TH 62	I-35 Richfield	TH 55	49,500 to 97,000	1,650 to 3,200	3.3%
TH 77	County Rd 42 Apple Valley	I-35 Apple Valley	39,000 to 57,000	1,500 to 1,900	3.5%
TH 77	I-35 Apple Valley	TH 13	63,000 to 73,000	2,450 to 2,600	3.7%
TH 77	TH 13	I-494 Richfield	88,000 to 97,000	2,200 to 2,400	2.5%
TH 77	I-494 Richfield	TH 62	67,000 to 70,000	1,950 to 2,000	2.9%
TH 41	TH 169	TH 212 Chaska	18,900	2,400	12.7%

[1] Also see "Light Commercial Vehicle Inventory" produced for Mn/DOT by SRF Consulting in 1999.

Table 7.4 Non-IRC Routes with Higher Commercial Vehicle Counts (continued)

Route	From	To	AADT	HCADT	Percent HCADT
TH 7	TH 41 Chanhassen	I-494 Minnetonka	25,500 to 48,500	1,200 to 1,500	3.6%
TH 12	Orono	I-494 Wayzata	26,000 to 73,000	975 to 1,800	2.8%
TH 55	Medina	I-494 Plymouth	21,300 to 51,000	1,200 to 1,750	4.1%
TH 55	I-494 Plymouth	TH 169 Medicine Lake	35,500 to 39,500	2,350 to 2,450	6.4%
TH 55	TH 169 Medicine Lake	TH 100 Golden Valley	30,000 to 39,500	2,200 to 2,450	6.7%
TH 55	TH 100 Golden Valley	Minneapolis	32,000 to 35,900	2,300	6.8%
TH 252	Brooklyn Park	I-694	50,000 to 66,000	1,400 to 1,650	2.6%
TH 65	Ham Lake	TH 118 Lexington	28,500 to 54,000	1,160 to 1,750	3.5%
TH 65	TH 10 Spring Lake Park	I-694 Columbia Heights	36,000 to 38,000	1,400 to 1,450	3.9%
TH 118	TH 118 Lexington	I-35 Mounds View	22,500 to 28,000	1,200 to 1,300	5.0%

* TH 13 should be considered a heavy commercial route. This route was selected because of its high HCADT volumes. Most facilities ranged from 1,300 to 3,000 HCADT, whereas TH 13 had a HCADT of 3,350 to 6,600. TH 41 had a high percentage of truck trips, but it did not have a large volume of truck trips; therefore it was not considered a high volume truck route.

7.3 Corridor-Level Performance Measurement

The final task of this study included the development of a performance measurement framework to help evaluate all modes of freight transportation; provide a basis for prioritization of future transportation infrastructure investment projects; and provide a methodology for updating and forecasting freight movement in the future. Mn/DOT also requested suggestions and examples for innovative approaches to funding freight projects. This study has developed an innovative performance measurement methodology that also provides a first step for the deployment of more advanced corridor analysis tools.

Overview

The objective of this subsection is to describe an approach to applying freight performance measures to prioritize multimodal freight corridors for improvement. This focuses on how performance measures might be used in Minnesota to:

- Identify deficiencies and/or opportunities for improvement;
- Assess the potential benefits of improvements; and
- Prioritize corridors as well as multimodal alternatives within corridors according to needs and benefits.

Rather than simply identifying one or a few performance measures to characterize freight movement in a corridor, this methodology focuses on a *process* for measuring the performance of a corridor. The hypothesis is that no single performance measure by itself will be adequate to identify needs and prioritize improvements. Instead, a corridor must be divided into discreet segments of analysis (e.g., line-haul, terminal, distribution network). This segment level of detail is required for identifying problem areas and analyzing opportunities. The approach is meant to be applied at a sketch-planning level, in order to identify specific areas for more in-depth analysis.

The choice of actual segment-level performance measures, of course, will be constrained by data availability. Previous efforts have been conducted in Minnesota by the Minnesota Freight Advisory Committee (MFAC) and the Mn/DOT Metro Division to identify specific freight-related performance measures, existing data, and data needs. Appendix G includes a list of performance measures identified by these groups. The list also includes measures identified by other states and MPOs that may be relevant to the corridor and segment-level analyses described here.

This discussion distinguishes performance measures from *indicators of demand*. Performance measures describe transportation "supply," in other words, how well the transportation system performs its function of moving goods. Indicators of demand describe the extent to which the transportation system is being utilized; for example, truck volumes or cargo ton-miles. Indicators of demand can be used in conjunction with supply-based performance measures to prioritize corridors for improvement. The ranking of corridors provided earlier in this section was based on the indicators of weight and value.

Approach

This approach starts from the hypothesis that the ultimate measure of performance for freight movement is the "total cost" of moving a unit of commodity through that corridor. The corridor may have two or more "intermodal alternatives" depending upon the combinations of modal options available. The total cost for an intermodal alternative can be considered as the sum of total costs across a set of discrete segments (networks, links, and terminals) that make up that alternative. Total logistics costs include the time-value of the commodity as well as the cost of moving or storing the commodity in each segment. From a public perspective, total costs also include externalities, such as roadway maintenance and air pollution. The lowest-cost intermodal alternative in a corridor may vary by type of commodity.

Figure 7.6 illustrates a process for assessing performance and prioritizing among corridors. The steps of the process include:

1. **Group commodities into like types**; for example, according to time sensitivity, value per weight, shipment size, routing availability, preferred modes, etc.

2. **Define corridors (significant origin-destination patterns) of major commodity flows.** These may include corridors to external destinations (e.g., Twin Cities to Chicago) as well as internal corridors (e.g., Twin Cities to Duluth). The origin or destination for some significant commodity flows may be dispersed rather than concentrated (e.g., grain from farming communities throughout Minnesota).

3. **Identify the modal alternatives within the corridor;** e.g., truck-only, truck-rail, truck-waterway, etc. Figure 7.7 provides an example.

Figure 7.6 Performance-Based Corridor Assessment Process

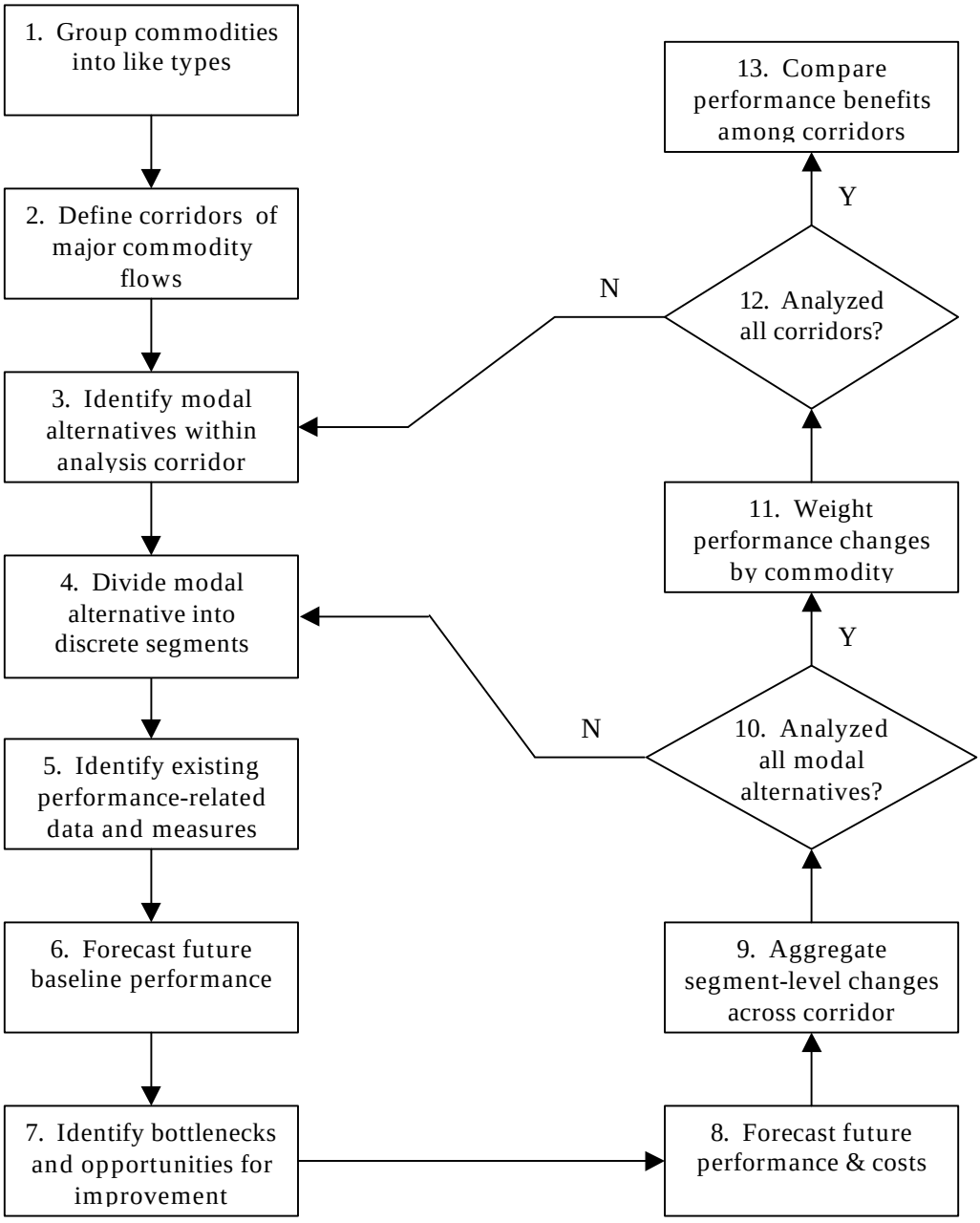
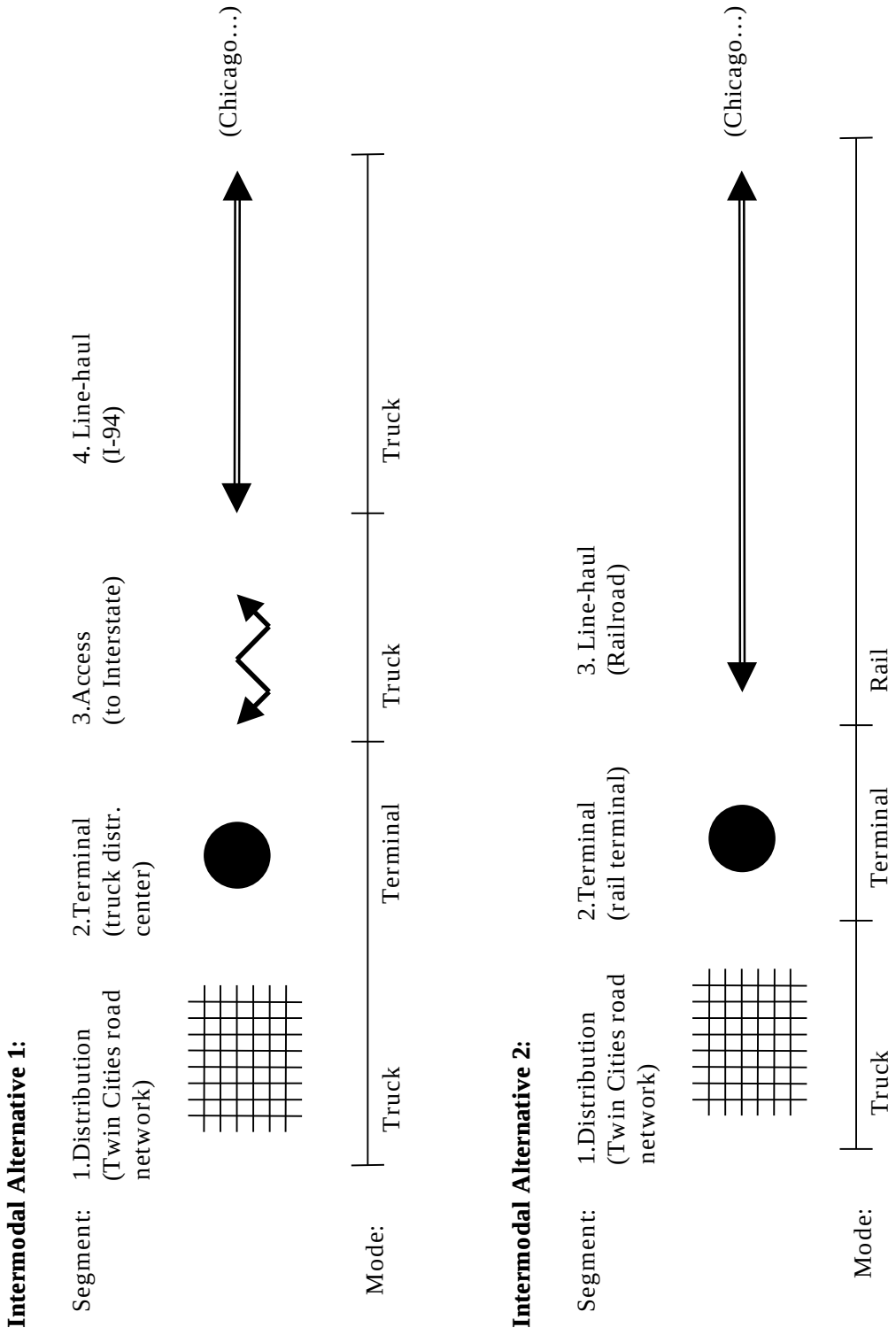


Figure 7.7 Example of Segments by Intermodal Alternatives
Twin Cities – Chicago Corridor



4. **Divide the modal alternative into discrete segments;** e.g., line-haul shipment; access from a distribution terminal to the line-haul; transfer / processing through the terminal; and local distribution.

5. **Identify existing performance-related data and measures.** Segment-level measures that directly impact total costs may include total travel or processing time; travel / processing time reliability; warehousing costs; other factors affecting operating costs such as accidents and pavement quality; and social externalities such as air pollution. Some segments – especially the distribution segment – may be to a set of dispersed destinations, e.g., from a warehouse in Rosedale to retail centers throughout the Twin Cities area, or from a railroad terminal in Worthington to nearby towns or farms. In this case, the performance measures for the distribution segment will be at the network level rather than describing a specific roadway link. Table 7.5 illustrates a possible framework for classifying performance data, using the example segments identified in Figure 7.7.

Table 7.5 Framework for Identifying Available Performance Data
Based on "Intermodal Alternatives" in Figure 2

	Corridor Segment					
Performance Category	**Distribution Network (Road)**	**Terminal (Truck-Truck)**	**Access (Terminal-Hwy)**	**Line-haul Segment (Highway)**	**Terminal (Truck-Rail)**	**Line-haul Segment (Rail)**
Overall Measure						
Total Logistics Costs						
Primary Cost Components						
Travel / Processing Time						
Travel / Processing Time Reliability						
Other Operating Costs						
Accidents / costs						
Externalities						
Proxy Measures						
Volume-Capacity Ratio						
Access / Infrastructure Availability						
Other…						

It is likely that some types of data will not be readily available for all segments. Where data are not currently available, any of the three following approaches may be used: 1) identify available data that can serve as reasonable proxies for the desired performance measures; 2) determine that the given aspect of performance is a relatively small part of overall performance or is beyond the agency's control, and can essentially be ignored in the analysis; or, 3) determine that additional data collection efforts are required because the measure is important and there are no adequate proxies.

6. **Estimate future baseline performance (optional)**. This step can help identify potential future bottlenecks or problems. At a minimum, it requires forecasts of goods movement volumes and/or other factors affecting transportation performance, such as highway congestion. A volume-capacity ratio can at least help identify existing and potential future problem areas for each segment. Volume-capacity, however, is not the most desirable measure because it does not directly indicate the costs of a problem area or the benefits of improvements. Ideally, forecast goods movement volumes can be related to performance measures such as travel times or total logistics costs. Therefore, it may be desirable to estimate, on a sketch-planning level, relationships between V/C and more direct measures of performance.

7. **Identify bottlenecks and opportunities for improvement.** To identify areas in which improvements may be needed or warranted, a number of approaches can be taken. These include:

   – Evaluate existing performance levels for individual segments and compare them to established benchmarks (such as performance on similar segments elsewhere) to identify where deficiencies may currently exist;

   – Forecast future volumes of goods movement, determine the impacts on the performance, and look at where performance may suffer in the future; and

   – Identify opportunities to improve performance (regardless of whether existing or future conditions appear "deficient") through new technology, upgraded infrastructure, improvement of alternative modes, or other means.

8. **Estimate future improved performance;** e.g., the improvements in travel times, accident rates, etc., that might be expected based on the options identified in the previous step. The approximate costs of improvements should also be identified so that they can be compared to benefits.

9. **Aggregate segment-level changes across the corridor.** The performance improvements and costs identified above may be aggregated across each of the segments that make up the intermodal alternative being analyzed.

10. **Repeat steps 4 through 9** until all modal alternatives in the corridor are analyzed.

11. **Weight performance changes by commodity.** The potential benefits of improvements must be weighted across the commodities that will be affected. This weighting involves two factors: 1) the value of the type of improvement (e.g., time savings) for each commodity class; and 2) the volume of each commodity class in the corridor (where volume is measured in the units for which the value in part (1) is assessed.) Also, any potential shifts in commodity flows from one modal alternative to another should be considered in this step.

    Modal preferences as well as the valuation of improvements by commodity group may have to be estimated qualitatively; or they may be developed at a sketch-planning level based, for example, on elasticities or choice weightings developed from various studies. While data to make these valuations may be limited, this is an important factor to consider so an estimate of some sort should be made.

12. **Repeat steps 3 through 11** until all corridors are analyzed.

13. **Compare the potential benefits and costs of performance improvements among corridors and intermodal alternatives.** Corridors with high levels of potential benefits relative to the costs of improvements are candidates for more detailed study. The results of the segment-level analysis defined above can help identify the issues or locations that should be the subject of further study and potential improvements.

This methodology establishes an innovative framework for multimodal freight planning that can be used to evaluate transportation improvements as they pertain to freight. At its simplest, this methodology can be used as a sketch planning tool by Mn/DOT; however, it provides the foundation for more sophisticated MIS evaluation. Three off-the-shelf modeling products have been used successfully in the past for similar multimodal freight corridors. These are described below.

7.4 Additional Corridor Evaluation Tools

A well-developed set of performance measures can be applied to several advanced analytical tools to model the economic impacts of different improvement options. Two such recognized analytical tools are the Federal Highway Administration's (FHWA) Surface Transportation Efficiency Analysis Model (STEAM) and the Federal Railroad Administration's RailDEC model.

STEAM is a computer program that was developed for FHWA by Cambridge Systematics in order to provide an analytical tool for estimating the impacts of transportation alternatives in a system planning context. These impacts could originate from a highway project or from another modal project (such as a rail freight investment) which improves highway operation by diverting vehicle trips to other modes. The STEAM software applies user-specified parameters, such as the value of time and air quality emission rates, and processes that information to forecast the benefits and costs of transportation alternatives.

RailDEC is a computer program that was developed for FRA in order to provide an analytical tool for estimating the impacts of rail investments. RailDEC calculates the direct user benefits of a rail investment as the product of the change in rail shipping costs between the base and alternative case and the change in rail demand for the base and alternative case. It also provides the ability to calculate resulting changes in truck demand.

The resulting cost and benefits from STEAM for truck shipments and other general highway travel and from RailDEC for rail shipments can be combined to produce a composite cost/benefit for each improvement. Outputs from these models, combined with capital, financing, and operating costs, can be integrated into a Regional Economic Modeling Inc. (REMI) model to develop a regional picture of economic impact by industry sector. When this level of analysis in not available, Cambridge Systematics has developed a sketch planning software tool, the Freight Transportation Investment Model (FTIM), that uses REMI output to evaluate highway freight projects with simple user inputs.

7.5 Innovative Financing

A multimodal freight corridor improvement program with diverse modal projects necessitates an approach that avoids one size fits all solutions. Therefore, a multimodal freight project funding strategy should be composed of three linked funding and financing solutions for three categories of projects: public sources, private participation, and revenue opportunities. Each category involves a set of likely funding sources and financing mechanisms.

The development of financing strategies is dependent on several speculative elements: 1) the growth in funding for discretionary U.S. DOT funding programs through the next several cycles of program reauthorization is dependent on unpredictable national political trends; 2) the availability of Congressional earmarks is partly dependent on the effectiveness of the Minnesota congressional delegation; and 3) innovate private sector partnerships and/or user fees have had relatively limited successful applications. Nevertheless, it should be possible to develop a reasonable range of strategies and funding availability estimates; matching these to specific projects which emerge; and to develop strategies for positioning these projects in the most favorable way.

Examples of Innovative Project Implementation

Below are some examples that could be implemented within the context of Minnesota's existing transportation institutions and decision-making structure. The proposed strategies are grouped into three major categories:

- **Infrastructure strategies** that include major improvements to key trade corridors in the State; improvements to landside highway and rail access to intermodal facilities; expansion and modernization projects at critical water ports and airports; and development of inland intermodal truck/rail transfer facilities.

  – Example: *Virginia Inland Port* – Virginia has developed an intermodal container facility on Norfolk Southern lines in close proximity to I-81 and I-66 in Front Royal, Virginia. The facility provides international cargo service via the ports at Hampton Roads, but shifts container storage and processing to inland locations

  – Example: *Sea-Air "Mainport" Strategy* – The Netherlands has sought to develop Schiphol Airport and Rotterdam Seaport as central nodes in the European distribution network. Through a combination of port promotion, multimodal access projects, and information technology applications, these ports are becoming global business centers whose growth is not limited by the size of local markets.

- **Operations strategies** that emphasize the deployment of Intelligent Transportation Systems (ITS) and other advanced technologies to improve the efficiency and effectiveness of the transportation system. In addition, these strategies recommend efforts to attract additional high-quality transportation service between Minnesota and key domestic and international markets.

  - Example: *I-95 Corridor FleetForward* – Public agencies and the motor carrier industry association have joined forces to develop a traveler information service for commercial vehicle operations in the congested Northeast corridor. When fully implemented, the system will provide commercial drivers and dispatchers with real-time information on congestion, incidents, weather, and construction projects.

  - Example: *Seattle TimeSaver project* – Seattle continues to develop management systems that provide integrated freeway and arterial control, as well as transit and emergency signal priority and safe movement through rail-highway grade crossings.

- **Policy strategies** that suggest modifications to existing transportation planning processes to strengthen the linkage between transportation and economic development priorities at the state and local levels. These include efforts to increase the involvement of the business and economic development communities in transportation planning; set priorities among projects based in part on economic development impacts; and pay greater attention to freight mobility needs. In addition, these strategies recommend steps to shorten the planning cycle for projects that could have a high economic impact.

  - Example: *Indiana DOT Major Corridor Investment-Benefit Analysis System* – INDOT developed a series of statewide and corridor-level models to estimate and compare the transportation and economic benefits of proposed major corridor highway investments in Indiana.

  - Example: *Oregon Immediate Opportunity Fund* – Oregon has developed a constrained investment strategy and an immediate opportunity fund to provide both a set of priorities for investment and some flexibility to respond to unforeseen circumstances. The identification of highway freight routes provides some additional guidance for the use of these funds.

7.6 Future Commodity Flow Analysis

The study produced an ArcView Geographic Information System (GIS) software interface specifically for this project in order to easily create commodity flow maps and to be able to map projected future commodity movements. Several methods exist for forecasting freight flows in the future, including using off-the-shelf industry forecasts mapped onto commodity usage, or developing more accurate regional economic growth models and forecasts. The first method relies on industry forecasts for counties, regions, or the State from sources such as the Bureau of Economic Analysis or private sources like DRI/McGraw-Hill. These forecasts for Standard Industrial Classification (SIC) codes for the appropriate region(s) are associated to STCC commodities through the use of a crosswalk table, such as a standard input-output table or the more recently developed Transportation Satellite Accounts tables. Growth in industrial output is used to proportionally grow commodity volumes in the corresponding region(s). These flows can then be mapped and compared to the base year flows documented in this report.

The second forecasting method involves a specific model developed for the region, such as a REMI model. The REMI model can account for unique local economic conditions and considers a large number of input variables for forecasting growth. Industrial growth is again related to commodity flows through a crosswalk table.

Forecasting commodity flows is useful for determining which freight corridors will be significant when current plans and programs are implemented. With a reliable model, Mn/DOT can better evaluate and prioritize investments now for future demand.

7.7 Conclusions

This section has identified the key goods movement corridors for Minnesota and several methods for analyzing them in detail for future freight planning and programming. This analysis identified multimodal corridors that could provide a focus for Mn/DOT as well as understanding of the elements that make these corridors important, including the statewide freight flows; the logistics practices of Minnesota businesses; and the multimodal freight infrastructure serving the State. These findings provide the OFR&W with a tool for freight advocacy, and freight planning. Section 8.0 below summarizes the recommendations of this study and suggests some detailed strategies that Mn/DOT could implement, under the direction of the OFR&W.

8.0 Recommendations

8.1 Study Findings

This report has documented the movement of freight within the state of Minnesota, the logistics patterns of key industries, modal freight operations, and key intrastate and interstate freight corridors. Key findings of the study include the following:

- Truck trips are increasing due to the dynamic growth of those sectors of the economy – such as high technology – that produce or consume high-value products for which rapid and reliable delivery is a priority. At the same time, competitive pressures facing the rail, marine, and air freight modes in the State are shifting some trips – both in rural areas and the Metro region – to trucks. These trends are placing increasing strain on the State's roadway infrastructure, which already is under pressure from the State's continued strong economic growth.

- As a major producer and transshipper of bulk commodities such as iron ore, coal, and grain, Minnesota relies heavily on its railroads and waterways. Maintaining the roles of these modes is critical for the health of the State's economy and transportation system, particularly to avoid the diversion of freight trips to the highway system with all of the potential resulting impacts on the roadways themselves, as well as the externalities associated with heavy truck travel. The role of both modes is under increasing threat. In the case of railroads, the threat is due to competitive pressures from other modes that are encouraging railroad consolidation and retrenchment. In the case of waterways, the threat is largely due to the relatively stagnant nature of modal facilities and service arrangements.

- Air freight, though constituting a relatively small share of total volume (particularly by weight), is a rapidly growing mode that is critical to the emerging high-technology sector of the economy. Air freight is intricately linked to truck transportation, since almost all air freight is ultimately picked up or delivered by a truck.

- Interstate and intrastate freight movement is heavily concentrated on a handful of key corridors, many of which face significant capacity constraints. These corridors focus on the principle freight hubs of Minneapolis/St. Paul and Duluth/Superior and include key multimodal interstate corridors to the Eastern, Southeastern and Northwestern United States, as well as primary intrastate corridors between the Metro region and particularly the Central, South Central and Southeast Minnesota districts. These intrastate corridors are dominated by truck and rail moves, while most of the key interstate corridors depend on each and every mode.

Mn/DOT has unique opportunities to address these concerns today, given a variety of recent institutional and policy developments at the state level. These include:

- New funding arrangements such as the proposed Multimodal Fund;

- Changes in planning processes, such the proposal to update the Statewide Plan on a two-year rather than four-year cycle using a bottom-up, multimodal approach;

- New institutional structures, including the new Mn/DOT positions for corridor and modal operations managers;

- Changes in public/private partnerships, including the continued evolution of the MFAC with the initiation of two new subcommittees on motor carriers and metropolitan area issues; and

- The State's aggressive focus on implementing rail passenger transportation programs in the Metro Area, which has the potential to relieve roadway congestion, but also may require multiple uses of freight transportation lines.

The findings of this study, and the review of this information by Mn/DOT staff and Minnesota Freight Advisory Committee (MFAC) members, have been used to develop recommendations for Mn/DOT in two areas:

- Broad freight policy objectives that can guide Mn/DOT's overall policy, planning, and programming activities; and

- Specific project-level recommendations that can address the needs of the various freight modes in Minnesota.

8.2 Freight Policy Objectives

Mn/DOT's freight policy should have four major objectives:

1. **Enable Multimodal Freight Transportation Options and Choices for Shippers**. Minnesota's economy requires broad-based strength in all modes of freight transportation: highways, because trucks move most consumer products and account for the majority of freight movements by value; rail, because the largest share of freight movements by weight are carried by the extensive rail network; marine, because important bulk shipments of coal, iron ore, and grain move through the State's ports and waterways; and air, because the highest-value shipments move on airplanes. Mn/DOT should seek to:

   – Accommodate growth in trucking activity by reducing urban bottlenecks and improving key truck routes, particularly those that connect farms and forests to elevators, terminals and mills.

   – Ensure the long-term viability of competitive rail service on key corridors throughout the State and encourage expansion of intermodal service.

- Overcome barriers to growth of water transportation, particularly by supporting the upgrade of outdated locks and other infrastructure.
- Accommodate growth in air freight by improving ground access to MSP and encouraging growth in air freight service outside of the Twin Cities.
- Support safe and efficient transfer of goods between these modes at airports, water ports, and rail terminals by improving intermodal infrastructure and operations and encouraging coordinated intermodal planning.

2. **Focus Investment in Key Freight Corridors**. Infrastructure investment should focus on the major freight corridors that link Minnesota's economy to other states and nations – highways, rail lines, rivers, lakes, and air corridors. These are the critical links for moving cargo between Minnesota and the rest of the world; increasing their safety and efficiency is required to ensure future growth of the State's economy. Mn/DOT should seek to:

   - Measure the existing and future performance of these key corridors to guide investment decisions;
   - Develop multimodal strategies for key freight movement corridors, whether they are interregional (within the state), interstate, or international;
   - Combine infrastructure investment with innovative operational and technology-based solutions; and
   - Identify projects that generate the greatest economic and efficiency benefits at the least cost.

3. **Develop Public/Private Partnerships**. Freight transportation service in Minnesota is provided largely by the private sector – in contrast to passenger transportation, where government is involved in nearly all aspects of the system. The traditional role of government with respect to freight has been to provide infrastructure funding through modal trust funds and to tax and regulate use of the system. Mn/DOT has an opportunity to work with the private sector to plan for and manage key elements of the freight transportation system. Mn/DOT should seek to:

   - Strengthen the role of MFAC in providing ongoing input to Mn/DOT's freight transportation policies, plans, and programs;
   - Encourage districts and MPOs to create or maintain similar freight advisory committees;
   - Coordinate with other states on improvements to key interstate freight corridors, particularly those affecting the Great Lakes and the Mississippi River;
   - Coordinate with Canadian and federal agencies regarding improvements to key international freight corridors;
   - Encourage MPOs, counties, and cities within Minnesota to work in partnership to address freight movements at a regional scale that cut across existing jurisdictional boundaries; and
   - Identify innovative partnerships and funding programs to accelerate freight projects on critical corridors so that needed improvements can occur on a timeframe consistent

with business needs. For example, the State could consider implementation of a multimodal freight fund available for high-priority studies and projects.

4. **Maintain a Mn/DOT Focal Point for Freight Policy and Shipper/Carrier Contact.** Freight transportation issues cut across all aspects of State transportation planning, yet require a unique set of technical knowledge, stakeholder contacts, and the ability to interface with the global freight planning community in both the public and private sectors. Therefore, it is critical that Mn/DOT maintain a dedicated freight planning office as represented by the current Office of Freight, Railroads, & Waterways (OFR&W). Among the functions to be performed by this office are the following:

   - Provide technical assistance on freight-related issues to other Mn/DOT offices, MPOs, and municipalities throughout the state.
   - Develop and maintain databases and decision support tools, including a set of performance measures for evaluating freight projects across mode, commodity and geography; and the incorporation of the freight flow data developed for this project into MPO travel demand forecasting models to support a higher degree of precision in modeling large freight flows on the State's highway system.
   - Continue to work with private sector freight stakeholders, including shippers and carriers, to better incorporate their viewpoints into the planning process, including strengthening the role of the MFAC in providing private sector input.
   - Ensure coordination of freight issues across Mn/DOT offices, and in particular with the Office of Motor Carrier Services (OMCS).

5. **Strengthen Freight Planning Activities in Mn/DOT.** This study provides a better understanding of the transportation needs of businesses in Minnesota, however continuing efforts are required to broadly integrate freight planning into the mainstream of transportation planning. The following recommendations are offered as logical next steps:

   - Develop a Statewide Freight Plan, building on the recommendations of this study, for inclusion in the Statewide Transportation Plan updates; encourage the update of the statewide plan every two years.
   - Encourage Mn/DOT's Statewide/District Plan Steering Committee to evaluate and select a department template to be used in the district planning efforts for identifying and recommending freight transportation improvements. Mn/DOT's Metropolitan Division has developed a "Strategic Business Plan Approach to Modal Planning" as a means to evaluate freight and passenger needs from a corridor perspective. Section 7 of this report provides another alternative for corridor analysis.
   - Pursue innovative approaches to project financing and implementation, including accessing available federal funds and promoting public/private partnerships.

8.3 Tactical Modal Recommendations

The second set of recommendations focuses on specific modal needs.

Truck

Increasing commerce and an increased reliance on trucking have begun to burden the highway infrastructure of Minnesota. Urban congestion is causing delays and increases in operating costs that affect the competitive position of Minnesota. Meanwhile, changes in business practices for shippers, manufacturers, motor carriers and other modal operations are creating a greater reliance on trucking. Mn/DOT needs to react to these changes by targeting operations and infrastructure improvements to the local and regional road network in a number of ways:

- Develop major investment strategies and performance standards (in conjunction with overall Mn/DOT planning strategies and performance measurement) to facilitate freight movement on the key truck highway corridors serving interregional, interstate, and international markets. These include congested and substandard routes in the Metro area such as I-94, I-494, I-694, and I-35, and other such routes as they relate to the findings of the freight flow analysis and the IRC. Within Minnesota, the highest valued freight corridors are those between the Metro region, and the central, southern and southeastern regions of the state, such as Routes 10, 371, 169, 212 and 52, as well as the TC&W, UP, and BNSF regional rail lines. The connection between Northeast Minnesota and Douglas County (WI) is the most vital in terms of weight as this is an important center for bulk material shipments. The interstate corridor between Minnesota and Wisconsin, Chicago, the Eastern Midwest and East Coast (primarily Interstate Route I-94, as well as the Great Lakes waterways and the BNSF and CP mainlines) is the most significant in terms of value and weight. The South and Southeast corridors (the same facilities as for the East corridor, but including I-35, the Mississippi River and the UP and IMRL rail lines) combined are nearly as valuable, while the Northwest corridor (I-94, CP and BNSF) carriers the second highest volume by weight.

- Examine the designation of the I-94 corridor as a Corridor of National Significance for funding under the U.S. DOT's Borders and Corridors Program.

- Ensure that the local roadway system can meet the requirements of truck transport, particularly in areas with large volumes of bulk shipments. This includes a variety of infrastructure investments including solving "hot spots" with high degrees of congestion or accidents; providing truck lanes, bypass ramps, staging areas and haul roads; and improving port/terminal and farm to market access roads. It also involves assessing the statewide 80,000 pound weight limit in conjunction with policies in neighboring states, and addressing springtime local road restrictions.

- Undertake efforts that result in closer coordination between freight and highway planning functions in Mn/DOT and motor carrier regulatory activities in the Office of Motor Carrier Services and the Commercial Vehicle Section of the State Patrol. Such coordination would help ensure consistent truck regulatory policies and enforcement

across Minnesota and the Upper Midwest, as well as leverage opportunities for coordination and data exchange in the application of ITS for regulatory and information purposes.

- Pursue the development of more public and private truck rest stops and parking areas on key corridor routes and in congested metropolitan areas. Provide additional signage and parking information services to utilize unmet capacity. Seek input from MFAC members on key capacity, amenity and safety concerns voiced by drivers.

Rail

There are presently two contradictory trends in the railroad industry which are likely to have major potential impacts on the Minnesota freight rail system in the coming years. Ironically, both trends could result in the diversion of some rail traffic to trucks, placing further stress on the roadway network. On the one hand, the industry is consolidating institutionally through mergers and acquisitions (as evidenced most recently by the proposed BNSF-CN merger), and also operationally with a push toward the use of higher capacity railcars (286,000 pound standard versus 263,000 pounds) and larger unit trains. These trends potentially threaten the State's sizeable investment in maintaining and growing a healthy short-line network, and could result in changing logistics patterns whereby short lines and smaller country grain elevators are bypassed via trucking to larger consolidation centers. On the other hand, the emerging trend toward grain identity preservation (for example, by excluding genetically altered grains for transshipment to EU countries), has the potential to change logistical patterns away from large bulk carload shipment toward intermodal containerized or truck-only shipments. Mn/DOT has a critical role to play in ensuring that these trends do not compromise the economic development and infrastructure investment strategies of the State. Thus, Mn/DOT should work with the State's railroads and shipping community to promote strategies that will maintain a diverse and vibrant rail network in the state. To that end, Mn/DOT should undertake the following steps:

- Continue to actively intervene in railroad merger cases before the STB; ensure that existing rail service remains and is competitive with other modal options. Many mergers are anticipated, and Minnesota – as a significant rail user in the Upper Plains – must remain active in the dialogue to preserve rail service and avoid negative impacts to Minnesota's roads and businesses.

- Take steps to maintain a healthy short-line industry including reducing capital costs through loan assistance; encouraging public/private partnerships that stimulate more capital investment; supporting regulatory zoning, land subsidies, and master planning efforts where needed; and proactively developing strategies to deal with identity preservation of grain issues, including single grade elevators and intermodal grain ramps. A statewide strategy should be developed to maintain short-line and feeder-line services and to negotiate with Class I railroads to maintain cost-effective interchange and market access.

- Identify a strategic rail network and conduct major investment studies on key freight corridors. Based on the key corridors identified in this study, interview results, and

data from the OFR&W's WAYSYS™, Mn/DOT has the tools to target studies on key rail lines.

- Expand intermodal service by helping to identify base-load customers in currently under-served markets, and facilitating or partnering in terminal development.

Water

In contrast to the dynamic environment in the railroad industry, the major threat to waterborne transportation is the relative complacency and stagnation within the system. Waterborne transportation, like rail, is a key component of the State's bulk transport system and its decline would result in diversion of large bulk shipments to heavy trucking. Recommendations include the following:

- Proactively partner with the U.S. Army Corps of Engineers and the Canadian government to support dam and lock improvements on the Mississippi River and Great Lakes/St. Lawrence Seaway systems;

- Support changes to the 1904 Cargo Preference Act, which artificially suppresses the use of the Great Lakes system for military-related transports by requiring that they be carried on U.S. flagged vessels;

- Work with the city of Minneapolis and the Metropolitan Council to ensure that the ongoing assessment of the best and highest use of the Minneapolis riverfront fully considers the needs of freight transportation; and

- Address highway congestion and maintenance issues on key terminal access routes such as Route 13 in Savage.

Air

The use of air freight is increasing dramatically worldwide. Minnesota has reacted well to business demands with new and planned air cargo facilities, however demand and congestion are already threatening to undermine these improvements. Mn/DOT should maintain an active role in air freight to be able to anticipate capacity needs and encourage a competitive air service environment. The following strategies are suggested:

- Proactively investigate the development of air cargo facilities at the second tier airports around the state in order to mitigate growth at MSP and reduce long-haul truck traffic between MSP and final origins/destinations across the state. Air carriers require a critical mass of demand to move outside of hub markets, and Mn/DOT could facilitate in the identification and organization of such markets.

- Work at a national level with the air carrier industry to reduce competitive disadvantages faced by air carriers at MSP versus Chicago, a situation which results in much air freight being trucked into the state from Chicago. Through the outreach capabilities of

the MFAC, identify users that would benefit from improved service; encourage current and potential air carriers to expand their offerings, especially direct overseas service. Also, identify opportunities for large hubbing or consolidation activities that would benefit from avoiding airside congestion and operating costs associated with Chicago.

- Continue to support efforts to mitigate landside congestion at MSP and potentially other airports that evolve into secondary air cargo hubs.

8.4 Conclusions

Freight transportation is critical to Minnesota's economic competitiveness. This study has demonstrated the importance of all modes of freight transportation – highway, rail, water, and air – and identified key commodity flows and corridors in the state. Mn/DOT has an opportunity to shape the future performance of this system through support for multimodal options; focused investment in key freight corridors; public/private partnerships; and strengthened freight planning activities.

Appendix A

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Appendix B

Documentation of Reebie Data

Documentation of Reebie Data

Freight Traffic Flow Data: Methodology, Sources, and Information

The freight traffic flow data for Minnesota has been drawn from three distinct databases: TRANSEARCH/IFVDB (Intermodal Freight Visual Data Base) for the domestic U.S. origins and terminations; TRANSEARCH Canada/U.S.; and TRANSEARCH Mexico/U.S. Each of these databases utilizes distinctly different data sources and processing methodologies.

Domestic U.S. Data

The IFVDB is the culmination of 15 years of development and production of the TRANSEARCH database of freight traffic flows. TRANSEARCH utilizes a multitude of mode-specific data sources to create a picture of the nation's freight traffic flows on a market-to-market commodity basis. The IFVDB further refines the geographic market identification to the county level.

TRANSEARCH is created each year using the following sources and development steps:

1. The Annual Survey of Manufacturers is processed to establish production levels by state and industry.

2. The STB Rail Waybill Sample is processed to develop all market-to-market rail activity by industry.

3. The Corps of Engineers Waterborne Commerce data is processed to develop all market-to-market water activity by industry.

4. FAA Enplanement Statistics and airport-to-airport cargo volumes, used in conjunction with information on commodity volumes moving by air from the Commodity Flow Survey are used to create detailed air flows.

5. The rail, water and air flow data are deducted from the ASM-based production data to establish preliminary levels of truck activity.

6. Our proprietary Motor Carrier Data Exchange Program provides information on actual market-to-market trucking industry movement activity. The Data Exchange Program includes carriers from both the private and for-hire segments of the industry, in both the truckload and LTL sectors. The truckload sample covers about six percent

of the market, and our LTL sample is about 40 percent. In total, information is received on over 75 million individual truck shipments. By way of comparison, the government's Commodity Flow Survey covers about 12 million shipments, spread across all modes, and the Rail Waybill's sample rate is about 2.5 percent.

TRANSEARCH is refined into the IFVDB with county-to-county market detail through the use of both our Motor Carrier Data Exchange inputs, and our FREIGHT LOCATER database of shipping establishments.

FREIGHT LOCATER provides information about the specific location of manufacturing facilities, along with measures of size (both in terms of employment and annual sales) and a description of the products produced. This information is aggregated to the county level, and used as the first step in assigning production the more detailed geographic areas.

Much of our Data Exchange inputs from the trucking industry are provided by zip code. The zip code information is translated to counties, and used to further refine production patterns. A compilation of county-to-county flows and a summary of termination activity is used to develop destination assignments.

When using the Minnesota freight traffic flow data, please make note of the following issues concerning the domestic U.S. data:

1. Coverage of truck traffic is limited for non-manufactured products. Truck movements of coal and fresh fruits and vegetables are included in the data, but truck movements of other non-manufactured items, such as grains, ores, minerals, and wastes are not covered.

2. Traffic movements originating in warehouses or distribution centers are shown as commodity code 5010. Specific details on the types of items being moved is not available. This is also true for the truck portion of rail/truck intermodal activity (code 5020), and the truck drayage of air freight activity (code 5030).

3. The inland or surface movement of import and export traffic volumes is included in the data. However, the flow patterns of this activity are based on the movement patterns of domestic sourced goods in the same market areas, and are not specific to import/export activity.

Canada/U.S. Data

Canada/U.S. traffic data is developed from cross border information compiled by Statistic Canada. The raw data covers State to/from Province movements by four-digit commodity. The mode coverage of the Canada/U.S. data is not as detailed as for domestic U.S. activity. The "rail" mode includes both carload and intermodal activity, "truck" includes truckload, LTL, and private.

The Canada/U.S. data is assigned to county levels using the patterns of domestic production and consumption. This technique has been successfully utilized for many of our clients in the past.

Mexico/U.S. Data

The source of Mexico/U.S. data is the Bureau of Transportation Statistics. The cross-border data that is collected is limited to truck and rail activity. This data is collected on a State to/from State basis. Assignment to county level activity is again based on the patterns of domestic production and consumption.

Table B.1 Three-Digit STCC Codes

STCC3	Commodity
11	Field crops
12	Fresh fruits or tree nuts
13	Fresh vegetables
14	Livestock or livestock products
14	Livestock or livestock products
15	Poultry or poultry products
19	Misc. farm products
84	Barks or gums, crude
86	Misc. forest products
91	Fresh fish or marine products
98	Fish hatcheries
101	Iron ores
102	Copper ores
105	Bauxite or other alum ores
106	Manganese ores
109	Misc. metal ores
112	Bituminous coal or lignite
131	Crude petrol. Or natural gas
132	Natural gasoline
141	Dimension stone, quarry
142	Broken stone or riprap
144	Gravel or sand
145	Clay ceramic or refrac. minerals
147	Chem. or fertilizer minerals
149	Misc. nonmetallic minerals
193	Tracked combat vehic. or parts
195	Small arms, 30 mm or less
196	Small arms ammo, 30 mm or less
201	Meat or poultry, fresh or chill
202	Dairy products
203	Canned or preserved food
204	Grain mill products

Table B.1 Three-Digit STCC Codes (continued)

STCC3	Commodity
205	Bakery products
206	Sugar, beet or cane
207	Confectionery or rel. prod
208	Beverages or flavor extracts
209	Misc. food preparations
211	Cigarettes
212	Cigars
213	Chewing or smoking tobacco
214	Stemmed or redried tobacco
221	Cotton broad-woven fabrics
222	Man-made or silk woven fiber
223	Wool broad-woven fabrics
224	Narrow fabrics
225	Knit fabrics
227	Floor coverings
228	Thread or yarn
229	Misc. textile goods
231	Men's or boy's clothing
233	Women's or children's clothing
235	Caps, hats or millinery
237	Fur goods
238	Misc. apparel or accessories
239	Misc. finished textile goods
241	Primary forest materials
242	Sawmill or planing mill prod
243	Millwork or prefab wood prod
244	Wooden containers
249	Miscellaneous wood products
251	Household or office furniture
253	Public building or related furniture
254	Lockers, partitions or shelves
259	Misc. furniture or fixtures
261	Pulp or pulp mill products
262	Paper
263	Fiber, paper or pulpboard
264	Converted paper or ppbd. prod
265	Containers or boxes, paper
266	Paper or building board
271	Newspapers
272	Periodicals
273	Books
274	Misc. printed matter
276	Manifold business forms
277	Greeting cards, seals, etc.
278	Blankbook, loose leaf binder
279	Svc. Indus. for print trades

Table B.1 Three-Digit STCC Codes (continued)

STCC3	Commodity
281	Industrial chemicals
282	Plastic matter or synth. fibers
283	Drugs
284	Soap or other detergents
285	Paints, lacquers, etc.
286	Gum or wood chemicals
287	Agricultural chemicals
289	Misc. chemical products
291	Prod of petroleum refining
295	Paving or roofing materials
299	Misc. coal or petroleum prod
301	Tires or inner tubes
302	Rubber or plastic footwear
303	Reclaimed rubber
304	Rub. or plas. hose or belting
306	Misc. fabricated products
307	Misc. plastic products
311	Leather
313	Boot or shoe cut stock
314	Leather footwear
315	Leather gloves or mittens
316	Leather luggage or handbags
319	Leather goods, nec.
321	Flat glass
322	Glassware, pressed or blown
324	Portland cement
325	Structural clay products
326	Pottery or related products
327	Concrete, gypsum, or plaster
328	Cut stone or stone prod
329	Abrasives, asbestos prod, etc.
331	Steel mill products
332	Iron or steel castings
333	Nonferr. primary smelter prod
335	Nonferrous metal basic shapes
336	Nonferrous metal castings
339	Misc. primary metal products
340	Fabricated metal products
341	Metal cans
342	Cutlery, hand tools or hardware
343	Plumbing or heating fixtures
344	Fabricated structural metal prod
345	Bolts, nuts, screws, etc.
346	Metal stampings
348	Misc. fabricated wire prod
349	Misc. fabricated metal prod

Table B.1 Three-Digit STCC Codes (continued)

STCC3	Commodity
351	Engines or turbines
352	Farm machinery or equipment
353	Constr. machinery or equipment
354	Metalworking machinery
355	Special industry machinery
356	General industrial machinery
357	Office or computing machinery
358	Service industry machines
359	Misc. machinery or parts
360	Electrical equipment
361	Electric trans. or distrib.
362	Industrial electrical equipment
363	Household appliances
364	Electric lighting or wire equipment
365	Radio or TV receiving sets
366	Communication equipment
367	Electronic components
369	Misc. electrical machinery
371	Motor vehic. or equipment
372	Aircraft or parts
373	Ships or boats
374	Railroad equipment
375	Motorcycles, bicycles or parts
376	Missile or space veh. parts
379	Misc. transportation equipment
380	Instrum., photo eq., optical eq.
381	Engrg., lab or scientific eq.
382	Measuring or controlling equipment
383	Optical instruments or lenses
384	Medical or dental instruments
385	Ophthalmic or opticians goods
386	Photographic equip or supplies
387	Watches, clocks, etc.
391	Jewelry, silverware, etc.
393	Musical instruments or parts
394	Toys, amusement, athletic equip.
395	Office or art materials
396	Costume jewelry or novelties
399	Misc. manufactured products
401	Ashes
402	Waste or scrap
411	Misc. freight shipments
422	Semi-trailers returned empty
431	Mail and express traffic
451	Shipper association traffic
461	FAK shipments

Table B.1 Three-Digit STCC Codes (continued)

STCC3	Commodity
462	Mixed shipments, multi-STCC
486	Waste other regulated materials Group E
487	Waste stream
490	Hazardous materials
491	Flammable liquids
492	Poisons
493	Corrosive materials
494	Other regulated materials Group A
495	Mixed loads
496	Other regulated materials Group E
501	Warehouse & distribution centers
502	Rail intermodal drayage
503	Air freight drayage

Appendix C

Commodity Flow Matrices

Table C.1 Intrastate O-D Matrix (Annual Tons)

Origin		Destination 1	2	3	4	5	6	7	8	28
1	ATP 1, Northeast MN	23,817,187	176,546	277,930	82,785	1,786,452	120,787	61,990	43,902	26,209,341
2	ATP 2, Northwest MN	203,457	56,967	102,831	42,895	1,027,077	94,282	93,037	67,164	410,221
3	ATP 3, Central MN	306,356	77,115	327,704	156,201	3,321,597	311,931	233,919	153,841	19,500
4	ATP 4, West Central MN	413,360	66,108	209,760	168,180	1,941,838	244,372	182,728	138,500	1,497,299
5	ATP 5, Metro Division	1,799,710	720,944	2,603,229	1,174,079	20,215,070	2,828,213	2,053,488	1,340,106	191,458
6	ATP 6, Southeast MN	303,251	119,555	513,515	219,259	4,254,930	636,690	357,850	251,055	2,040
7	ATP 7, S.Central MN	257,662	85,423	394,182	167,513	3,843,058	750,995	393,490	202,866	1,925
8	ATP 8, Southwest MN	215,312	67,283	295,882	140,130	3,131,869	495,518	273,122	170,373	203,680
28	Douglas County, WI	1,136,576	10,702	54,205	2,651	439,074	143,579	20,896	3,331	477,701

Table C.2 Total O-D Matrix (Annual Tons)

Origin		Destination 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	ATP 1, Northeast MN	23,817,187	176,546	277,930	82,785	1,786,452	120,787	61,990	43,902	313,498	38,447	98,845	350,589	13,447,434	81,295	1,574,719	15,435,977
2	ATP 2, Northwest MN	203,457	56,967	102,831	42,895	1,027,077	94,282	93,037	67,164	535,088	36,695	258,867	102,404	153,359	234,278	353,976	133,929
3	ATP 3, Central MN	306,356	77,115	327,704	156,201	3,321,597	311,931	233,919	153,841	98,701	78,807	169,917	86,226	195,505	140,489	79,086	173,227
4	ATP 4, West Central MN	413,360	66,108	209,760	168,180	1,941,838	244,372	182,728	138,500	386,297	292,526	104,617	2,537,141	236,963	118,116	276,120	91,696
5	ATP 5, Metro Division	1,799,710	720,944	2,603,229	1,174,079	20,215,070	2,828,213	2,053,488	1,340,106	1,075,805	598,378	2,498,072	10,564,813	3,733,988	1,200,562	750,632	1,458,254
6	ATP 6, Southeast MN	303,251	119,555	513,515	219,259	4,254,930	636,690	357,850	251,055	128,810	105,137	508,087	135,565	812,667	228,934	227,427	202,175
7	ATP 7, S. Central MN	257,662	85,423	394,182	167,513	3,843,058	750,995	393,490	202,866	156,447	113,861	1,580,691	182,699	1,458,223	1,081,053	402,419	164,679
8	ATP 8, Southwest MN	215,312	67,283	295,882	140,130	3,131,869	495,518	273,122	170,373	114,392	81,542	358,444	77,777	359,609	189,506	114,063	138,785
9	North Dakota	903,203	194,790	439,863	267,542	3,859,927	723,858	184,984	133,845	-	-	-	-	-	-	-	-
10	South Dakota	143,534	12,864	64,272	36,384	982,091	650,596	191,169	30,886	-	-	-	-	-	-	-	-
11	Iowa	221,172	36,373	252,338	144,525	5,201,157	237,406	240,875	242,063	-	-	-	-	-	-	-	-
12	Wisconsin	130,991	52,526	169,137	64,646	2,757,662	193,672	144,537	96,497	-	-	-	-	-	-	-	-
13	Chicago	27,360	18,211	15,357	70,595	1,503,441	102,576	28,193	6,957	-	-	-	-	-	-	-	-
14	Lower Plains	28,304	7,109	32,801	73,551	1,238,363	41,563	66,632	48,786	-	-	-	-	-	-	-	-
15	Central Midwest	59,160	6,406	21,768	4,716	663,918	64,536	16,688	3,368	-	-	-	-	-	-	-	-
16	Eastern Midwest	2,635,697	29,886	125,552	36,286	2,836,876	107,421	71,289	38,948	-	-	-	-	-	-	-	-
17	Northwest	4,700,439	292,961	8,663,899	438,896	9,032,828	19,622	109,154	104,769	-	-	-	-	-	-	-	-
18	Southwest	25,375	3,786	10,703	7,214	464,408	12,293	9,168	10,864	-	-	-	-	-	-	-	-
19	South Central	34,784	20,421	32,597	29,725	632,583	63,134	84,171	43,605	-	-	-	-	-	-	-	-
20	Southeast	325,040	57,328	249,355	49,197	2,728,169	118,730	103,521	70,725	-	-	-	-	-	-	-	-
21	Northeast	47,103	5,143	53,092	8,397	1,245,753	67,330	55,740	15,570	-	-	-	-	-	-	-	-
22	Pacific Southwest	12,405	6,204	12,365	6,447	373,622	49,840	119,202	88,631	-	-	-	-	-	-	-	-
23	Louisiana	5,933	4,598	9,124	454	2,310,614	16,265	31,775	1,999	-	-	-	-	-	-	-	-
24	Western Canada	727,290	148,610	477,152	209,444	3,353,693	596,725	345,170	143,858	-	-	-	-	-	-	-	-
25	Central Canada	227,523	29,224	100,137	15,183	1,032,663	42,858	61,165	26,519	-	-	-	-	-	-	-	-
26	Eastern Canada	33,463	7,970	25,920	3,050	192,459	9,701	10,135	6,822	-	-	-	-	-	-	-	-
27	Mexico	-	-	-	-	125,891	-	-	-								
28	Douglas County, WI	1,136,576	10,702	54,205	2,651	439,074	143,579	20,896	3,331	33,895	4,098	29,930	2,676,006	6,225,786	66,499	2,072,959	13,248,037
	Total	**38,741,648**	**2,315,054**	**15,534,671**	**3,619,944**	**80,497,083**	**8,744,495**	**5,544,086**	**3,485,849**	**2,842,933**	**1,349,491**	**5,607,470**	**16,713,220**	**26,623,533**	**3,340,732**	**5,851,401**	**31,046,759**
	MN	**28,452,871**	**1,380,643**	**4,779,238**	**2,153,692**	**39,960,965**	**5,626,368**	**3,670,518**	**2,371,138**	**2,842,933**	**1,349,491**	**5,607,470**	**16,713,220**	**26,623,533**	**3,340,732**	**5,851,401**	**31,046,759**
	MN Intraregional								**117,408,601**								

Table C.2 Total O-D Matrix (Annual Tons) (continued)

		Destination															
Origin		**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**Total**	**MN(+WI)**	**Intra**	**Inbounds**
1	ATP 1, Northeast MN	172,410	3,122,525	107,426	658,426	710,830	108,348	31,714	151,386	5,530,602	11,522	-	26,209,341	94,522,913	52,576,921		
2	ATP 2, Northwest MN	405,658	131,058	110,402	126,456	78,224	222,233	115,207	40,107	13,652	2,855	-	410,221	5,152,382	2,097,932		
3	ATP 3, Central MN	113,600	71,779	93,370	213,761	221,811	128,096	12,817	58,476	34,237	4,498	-	19,500	6,882,566	4,908,164		
4	ATP 4, West Central MN	1,827,778	52,523	71,072	115,100	92,118	55,886	55,990	25,920	19,963	2,793	-	1,497,299	11,224,764	4,862,144		
5	ATP 5, Metro Division	1,344,132	459,670	862,272	1,733,245	1,531,746	782,038	8,021,743	335,025	234,591	35,941	623,938	191,458	70,771,145	32,926,298		
6	ATP 6, Southeast MN	76,553	113,938	205,455	223,597	359,740	130,373	901,708	44,131	75,505	4,411	-	2,040	11,142,358	6,658,145		
7	ATP 7, S. Central MN	953,104	233,333	534,568	175,347	254,935	337,286	321,757	111,387	71,265	6,690	-	1,925	14,236,860	6,097,115		
8	ATP 8, Southwest MN	2,405,401	116,527	259,990	231,641	142,730	80,693	14,498	59,814	59,152	4,202	-	203,680	9,801,936	4,993,169	117,408,601	
9	North Dakota	-	-	-	-	-	-	-	-	-	-		1,035,654	7,743,666	7,743,666		
10	South Dakota	-	-	-	-	-	-	-	-	-	-		278,660	2,390,456	2,390,456		
11	Iowa	-	-	-	-	-	-	-	-	-	-		45,825	6,621,735	6,621,735		
12	Wisconsin	-	-	-	-	-	-	-	-	-	-		534,484	4,144,153	4,144,153		
13	Chicago	-	-	-	-	-	-	-	-	-	-		83,216	1,855,906	1,855,906		
14	Lower Plains	-	-	-	-	-	-	-	-	-	-		2,126	1,539,234	1,539,234		
15	Central Midwest	-	-	-	-	-	-	-	-	-	-		123,546	964,106	964,106		
16	Eastern Midwest	-	-	-	-	-	-	-	-	-	-		898,206	6,780,161	6,780,161		
17	Northwest	-	-	-	-	-	-	-	-	-	-		13,745,849	37,108,418	37,108,418		
18	Southwest	-	-	-	-	-	-	-	-	-	-		2,515	546,325	546,325		
19	South Central	-	-	-	-	-	-	-	-	-	-		33,517	974,537	974,537		
20	Southeast	-	-	-	-	-	-	-	-	-	-		7,439	3,709,505	3,709,505		
21	Northeast	-	-	-	-	-	-	-	-	-	-		12,396	1,510,524	1,510,524		
22	Pacific Southwest	-	-	-	-	-	-	-	-	-	-		1,115	669,832	669,832		
23	Louisiana	-	-	-	-	-	-	-	-	-	-		956	2,381,718	2,381,718		
24	Western Canada	-	-	-	-	-	-	-	-	-	-		242,865	6,244,807	6,244,807		
25	Central Canada	-	-	-	-	-	-	-	-	-	-		245,684	1,780,956	1,780,956		
26	Eastern Canada	-	-	-	-	-	-	-	-	-	-	-	6,761	296,281	296,281		
27	Mexico										-	-		125,891	125,891		87,388,210
28	Douglas County, WI	65,321	20,340	185,395	25,553	49,556	20,710	38,746	77,569	170,505	72,399		477,701	27,372,018	2,288,713		
	Total	**7,363,958**	**4,321,693**	**2,429,952**	**3,503,126**	**3,441,691**	**1,865,664**	**9,514,181**	**903,815**	**6,209,472**	**145,311**	**623,938**	**46,313,982**	**338,495,151**			
	MN	**7,363,958**	**4,321,693**	**2,429,952**	**3,503,126**	**3,441,691**	**1,865,664**	**9,514,181**	**903,815**	**6,209,472**	**145,311**	**623,938**	**29,013,167**				
																Interregional:	
	MN Outbounds											**133,698,340**				**221,086,550**	

Appendix D

Commodity Flow Maps and Tables

Table D.1 Top 20 Commodities by Tonnage Moved in Minnesota by Mode

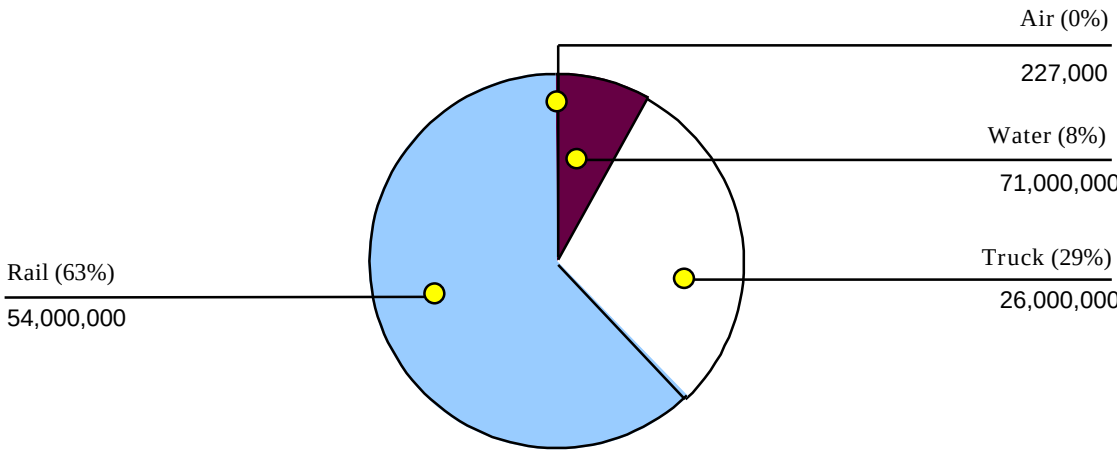
STCC3	Commodity	Total	Truck	Rail	Water	Air
101	Iron ores	93,815,616	5	57,476,225	36,339,386	–
112	Bituminous coal or lignite	59,630,192	34,977	45,515,794	14,079,421	–
11	Field crops	35,950,856	1,198,605	26,885,776	7,866,078	–
327	Concrete, gypsum, or plaster	15,563,146	15,326,794	236,293	–	–
501	Warehouse and distribution centers	14,347,158	14,347,158	–	–	
131	Crude petroleum or natural gas	11,651,312	50,604	–	–	–
291	Products of petroleum refining	9,967,839	8,668,144	222,082	329,782	16
209	Misc. food preparations	9,596,953	8,068,174	1,182,599	346,172	–
204	Grain mill products	8,735,745	6,229,263	1,426,400	1,080,080	2
295	Paving or roofing materials	5,737,566	5,682,603	43,446	11,381	–
202	Dairy products	5,421,991	5,368,438	47,067	6,484	–
281	Industrial chemicals	5,133,031	1,479,642	3,532,128	112,973	186
208	Beverages or flavor extracts	4,993,187	4,097,212	824,864	70,508	14
144	Gravel or sand	4,281,757	11,499	1,557,759	2,712,499	–
262	Paper	3,779,331	2,500,330	1,275,439	3,140	273
201	Meat or poultry, fresh or chilled	3,779,179	3,663,607	60,245	55,327	–
287	Agricultural chemicals	3,766,909	1,695,687	699,243	1,371,967	12
249	Misc. wood products	3,511,761	2,486,815	960,378	–	64
402	Waste or scrap	3,394,154	24,224	914,244	2,455,347	210
324	Portland cement	3,015,573	358,328	1,347,923	1,309,322	–
502	Rail intermodal drayage	2,607,420	2,607,420	–	–	
142	Broken stone or riprap	2,475,857	111	748,349	1,727,394	–
242	Sawmill or planing mill products	2,389,562	883,955	1,505,462	–	–
241	Primary forest materials	2,044,594	1,756,671	287,923	–	–
329	Abrasives, asbestos products, etc.	1,880,367	717,443	1,126,698	36,065	161
206	Sugar, beet or cane	1,818,966	469,323	1,082,466	267,177	–
461	Fak shipments	1,796,587	–	1,796,587	–	
371	Motor vehicle or equipment	1,751,200	954,344	793,186	3,317	353
243	Millwork or prefab wood products	1,727,043	1,595,955	131,083	–	3
203	Canned or preserved food	1,664,982	1,466,212	139,037	59,733	–

Table D.2 Top 20 Commodities by Value Moved in Minnesota by Mode

STCC3	Commodity	Total ($)	Truck ($)	Rail ($)	Water ($)	Air ($)
501	Warehouse and distribution centers	117,090,959,741	117,090,959,741	–	–	–
502	Rail intermodal drayage	21,279,845,913	21,279,845,913	–	–	
461	Fak shipments	14,662,422,603	–	14,662,422,603	–	
371	Motor vehicle or equipment	9,322,601,572	4,443,002,116	4,868,760,153	10,838,715	588
274	Misc. printed matter	7,451,013,656	7,331,167,053	108,269,157	6,427,883	5,149,564
202	Dairy products	6,980,473,602	6,916,287,834	56,235,502	7,950,266	
201	Meat or poultry, fresh or chilled	6,387,086,652	6,208,669,546	83,651,510	94,765,597	
243	Millwork or prefab wood products	4,264,591,215	4,158,785,221	105,805,994	–	
11	Field crops	4,013,055,716	137,473,129	3,004,678,507	870,904,080	
357	Office or computing machinery	3,688,730,315	3,511,936,840	–	–	176,793,475
262	Paper	3,468,233,268	2,346,360,802	1,118,616,776	3,255,690	
367	Electronic components	3,422,040,141	3,349,269,919	–	–	72,770,222
307	Misc. plastic products	3,012,931,638	2,996,385,336	11,167,527	795,343	4,583,432
204	Grain mill products	2,925,915,861	2,138,856,865	426,180,543	360,878,453	
384	Medical or dental instruments	2,916,077,526	2,796,150,609	14,945,026	5,852,074	99,129,817
101	Iron ores	2,909,836,971	–	1,894,536,122	1,015,300,850	
503	Air freight drayage	2,799,101,784	2,799,101,784	–	–	
352	Farm machinery or equipment	2,764,530,867	2,698,625,322	41,107,075	–	24,798,470
208	Beverages or flavor extracts	2,550,331,813	2,120,970,818	393,000,793	36,360,201	
209	Misc. food preparations	2,524,928,276	2,013,383,903	403,658,104	107,886,269	
362	Industrial electrical equipment	2,418,417,515	2,408,430,056	–	9,987,460	
359	Misc. machinery or parts	2,392,498,484	2,360,724,396	31,672,010	–	102,078
353	Construction machinery or equipment	2,371,251,510	2,274,281,044	13,467,306	8,629,526	74,873,635
369	Misc. electrical machinery	2,276,470,997	2,276,470,997	–	–	
287	Agricultural chemicals	2,270,206,815	596,865,087	122,028,982	1,551,299,494	13,252
291	Products of petroleum refining	2,212,371,683	2,089,158,237	42,355,732	80,857,714	
203	Canned or preserved food	2,141,394,141	1,933,914,274	128,387,594	79,092,273	
366	Communication equipment	1,871,188,215	1,802,700,746	–	–	68,487,469
356	General industrial machinery	1,756,939,031	1,686,039,219	–	–	70,899,812
112	Bituminous coal or lignite	1,595,394,547	936,236	1,218,357,887	376,100,424	

Figure D.1 Interstate Freight Moving in Minnesota by Mode

Inbound



Outbound

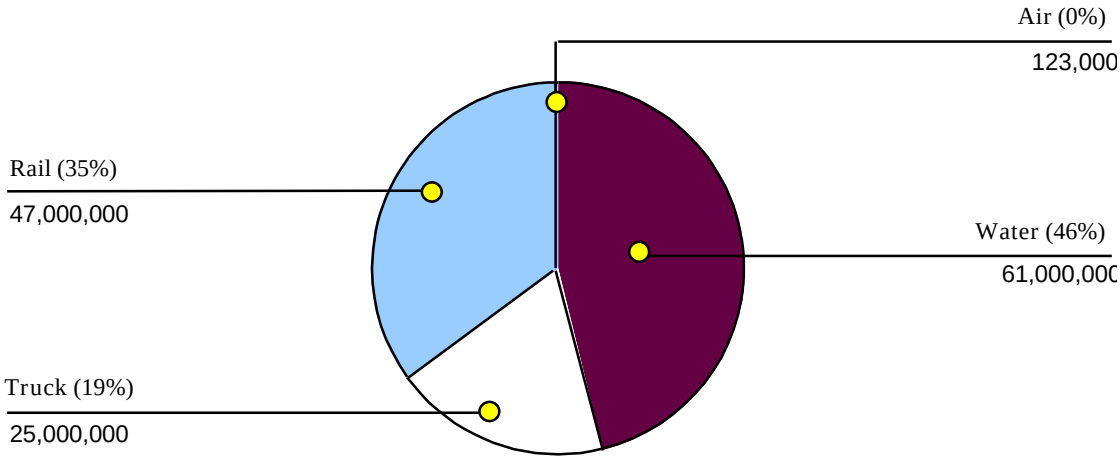


Figure D.2 Total Commodity Flows by Value for Minnesota Regions

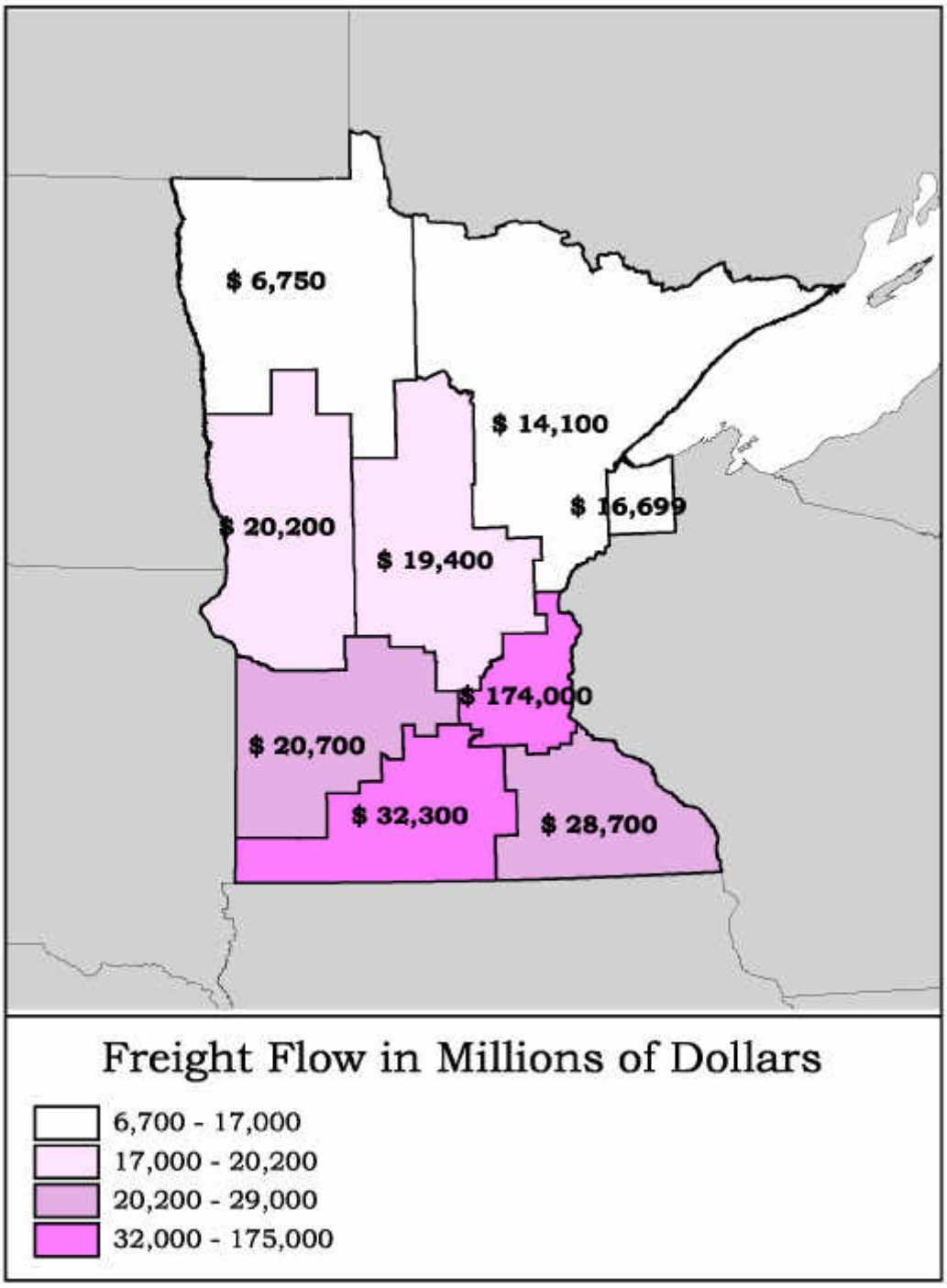


Table D.3 Total Flows by Weight within Minnesota Regions (in tons)

	Total	Outbound Interstate		Inbound Interstate		Intrastate		Intraregional		Overhead	
ATP 1, Northeast MN	90,108,272	41,945,992	47%	10,288,778	11%	13,853,518	15%	23,817,187	26%	202,796	0%
ATP 2, Northwest MN	7,410,072	3,054,449	41%	934,410	13%	3,152,578	43%	56,967	1%	211,667	3%
ATP 3, Central MN	18,808,240	1,974,401	10%	10,755,433	57%	5,175,494	28%	327,704	2%	575,208	3%
ATP 4, Western MN	23,667,971	6,362,620	27%	1,466,252	6%	6,352,869	27%	168,180	1%	9,318,050	39%
ATP 5, Metro Division	121,441,273	37,844,847	31%	40,757,337	34%	14,935,914	12%	20,215,070	17%	7,688,105	6%
ATP 6, Southeast MN	23,199,460	4,484,213	19%	3,118,135	13%	7,110,983	31%	636,690	3%	7,849,439	34%
ATP 7, Southern MN	29,568,362	8,139,745	28%	1,873,567	6%	8,166,709	28%	393,490	1%	10,994,850	37%
ATP 8, Southwest MN	18,787,101	4,808,767	26%	1,114,710	6%	5,745,792	31%	170,373	1%	6,947,459	37%
Douglas County, WI	70,037,633	25,083,305	36%	17,300,815	25%	23,345,945	33%	477,701	1%	3,829,867	5%
Total Estimated Tonnage	**403,028,383**	**133,698,340**	**33%**	**87,609,439**	**22%**	**87,839,802**	**22%**	**46,263,362**	**11%**	**47,617,441**	**12%**

Table D.4 Total Flows by Value within Minnesota Regions (in dollars)

	Total	Outbound Interstate		Inbound Interstate		Intrastate		Intraregional		Overhead	
ATP 1, Northeast MN	$14,056,094,647	$4,160,093,505	30%	$2,668,122,757	19%	$5,633,862,411	40%	$1,415,149,901	10%	$178,866,072	1%
ATP 2, Northwest MN	$6,747,231,711	$1,594,255,874	24%	$1,390,792,570	21%	$3,434,890,733	51%	$140,602,240	2%	$186,690,294	3%
ATP 3, Central MN	$19,378,492,072	$4,274,844,668	22%	$4,102,209,927	21%	$9,974,853,865	51%	$519,250,156	3%	$507,333,456	3%
ATP 4, Western MN	$20,174,411,329	$2,661,238,687	13%	$2,749,506,834	14%	$5,911,989,531	29%	$633,156,177	3%	$8,218,520,100	41%
ATP 5, Metro Division	$174,282,729,122	$50,205,115,124	29%	$62,752,790,837	36%	$10,703,367,513	6%	$43,840,547,037	25%	$6,780,908,610	4%
ATP 6, Southeast MN	$28,745,431,166	$5,522,722,782	19%	$4,038,829,503	14%	$11,356,823,479	40%	$903,850,203	3%	$6,923,205,198	24%
ATP 7, Southern MN	$32,312,092,045	$6,896,166,028	21%	$3,097,711,723	10%	$11,746,504,208	36%	$874,252,386	3%	$9,697,457,700	30%
ATP 8, Southwest MN	$20,659,471,687	$3,754,090,726	18%	$2,042,000,435	10%	$8,290,098,271	40%	$445,623,417	2%	$6,127,658,838	30%
Douglas County, WI	$16,703,903,865	$7,169,802,358	43%	$3,440,443,053	21%	$2,593,241,912	16%	$122,473,848	1%	$3,377,942,694	20%
Total Estimated Value	**$333,059,857,644**	**$86,238,329,753**	**26%**	**$86,282,407,640**	**26%**	**$69,645,631,923**	**21%**	**$48,894,905,365**	**15%**	**$41,998,582,962**	**13%**

Figure D.3 Total Interstate Commodity Flows by Weight to Minnesota

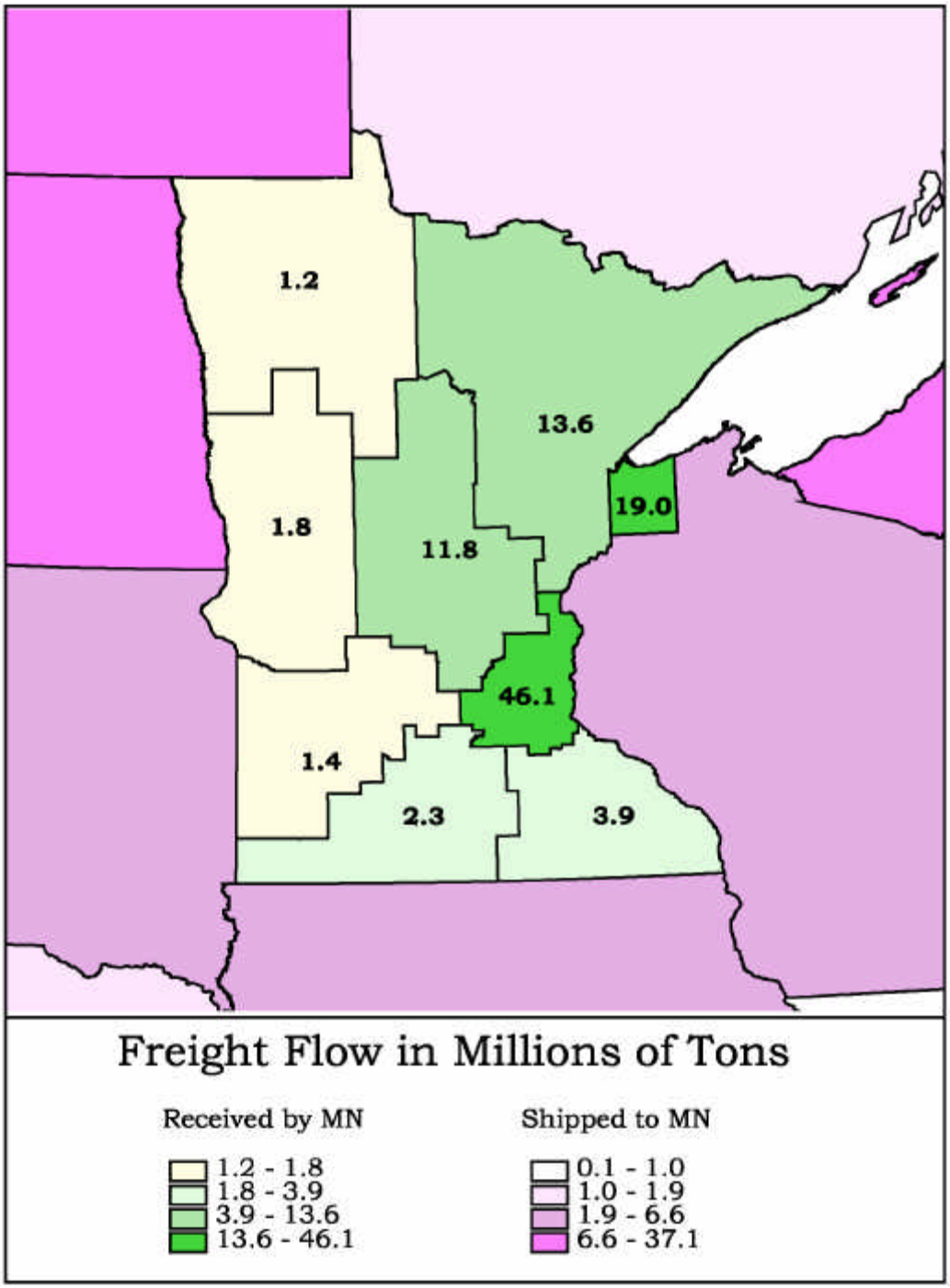


Figure D.4 Total Interstate Commodity Flows by Weight from Minnesota

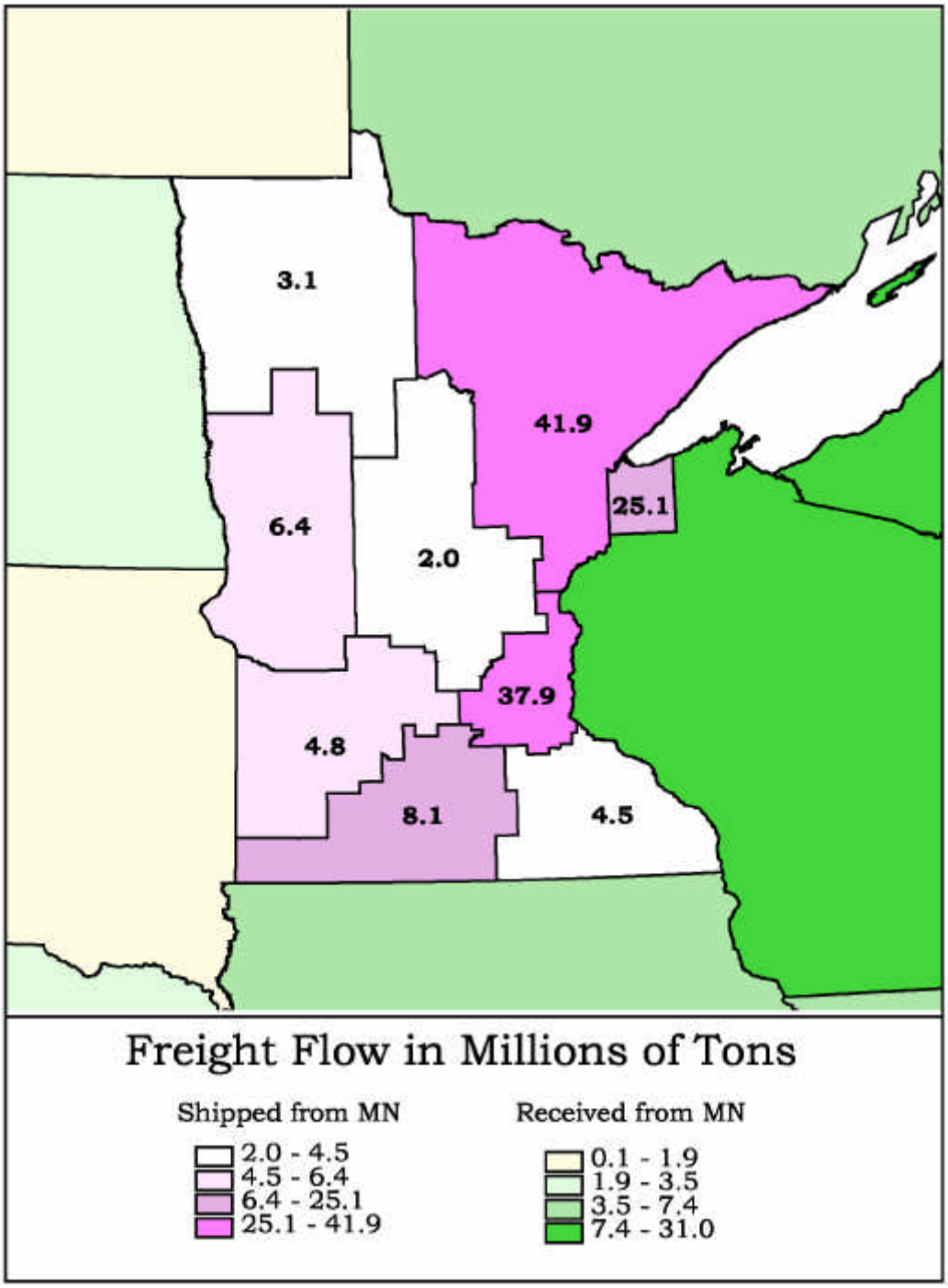


Figure D.5 Total Intrastate Commodity Flows by Weight Received by Minnesota Regions

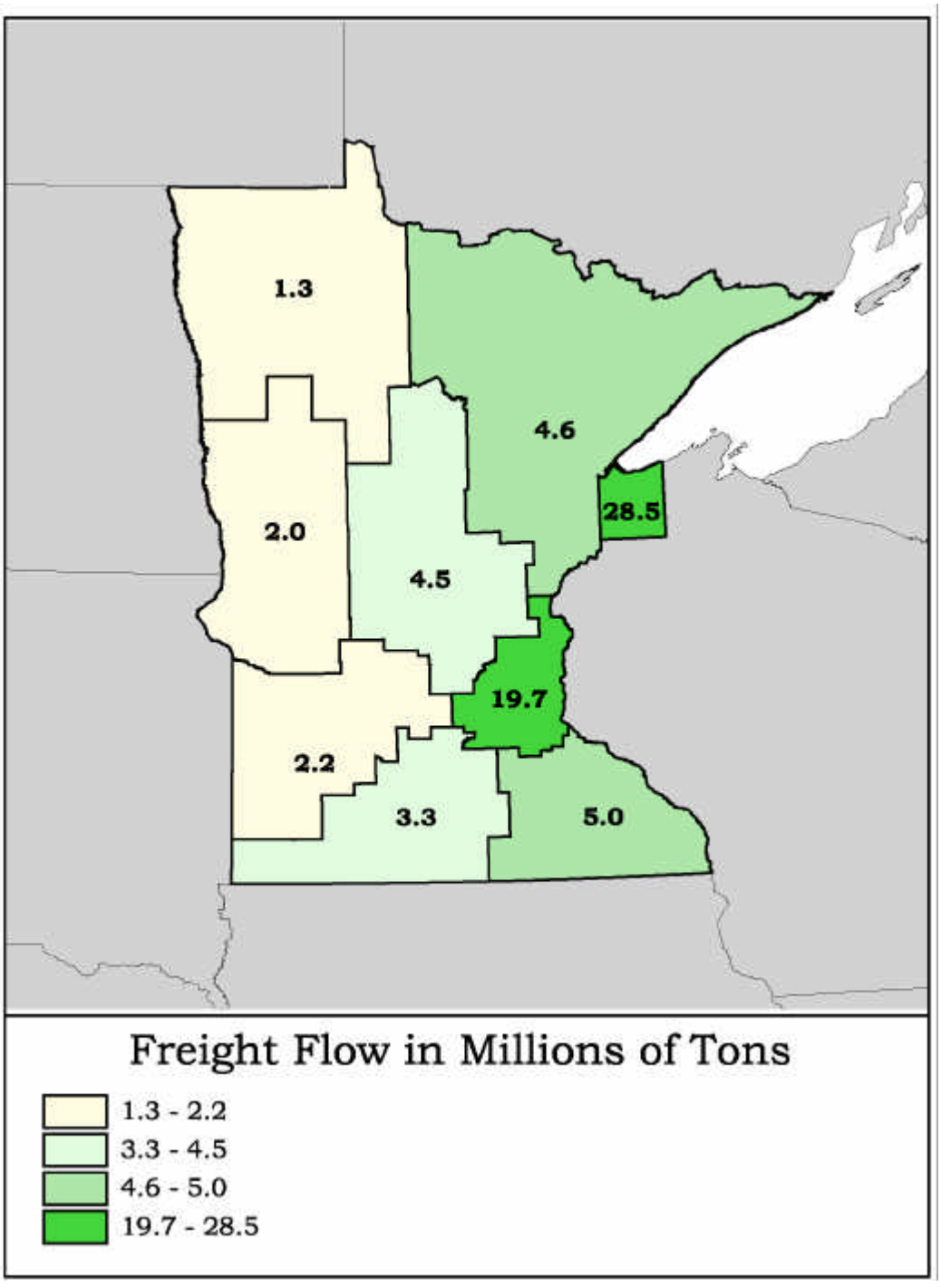


Figure D.6 Total Intrastate Commodity Flows by Weight Shipped by Minnesota Regions

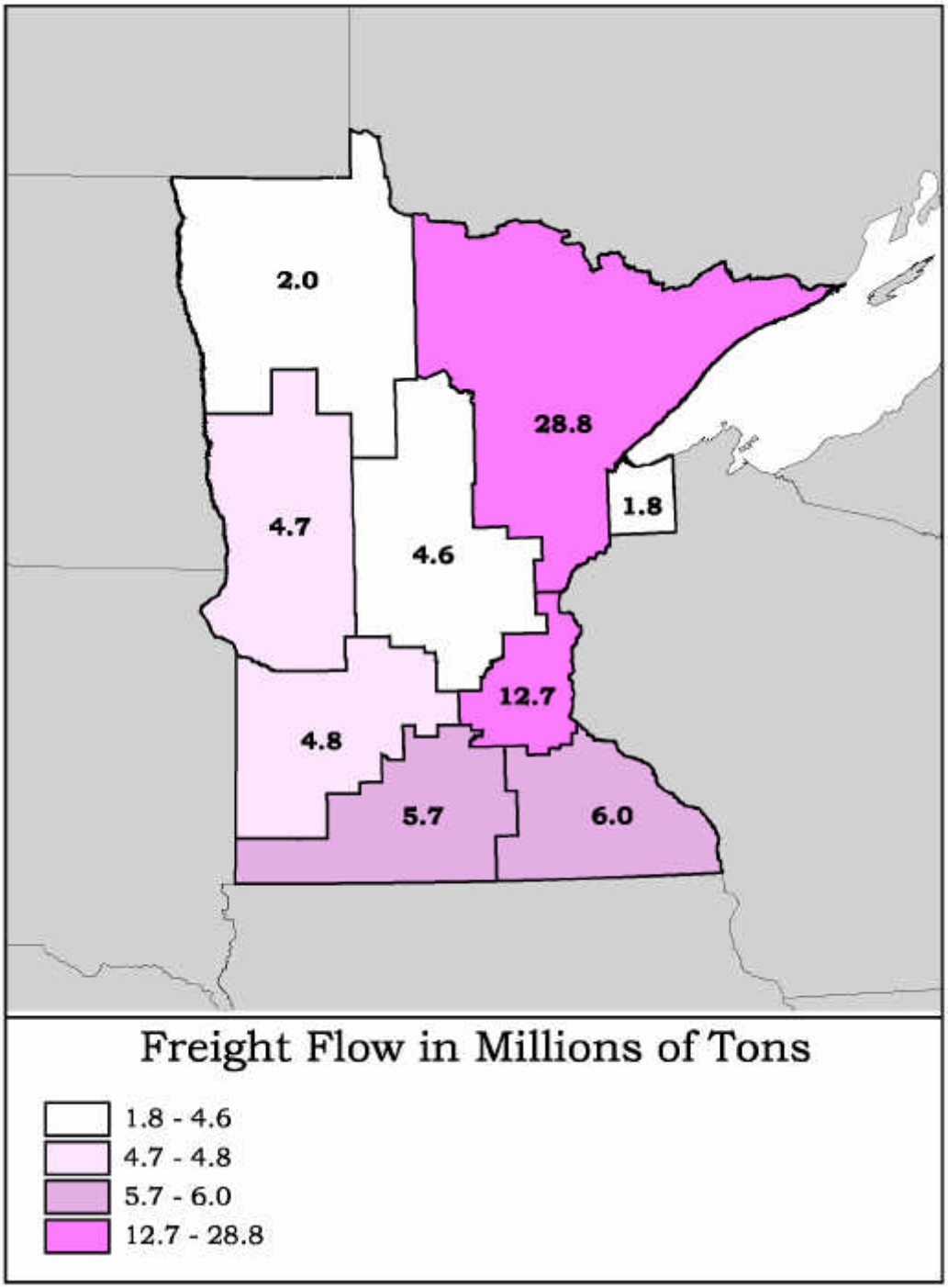


Figure D.7 Total Intraregional Commodity Flows by Weight in Each Minnesota Region

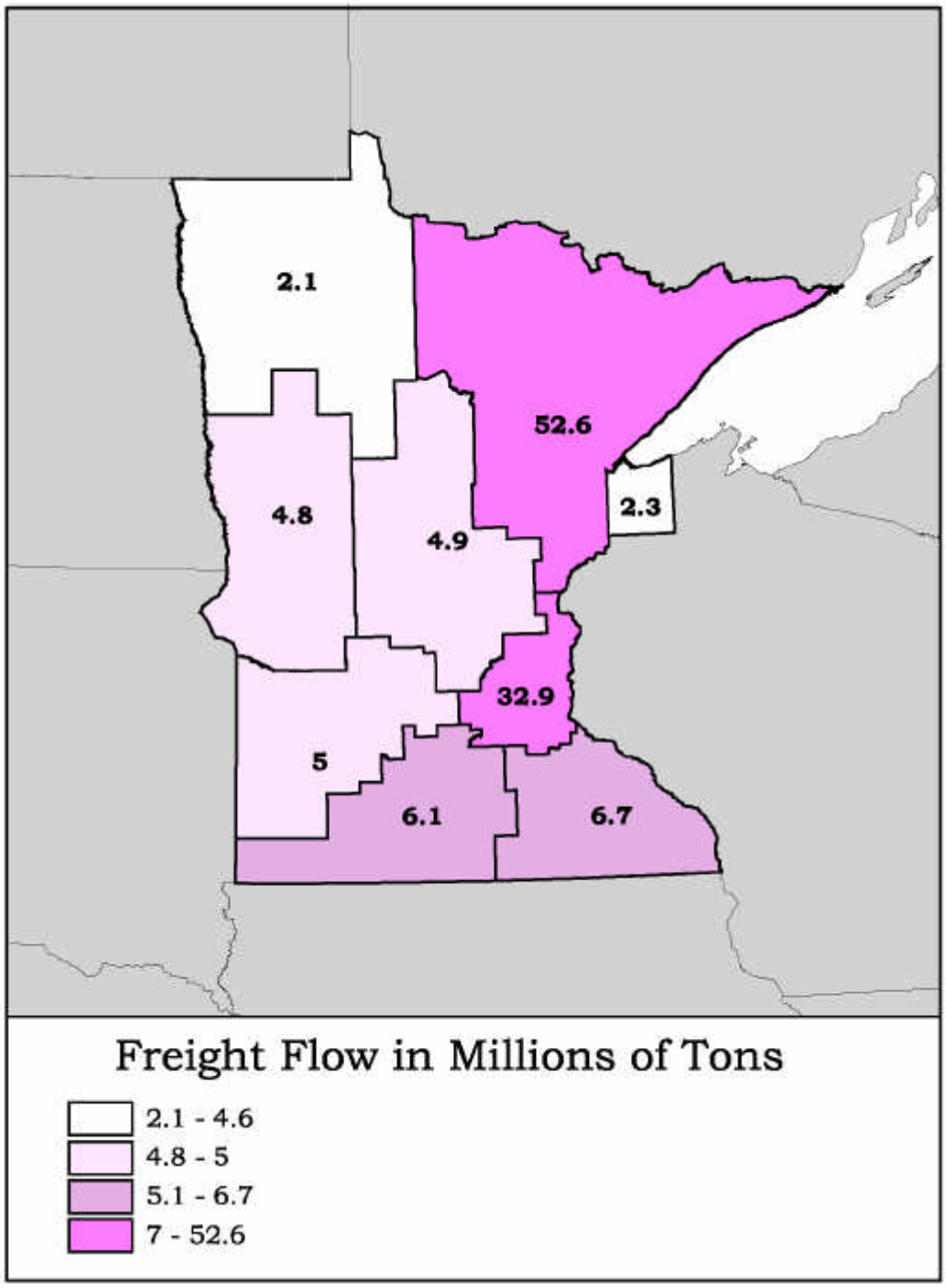


Figure D.8 Total Interstate Commodity Flows by Value to Minnesota

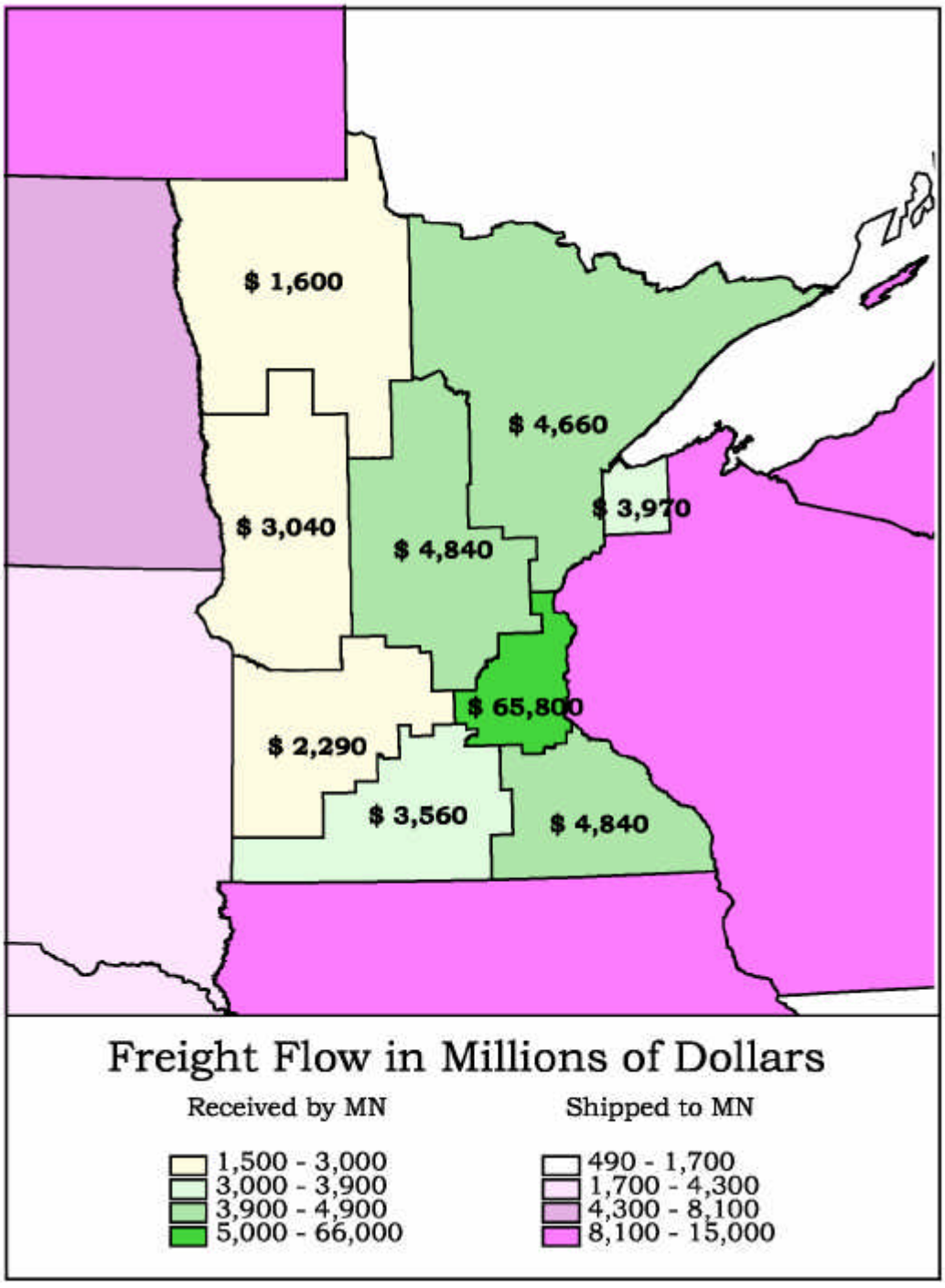


Figure D.9 Total Interstate Commodity Flows by Value from Minnesota

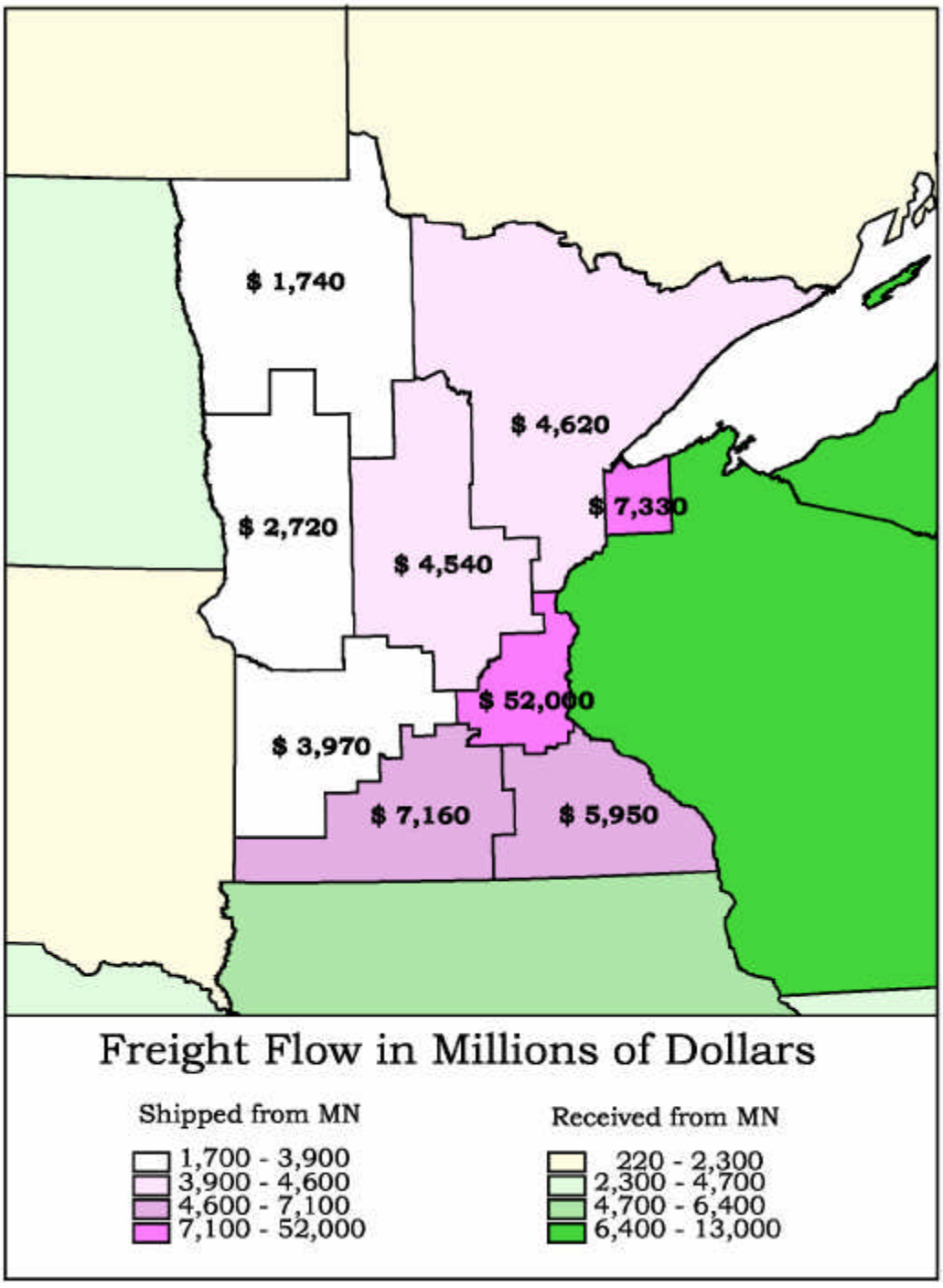


Figure D.10 Total Intrastate Commodity Flows by Value Received by Minnesota Regions

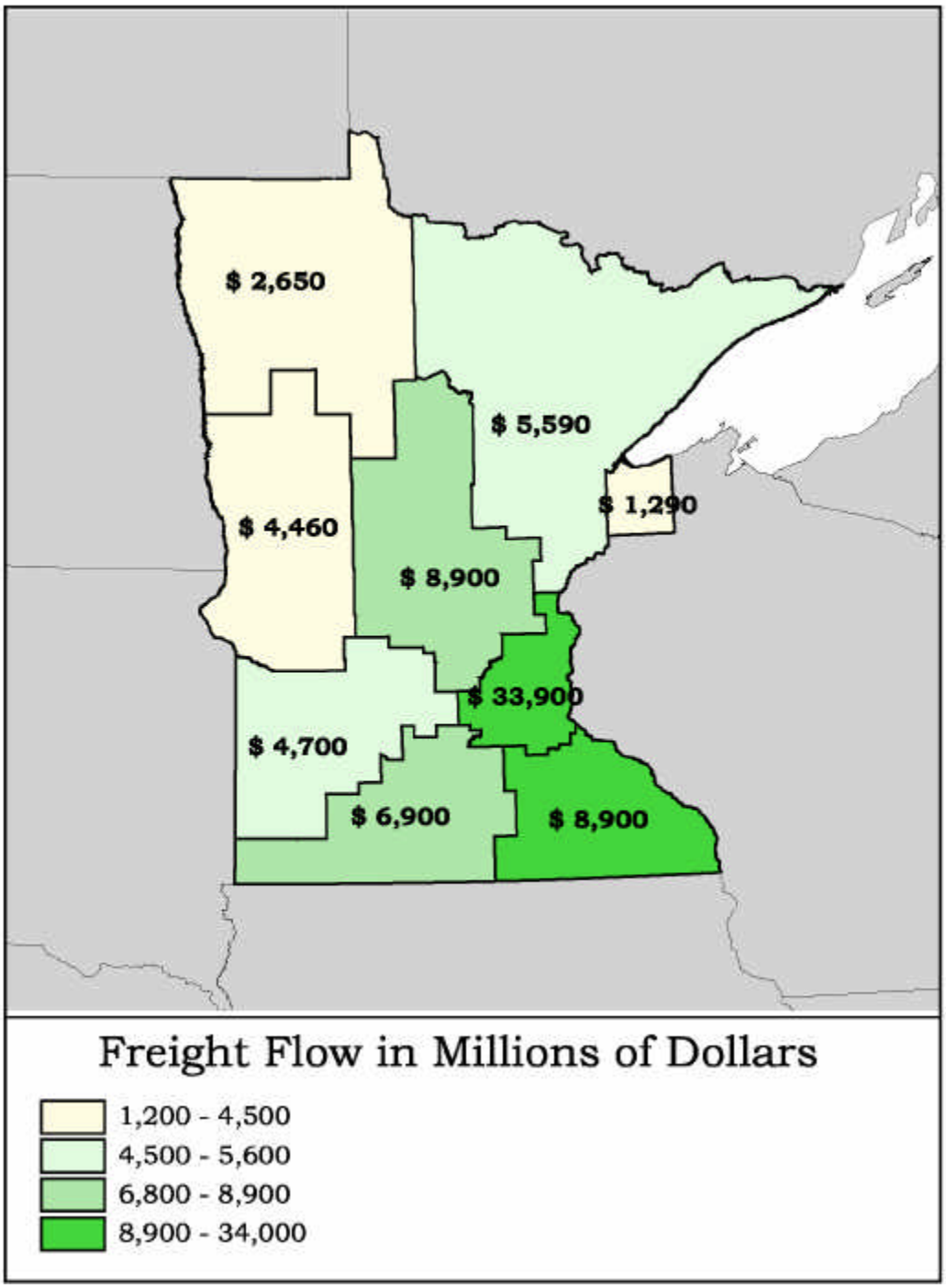


Figure D.11 Total Intrastate Commodity Flows by Value Shipped by Minnesota Regions

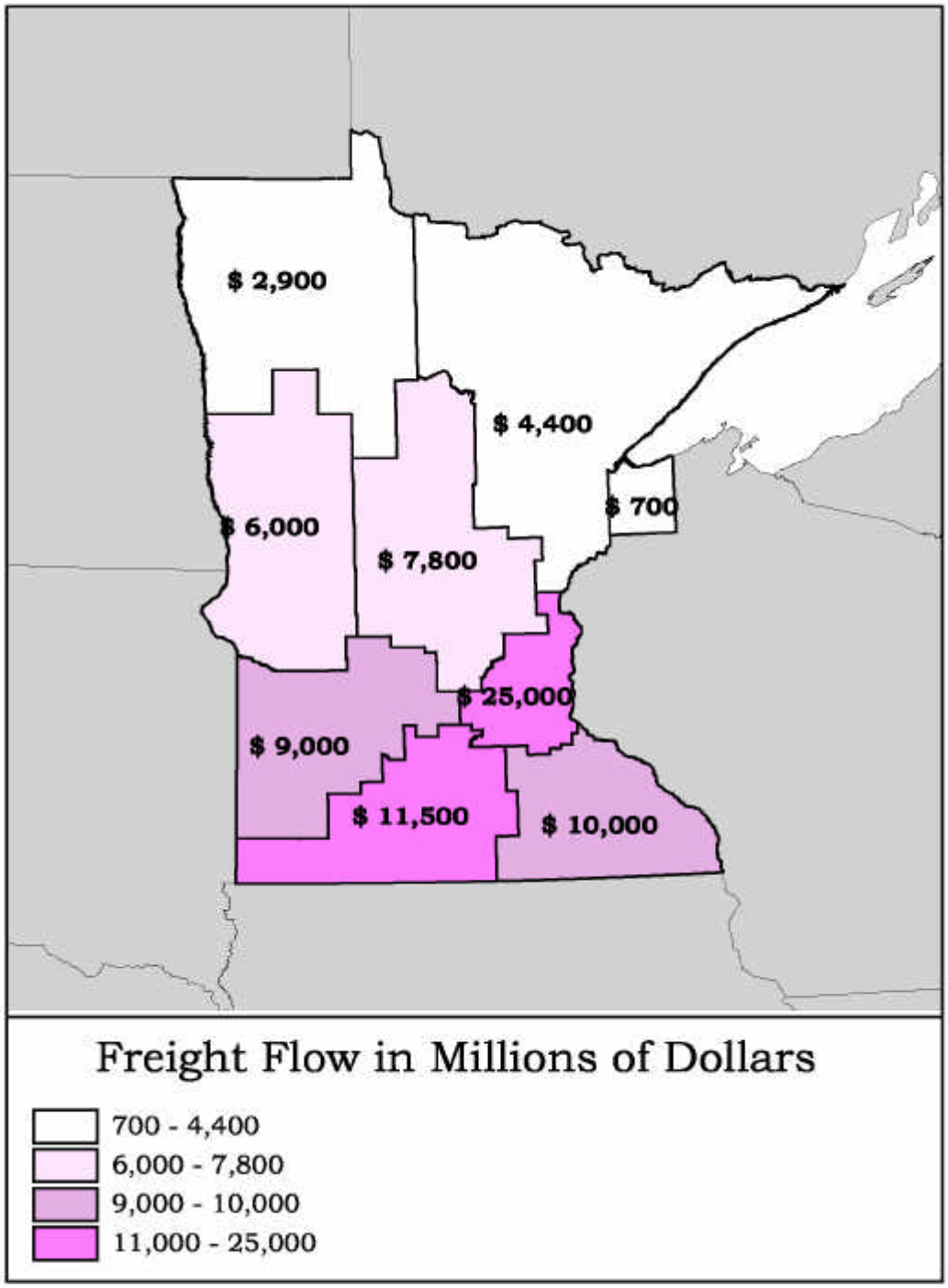


Figure D.12 Total Intraregional Commodity Flows by Value in Each Minnesota Region

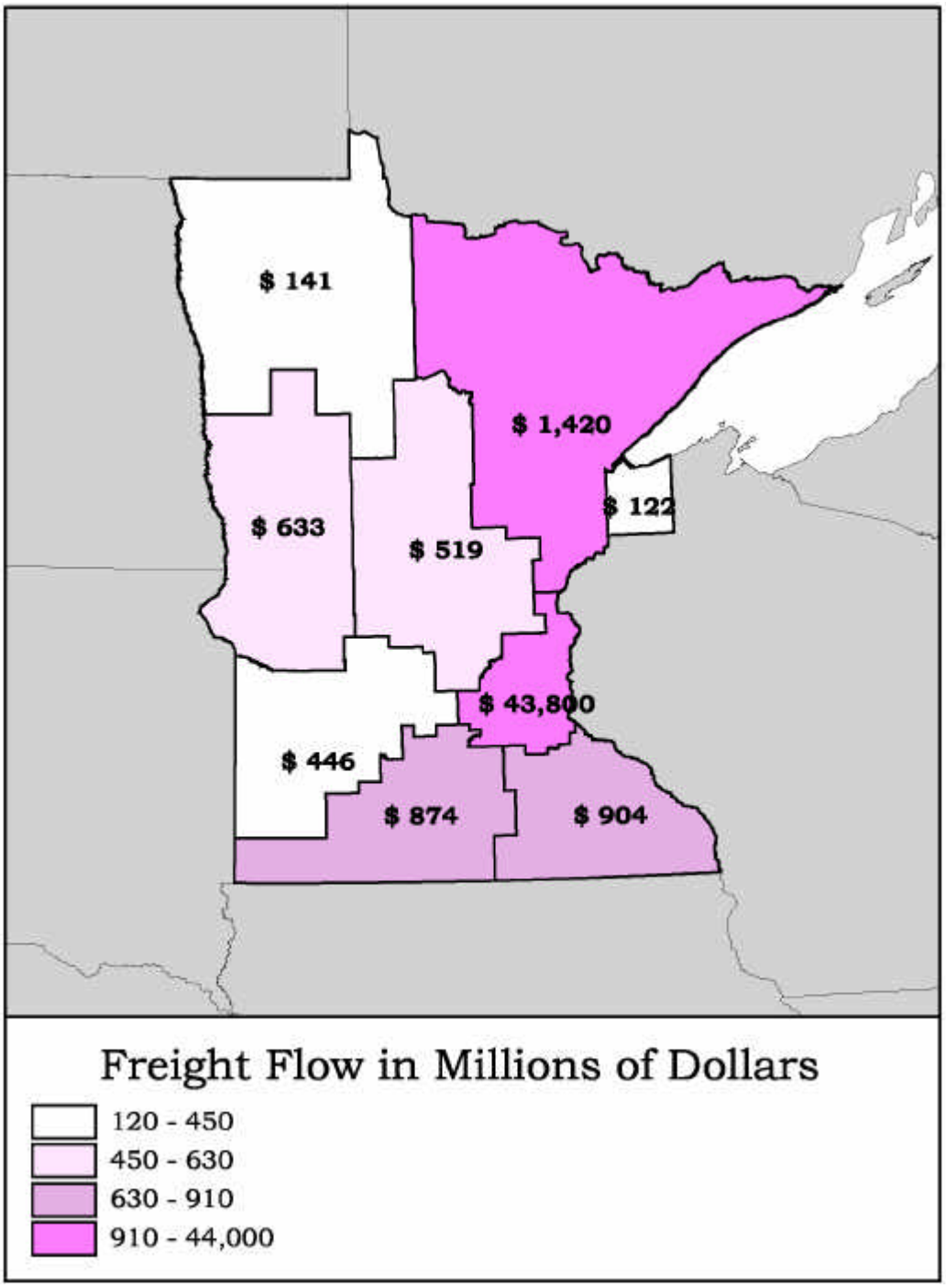


Figure D.13 Inbound Interstate Commodity Flow Weight by Truck

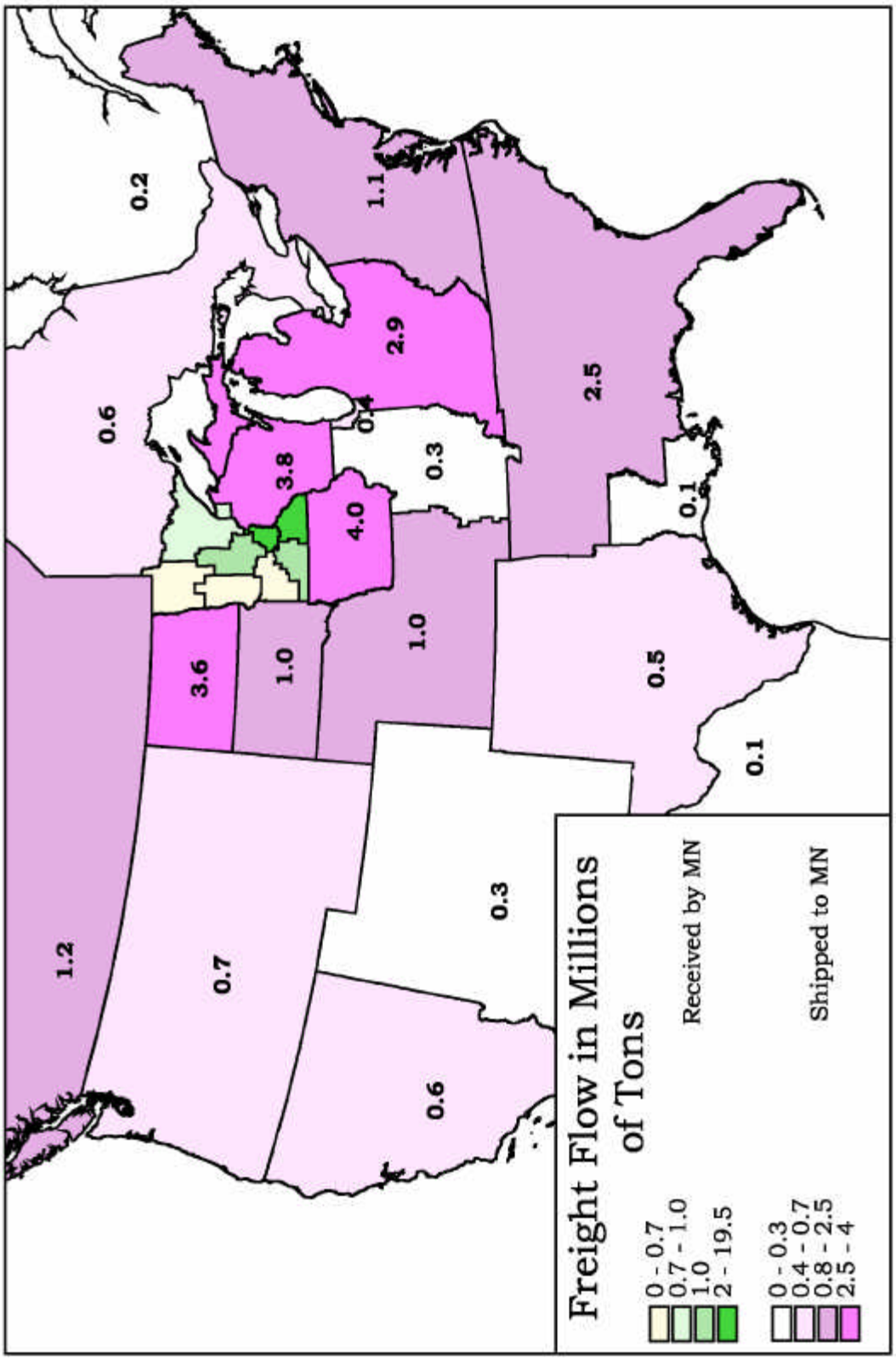


Figure D.14 Outbound Interstate Commodity Flow Weight by Truck

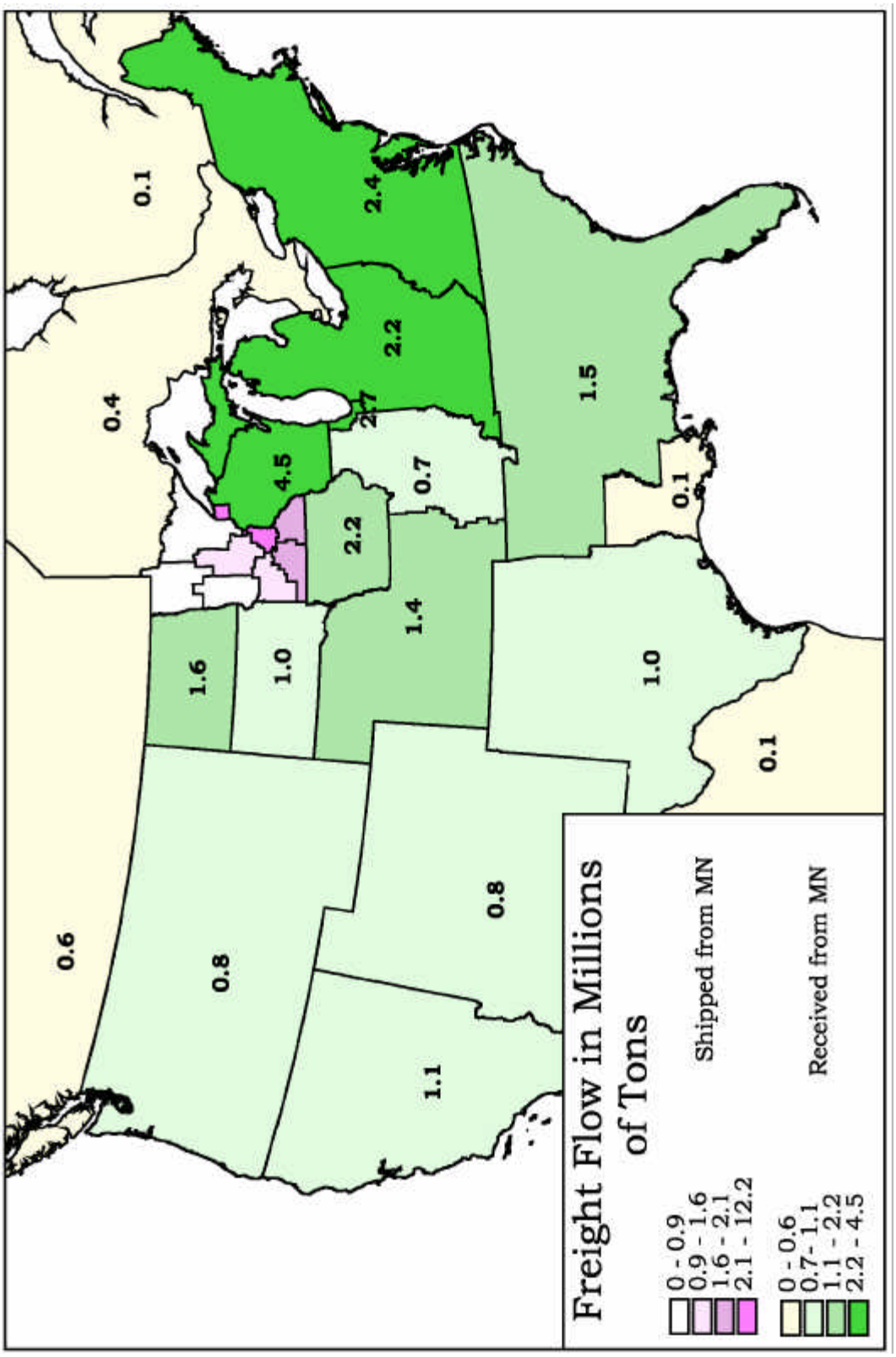


Figure D.15 Inbound Interstate Commodity Flow Value by Truck

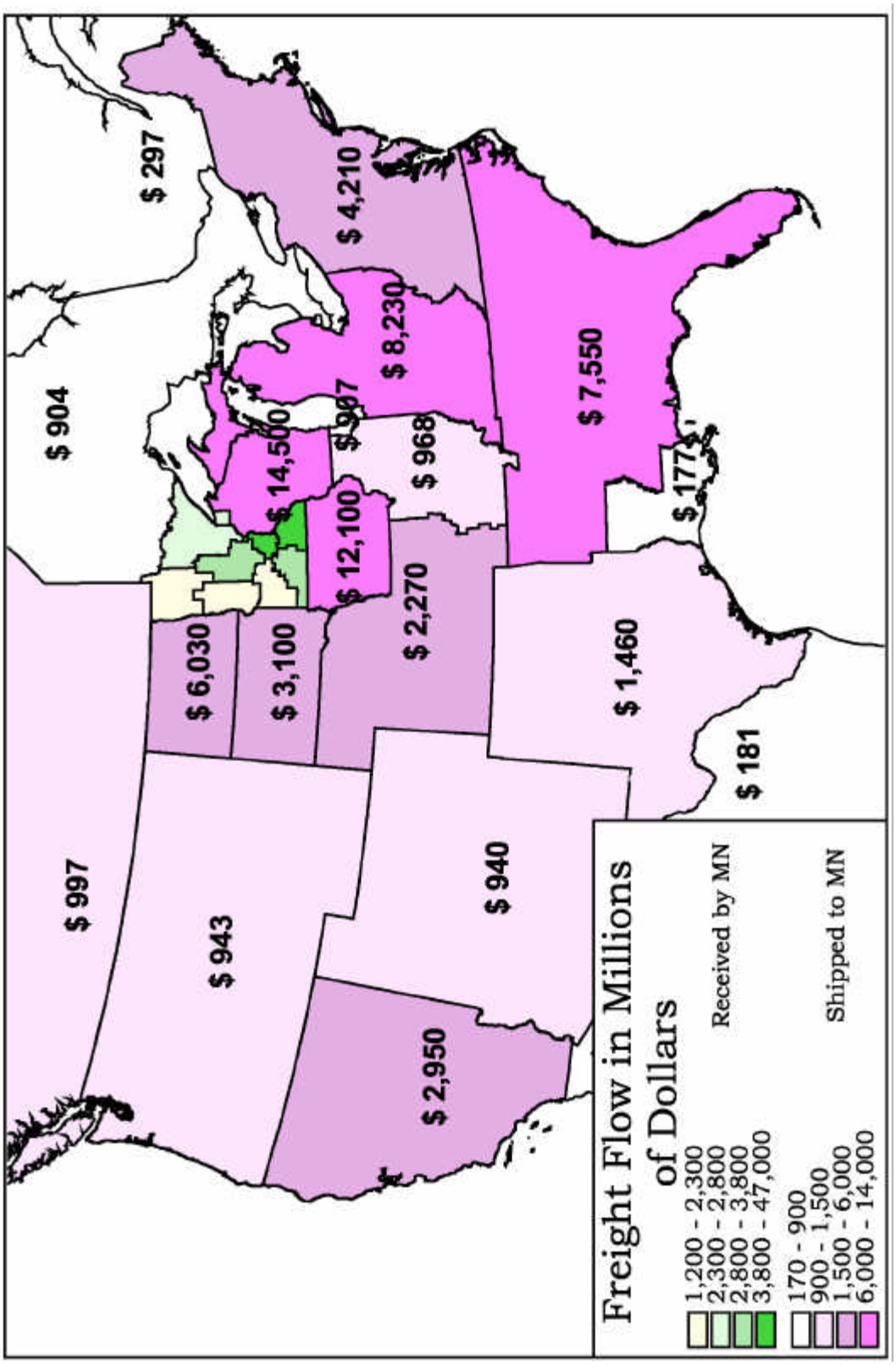


Figure D.16 Outbound Interstate Commodity Flow Value by Truck

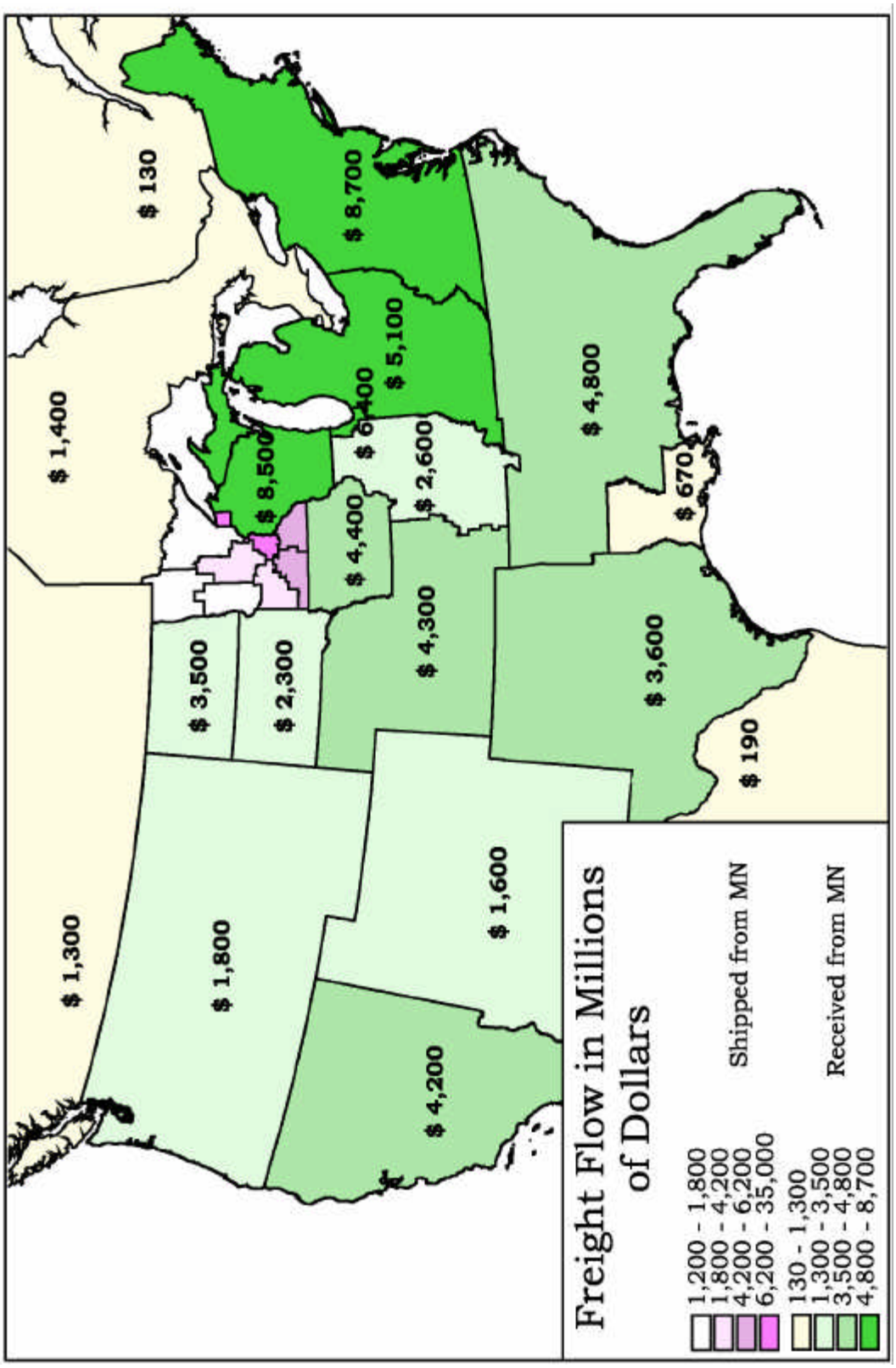


Figure D.17 Top Truck Commodities

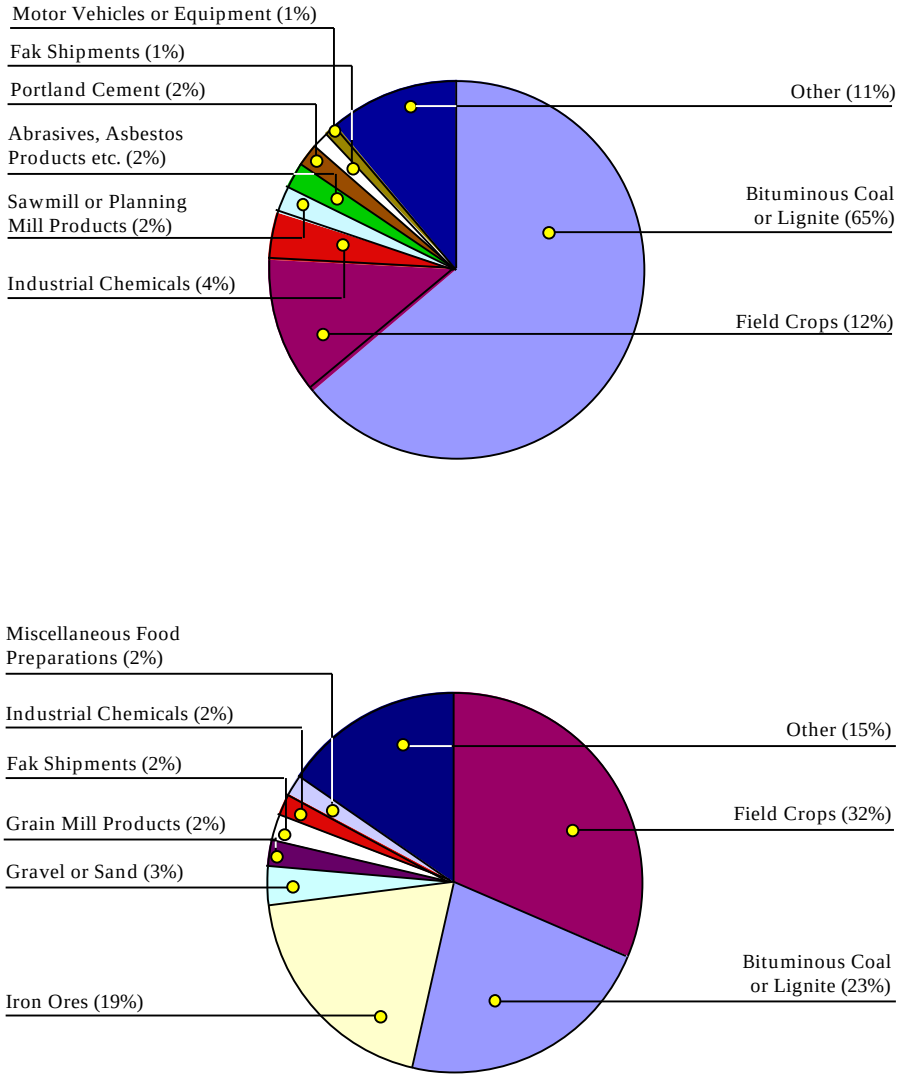


Figure D.18 Inbound Interstate Commodity Flow Weight by Rail

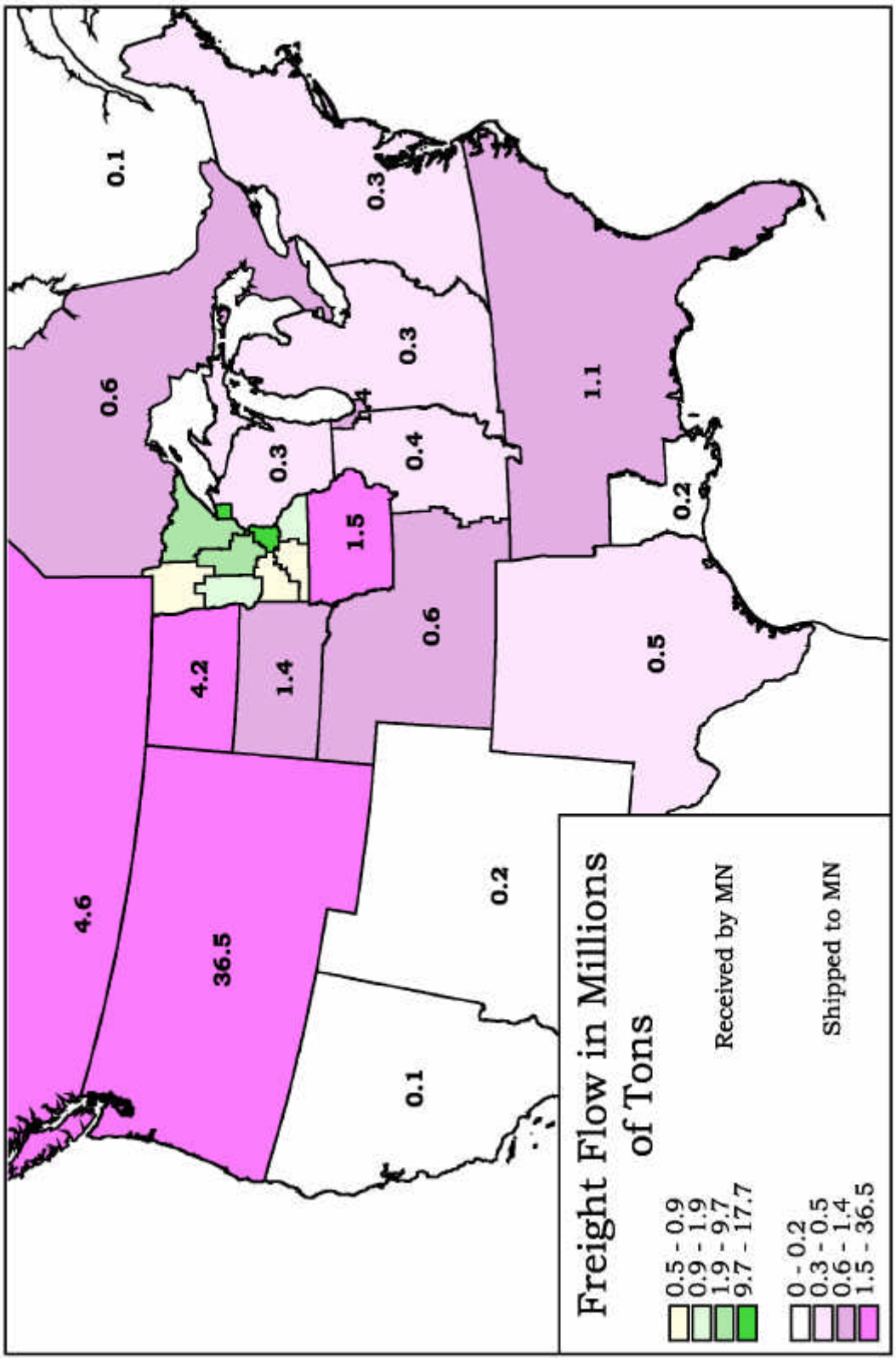


Figure D.19 Outbound Interstate Commodity Flow Weight by Rail

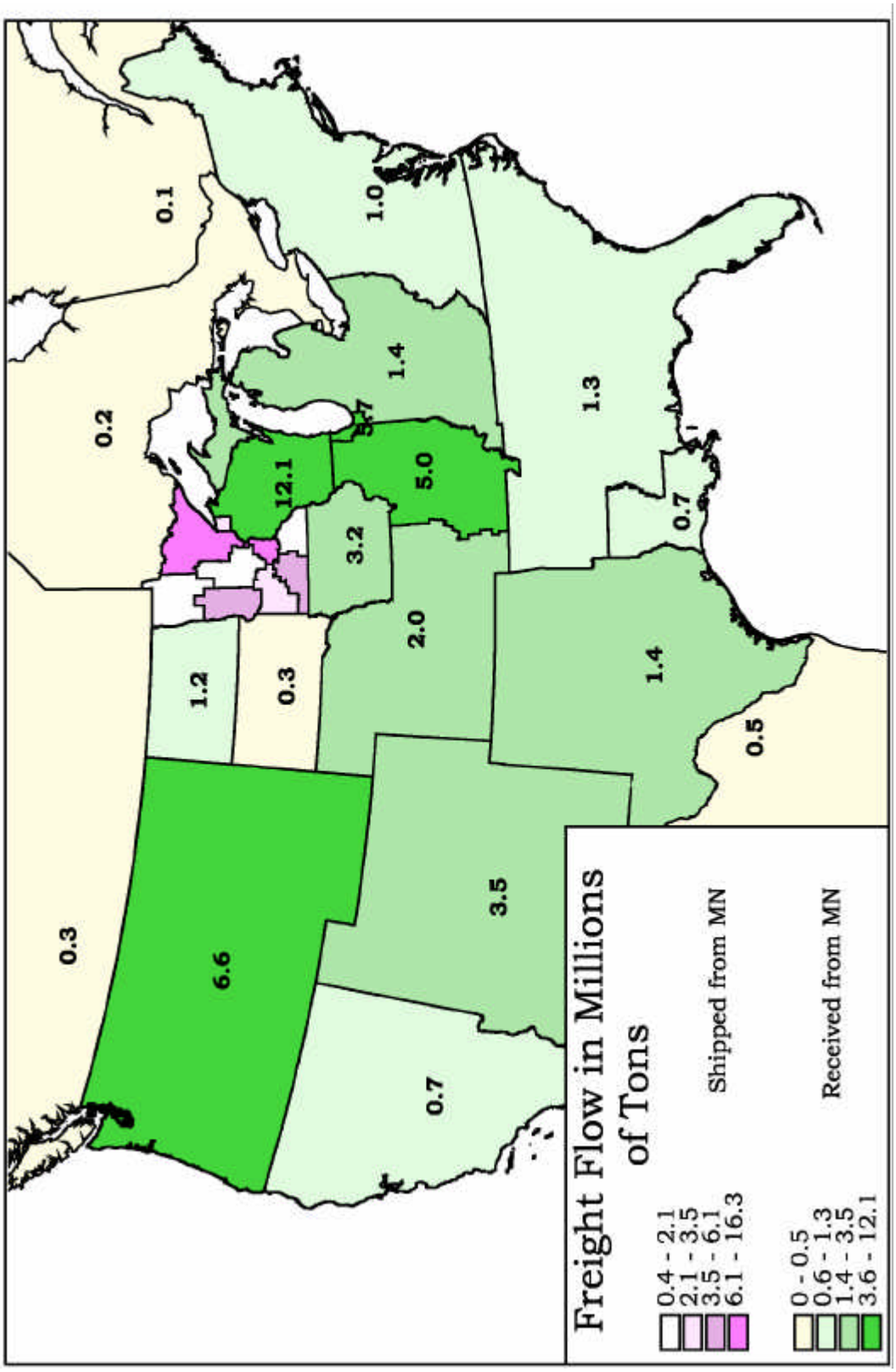


Figure D.20 Inbound Interstate Commodity Flow Value by Rail

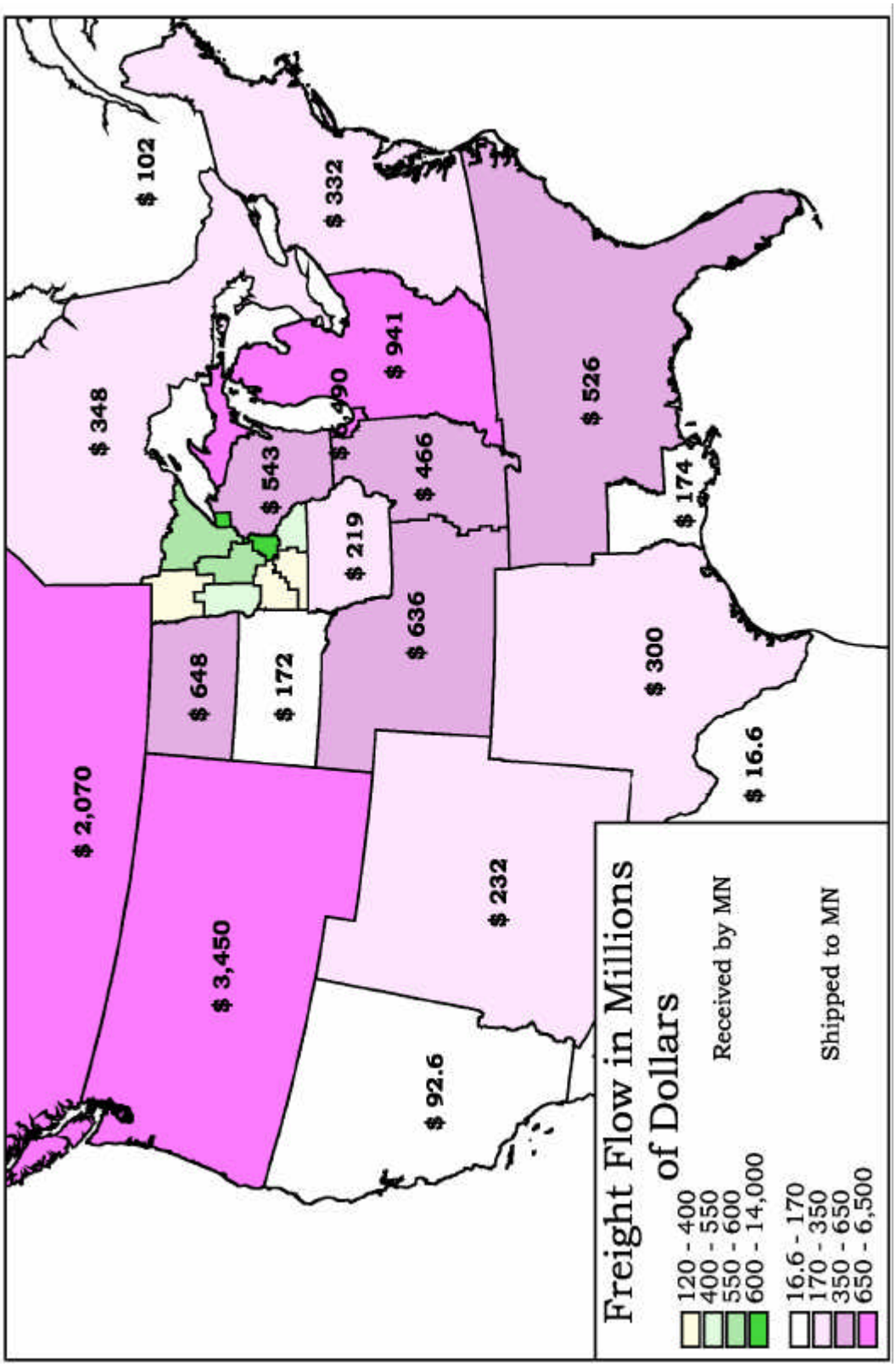


Figure D.21 Outbound Interstate Commodity Flow Value by Rail

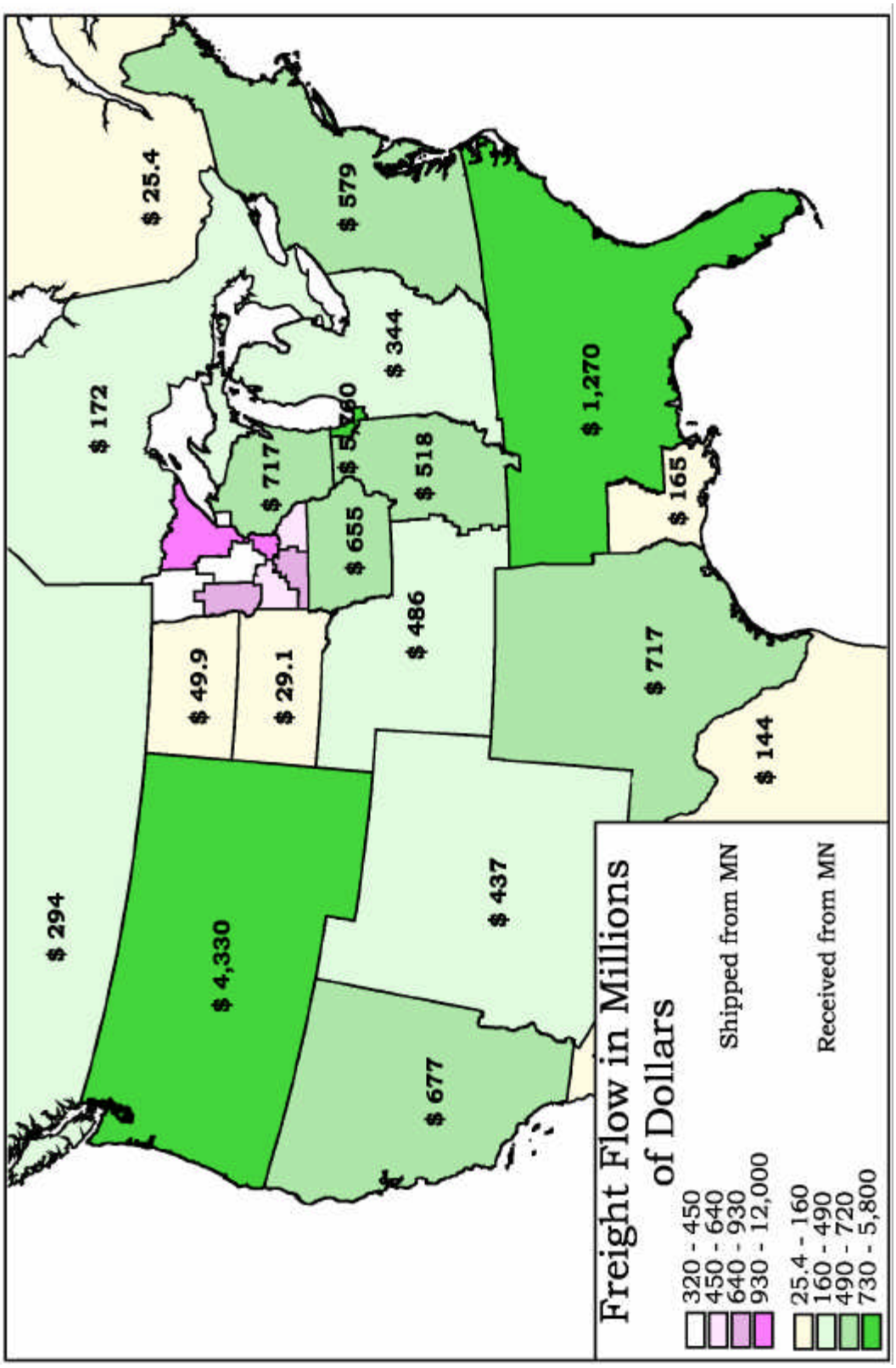
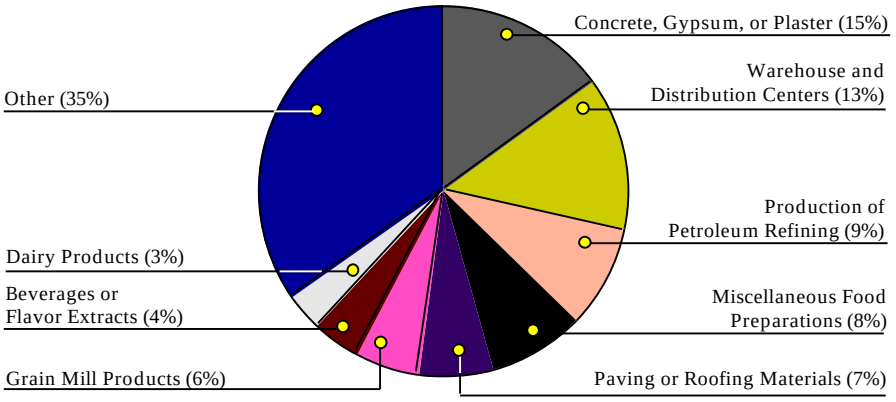


Figure D.22 Top Rail Commodities



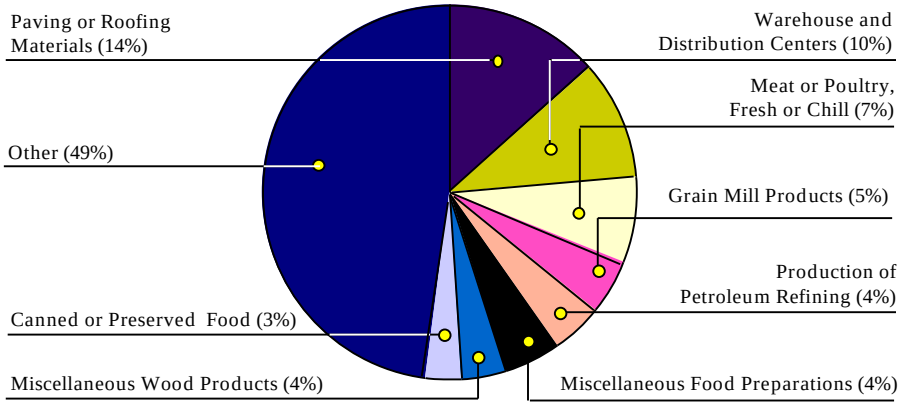


Figure D.23 Inbound Interstate Commodity Flow Weight by Water

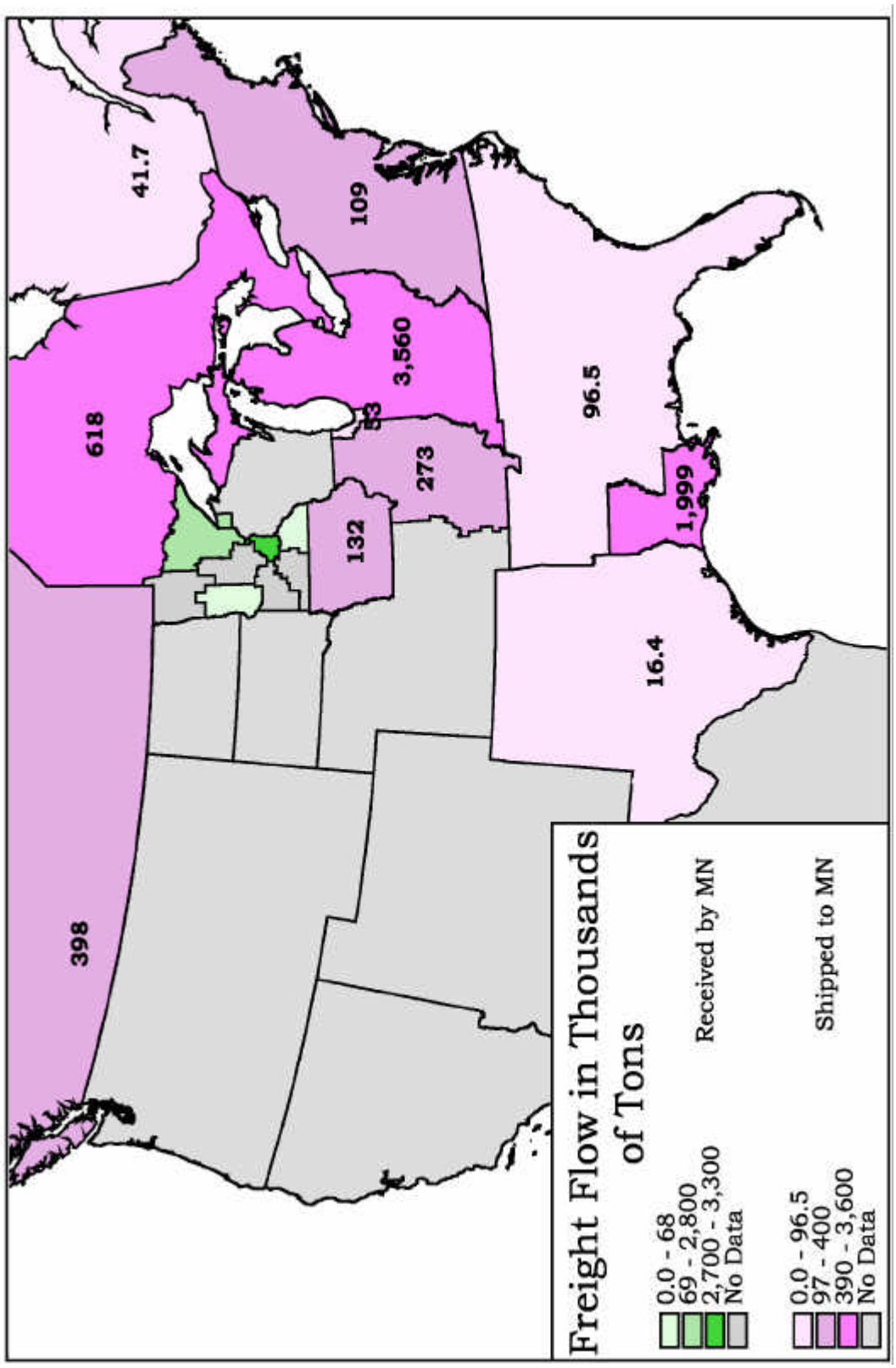


Figure D.24 Outbound Interstate Commodity Flow Weight by Water

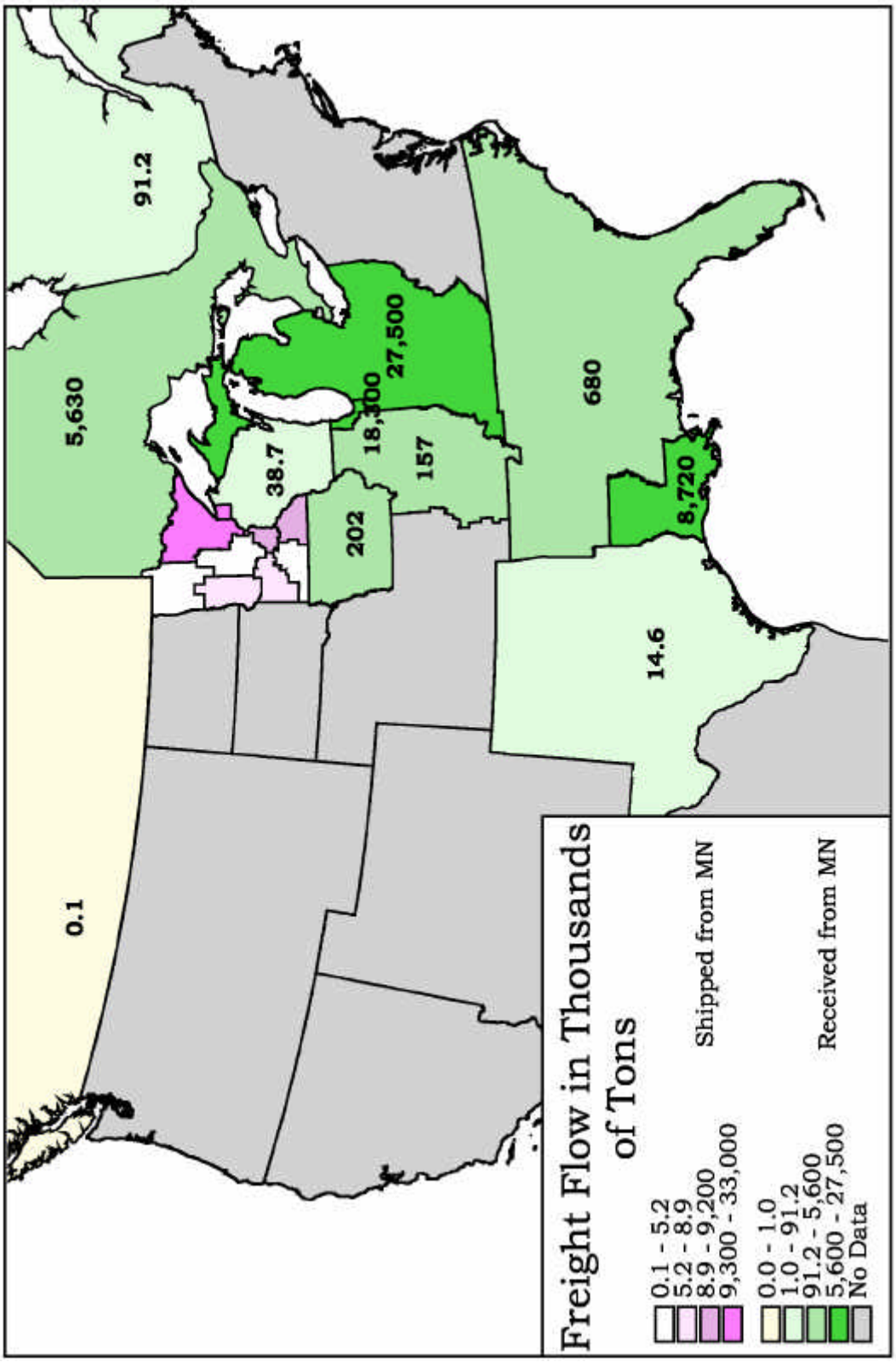


Figure D.25 Inbound Interstate Commodity Flow Value by Water

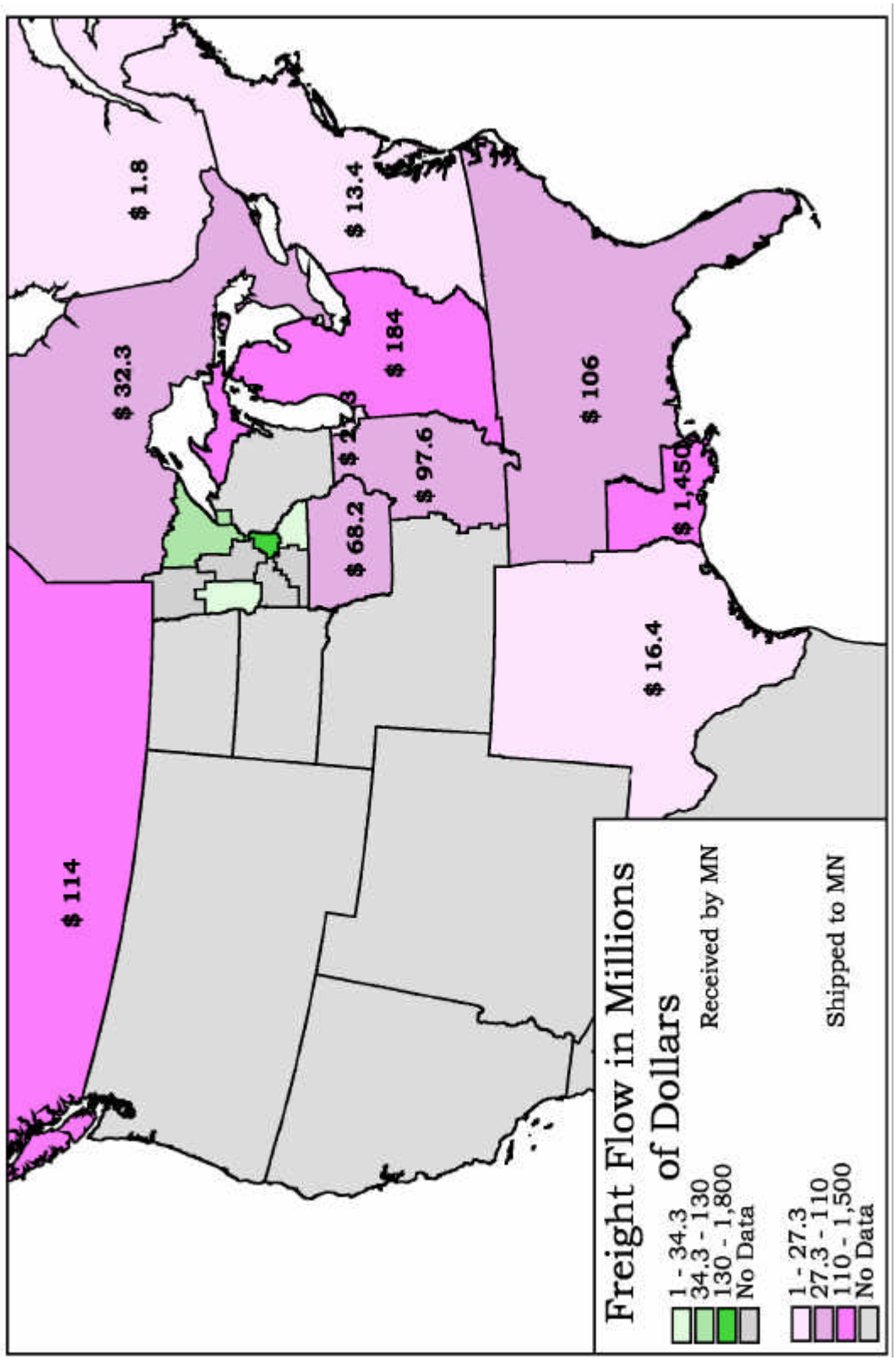


Figure D.26 Outbound Interstate Commodity Flow Value by Water

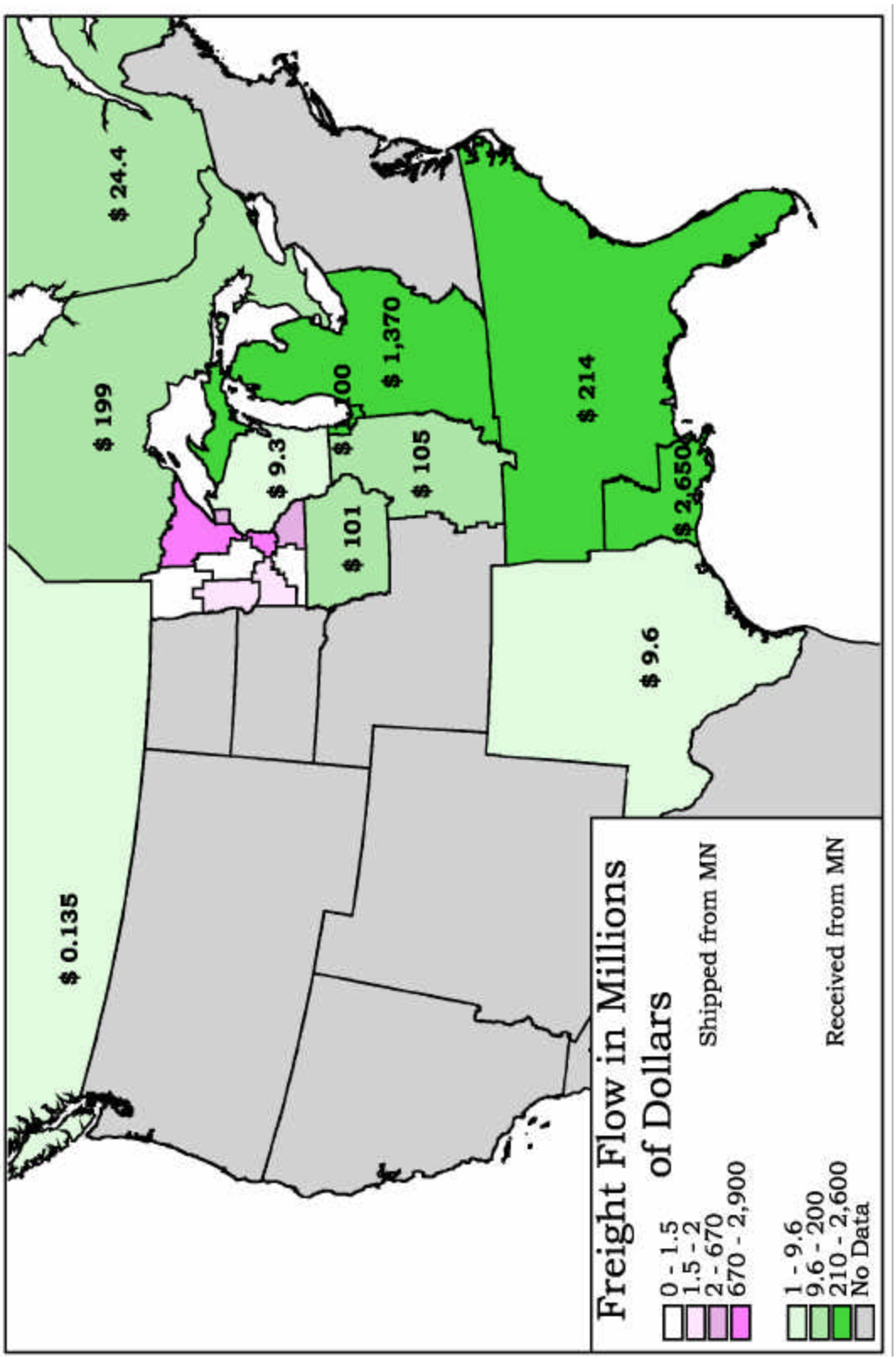


Figure D.27 Inbound Interstate Commodity Flow Weight by Air

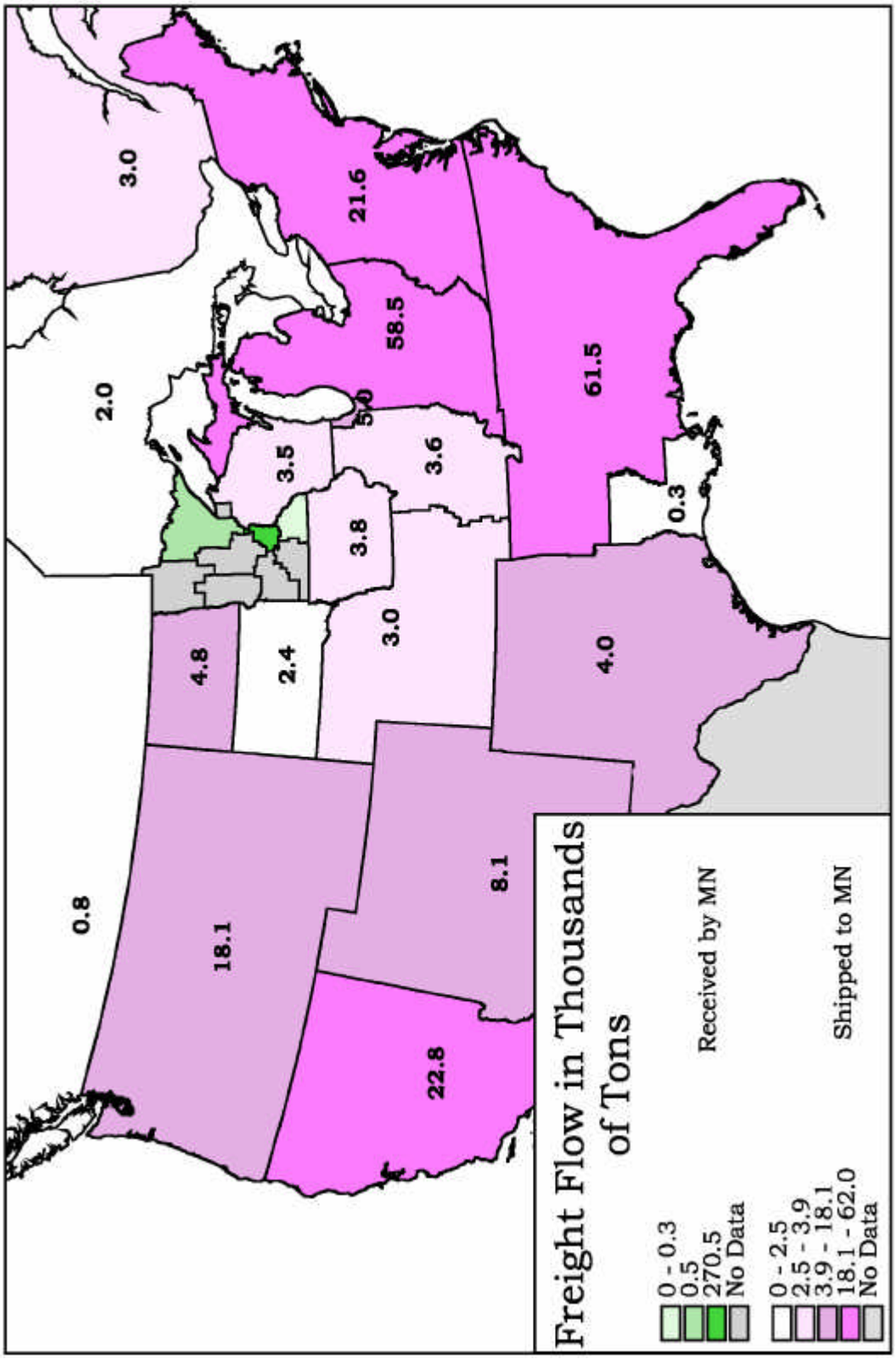


Figure D.28 Outbound Interstate Commodity Flow Weight by Air

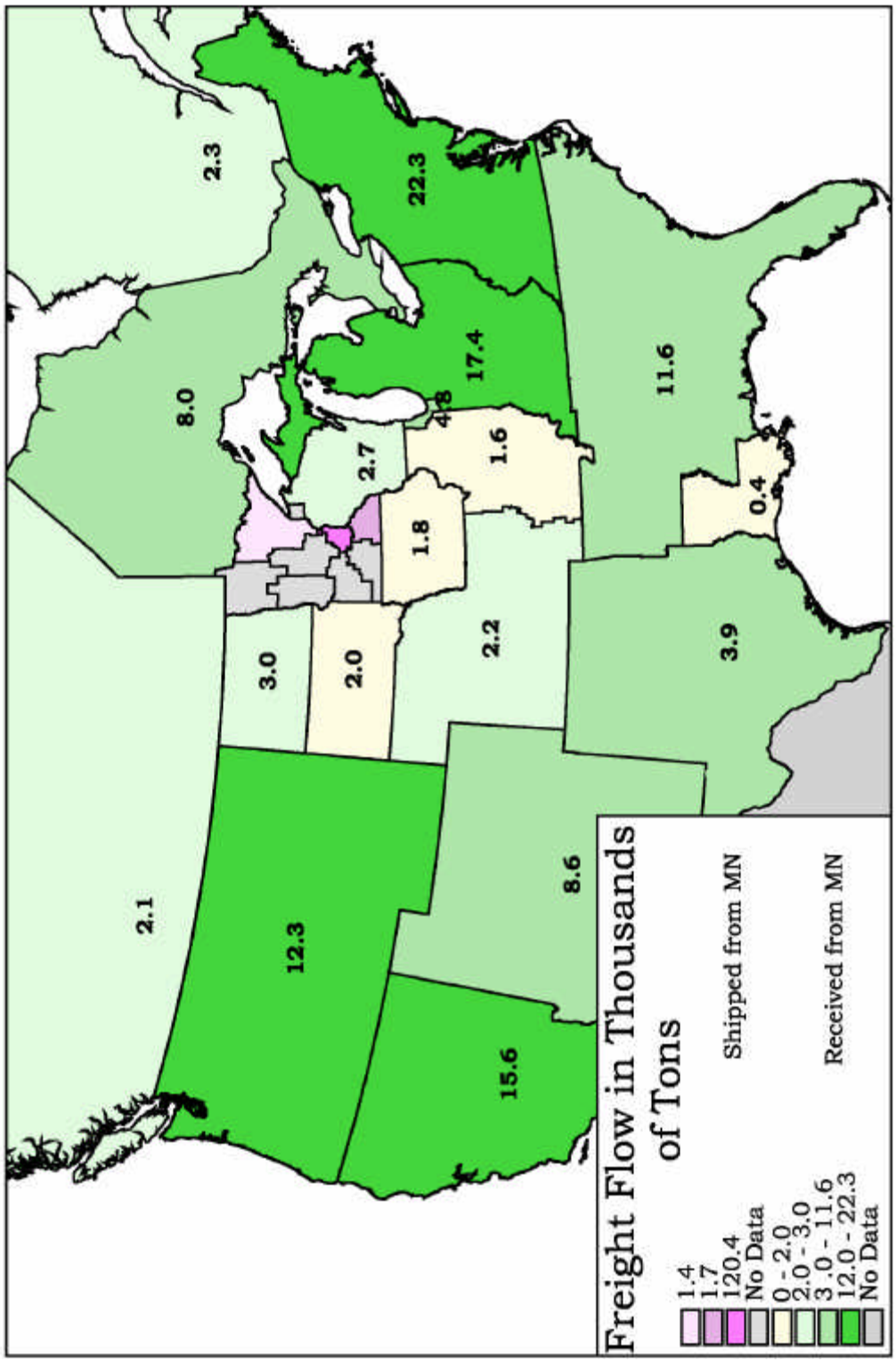


Figure D.29 Inbound Interstate Commodity Flow Value by Air

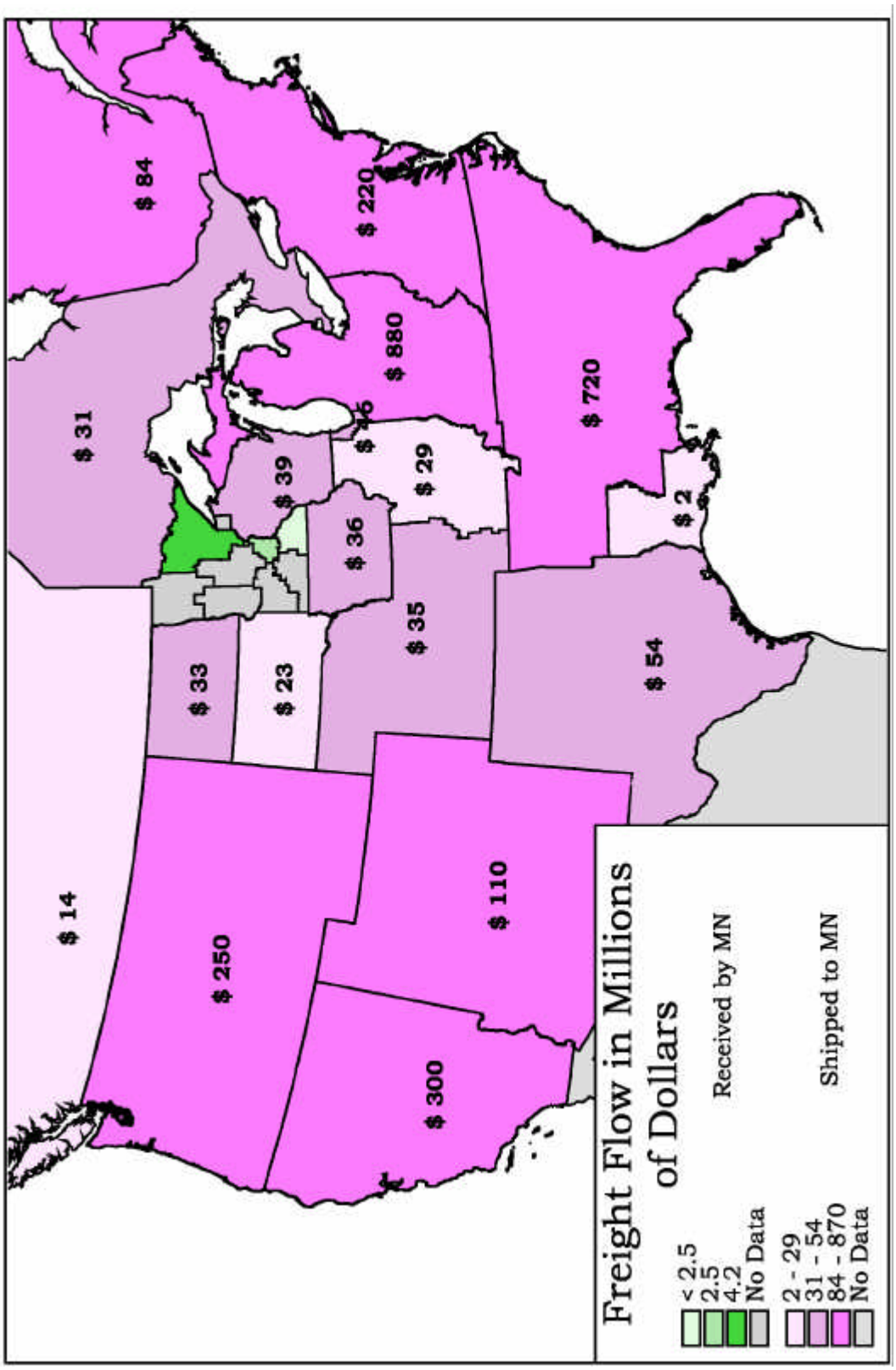


Figure D.30 Outbound Interstate Commodity Flow Value by Air

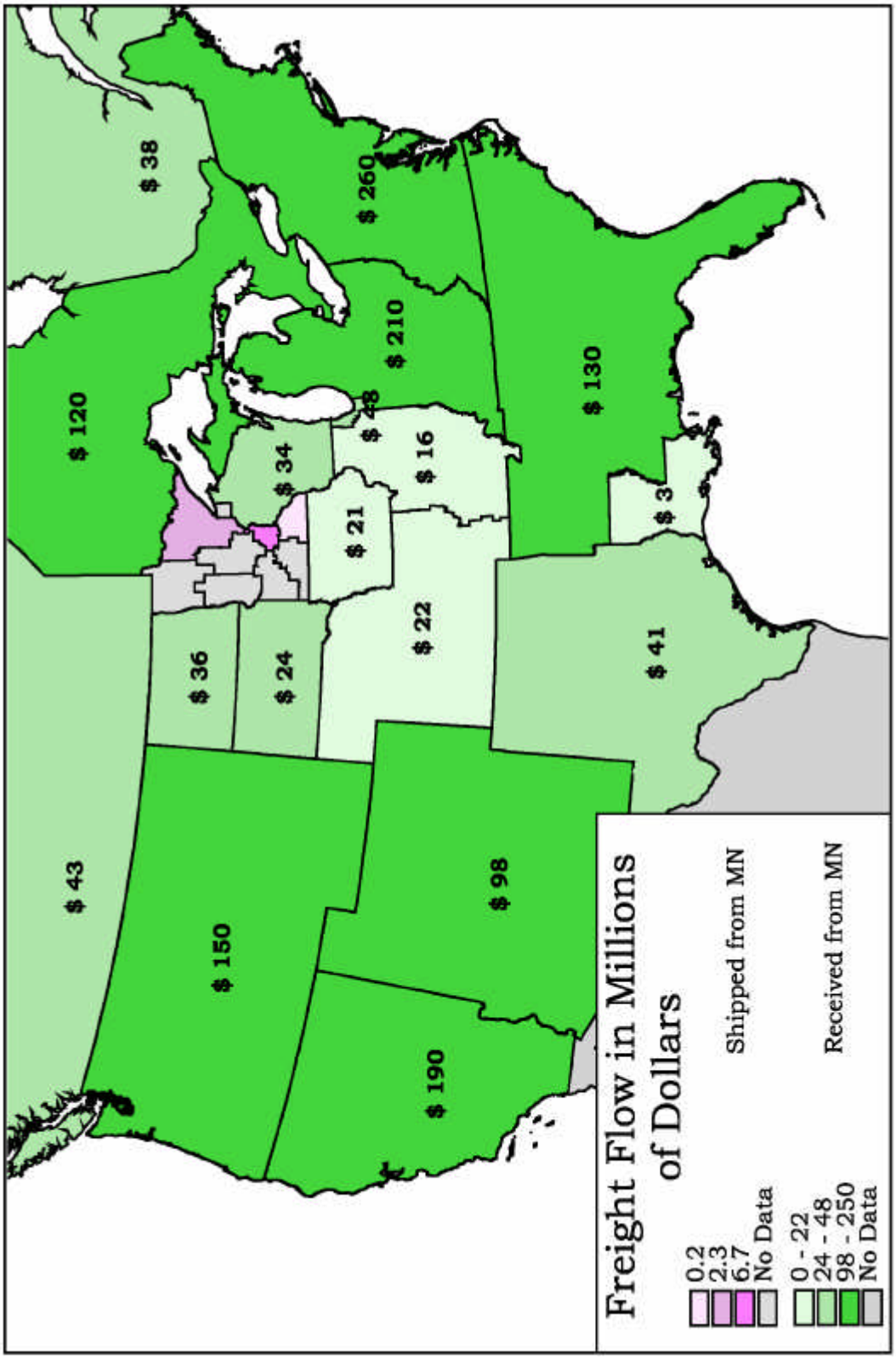


Figure D.31 Outbound Interstate Iron Ore Flows by Weight

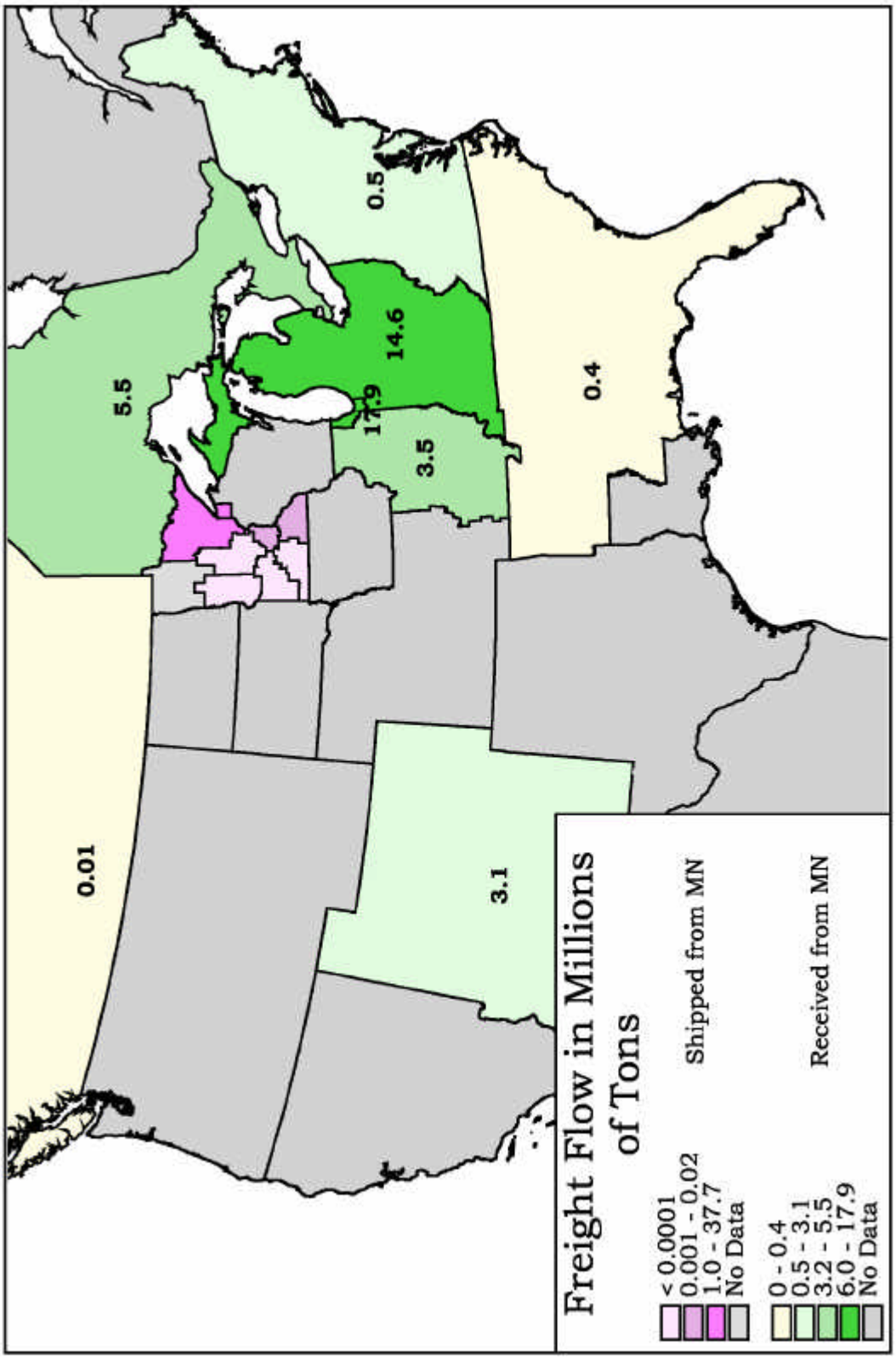


Figure D.32 Inbound Interstate Bituminous Coal Flows by Weight

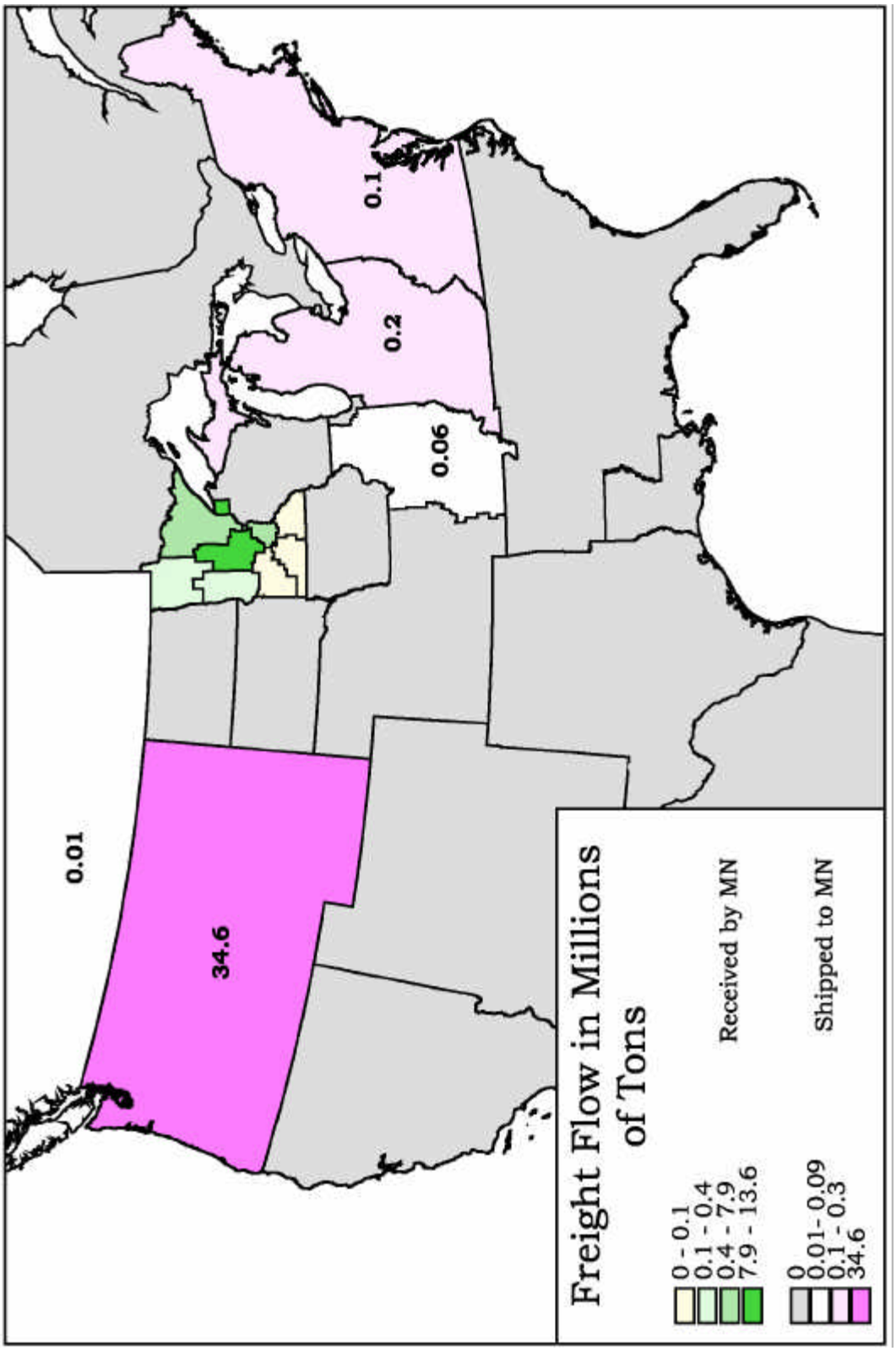


Figure D.33 Outbound Interstate Bituminous Coal Flows by Weight

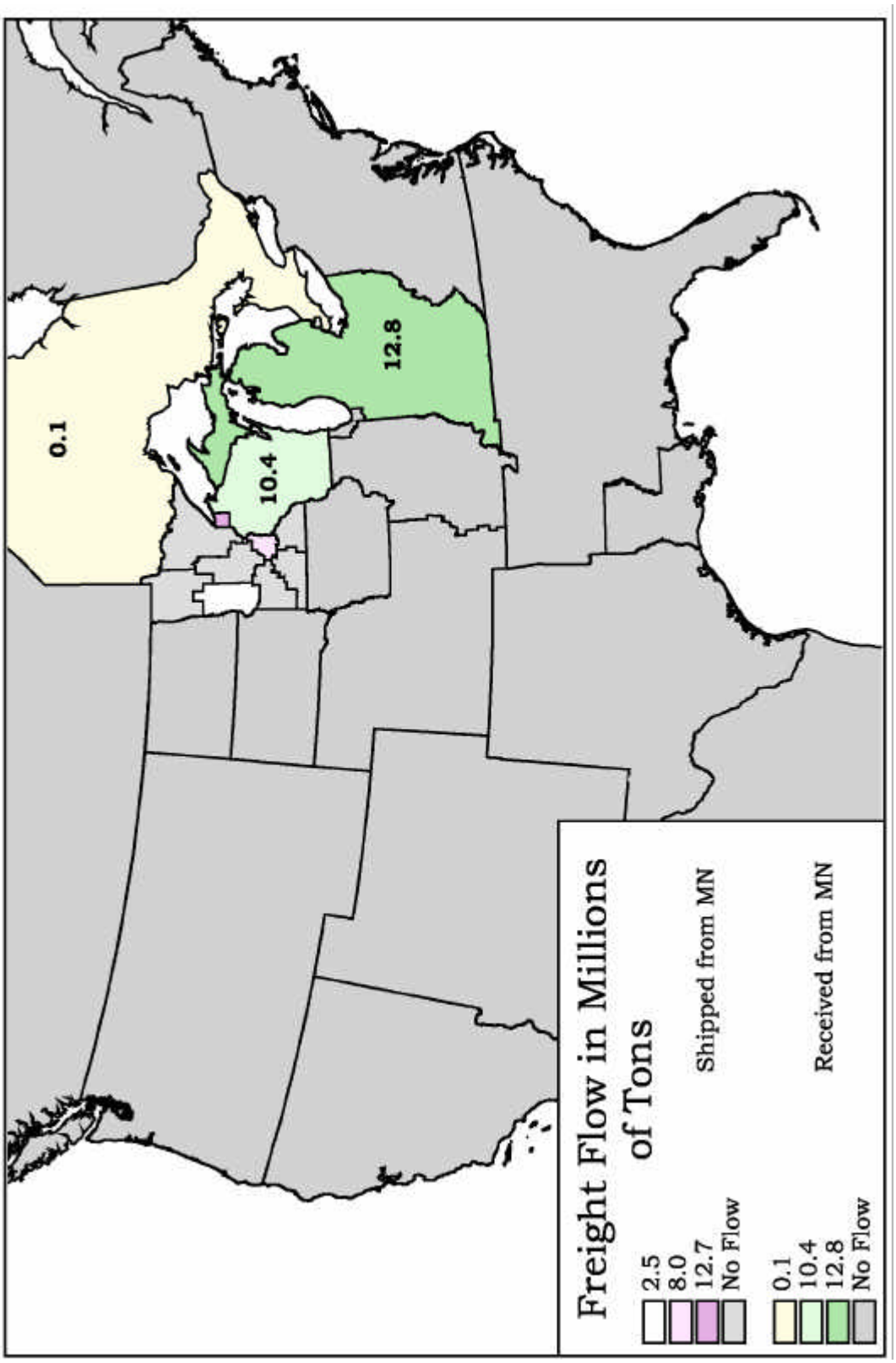


Figure D.34 Inbound Interstate Field Crops Flows by Weight

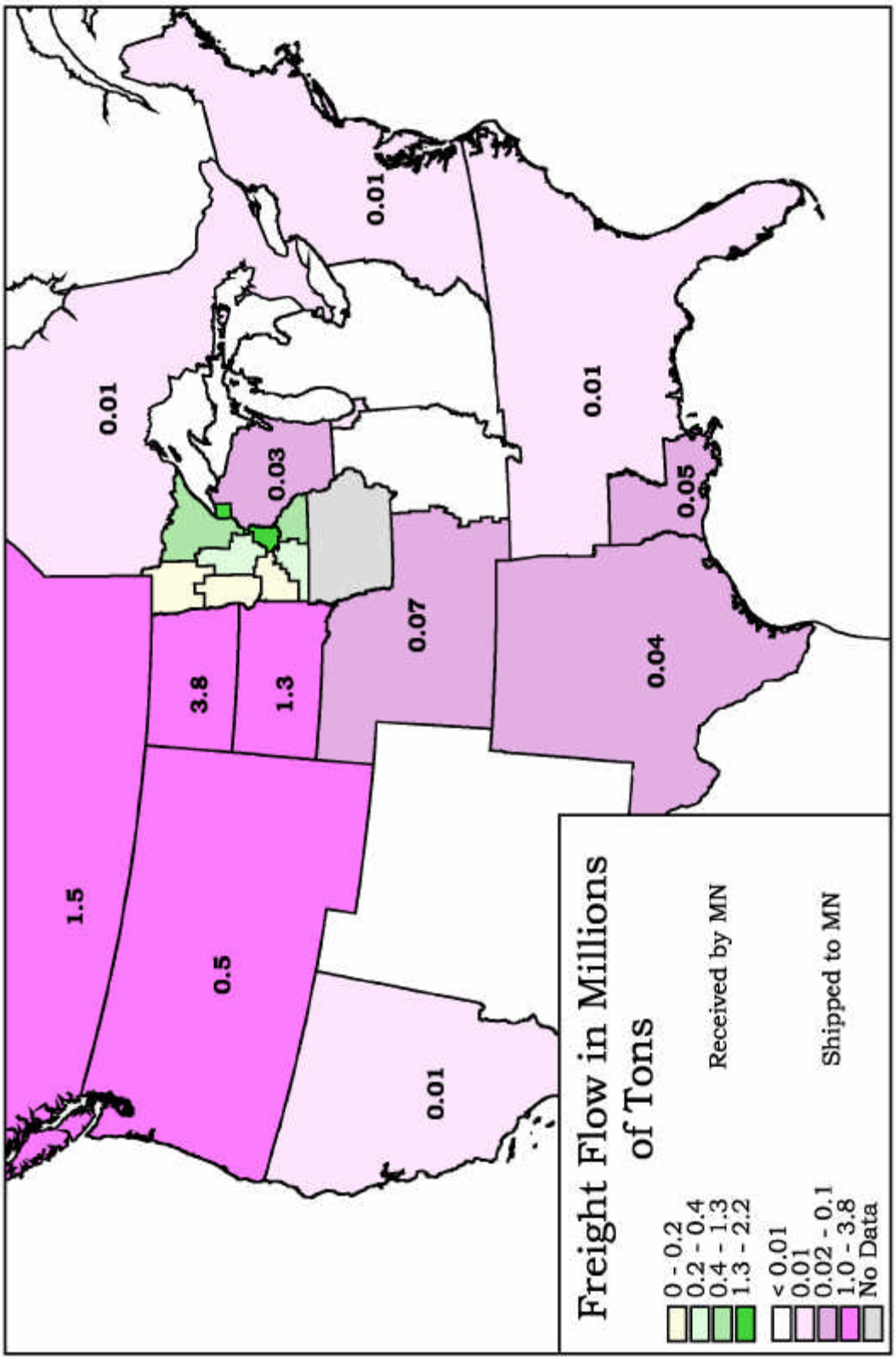


Figure D.35 Outbound Interstate Field Crops Flows by Weight

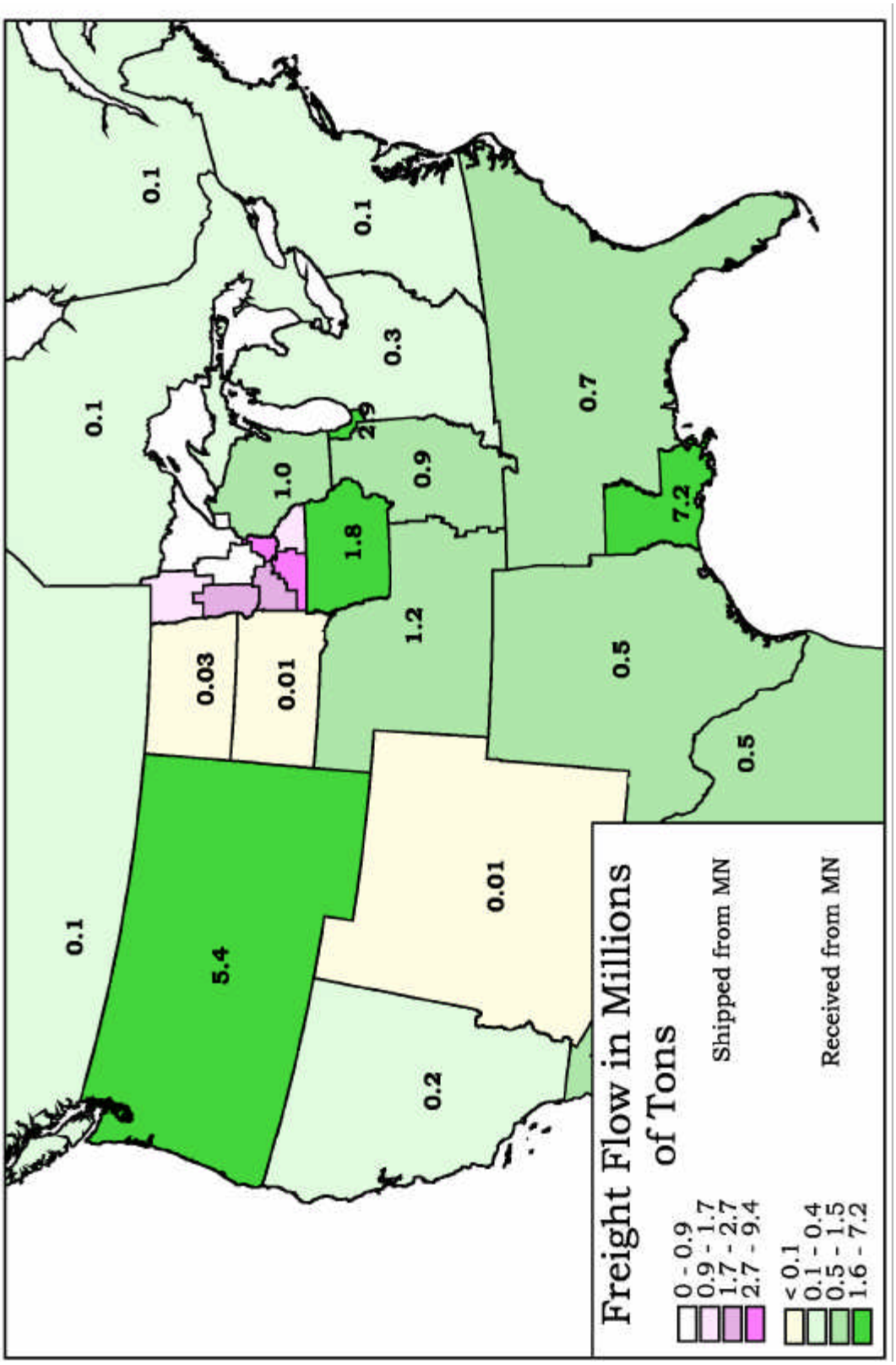


Figure D.36 Timber Movements in Northern Minnesota

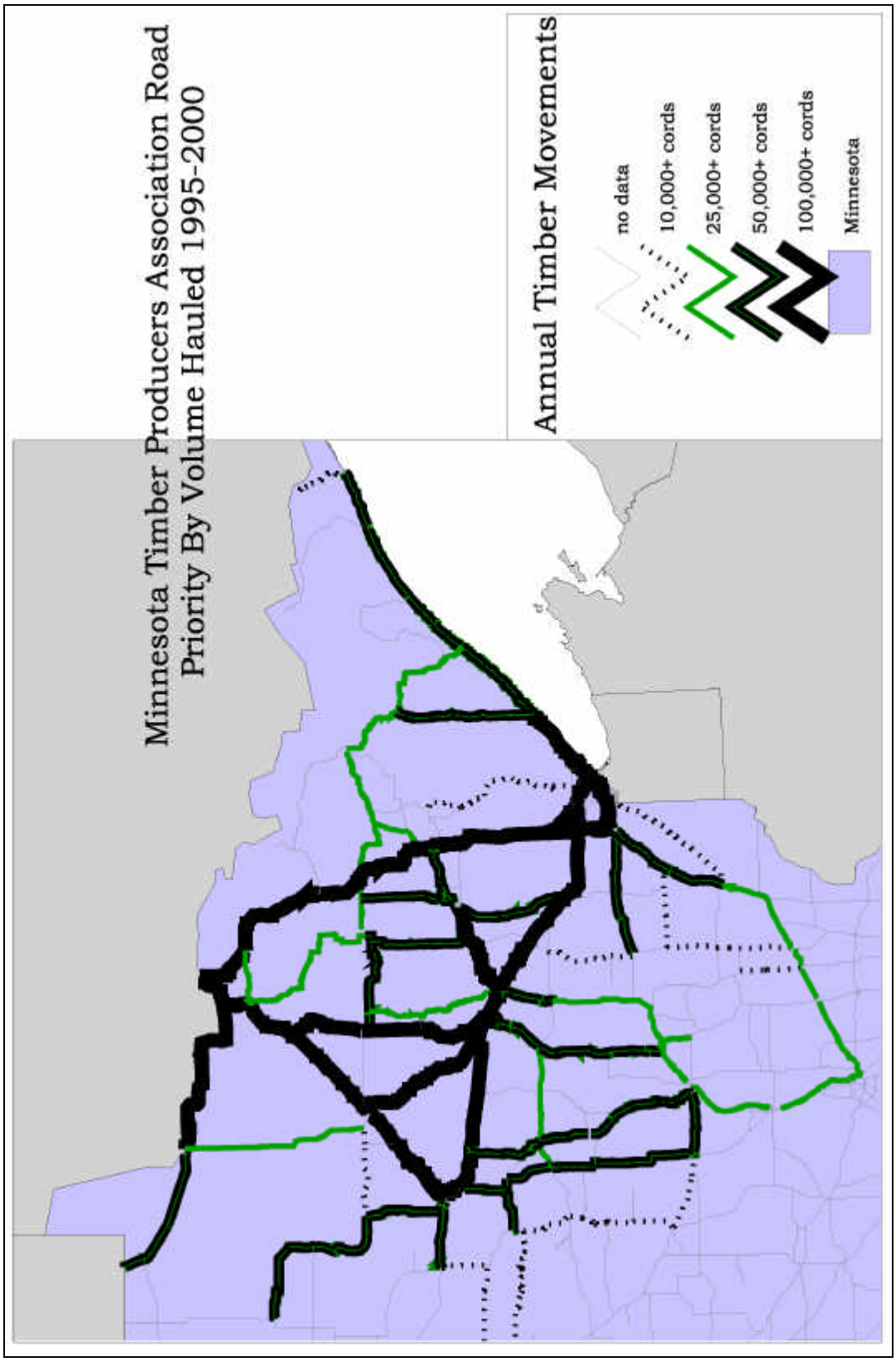


Figure D.37 Sugar Beet Movements in Northwest Minnesota

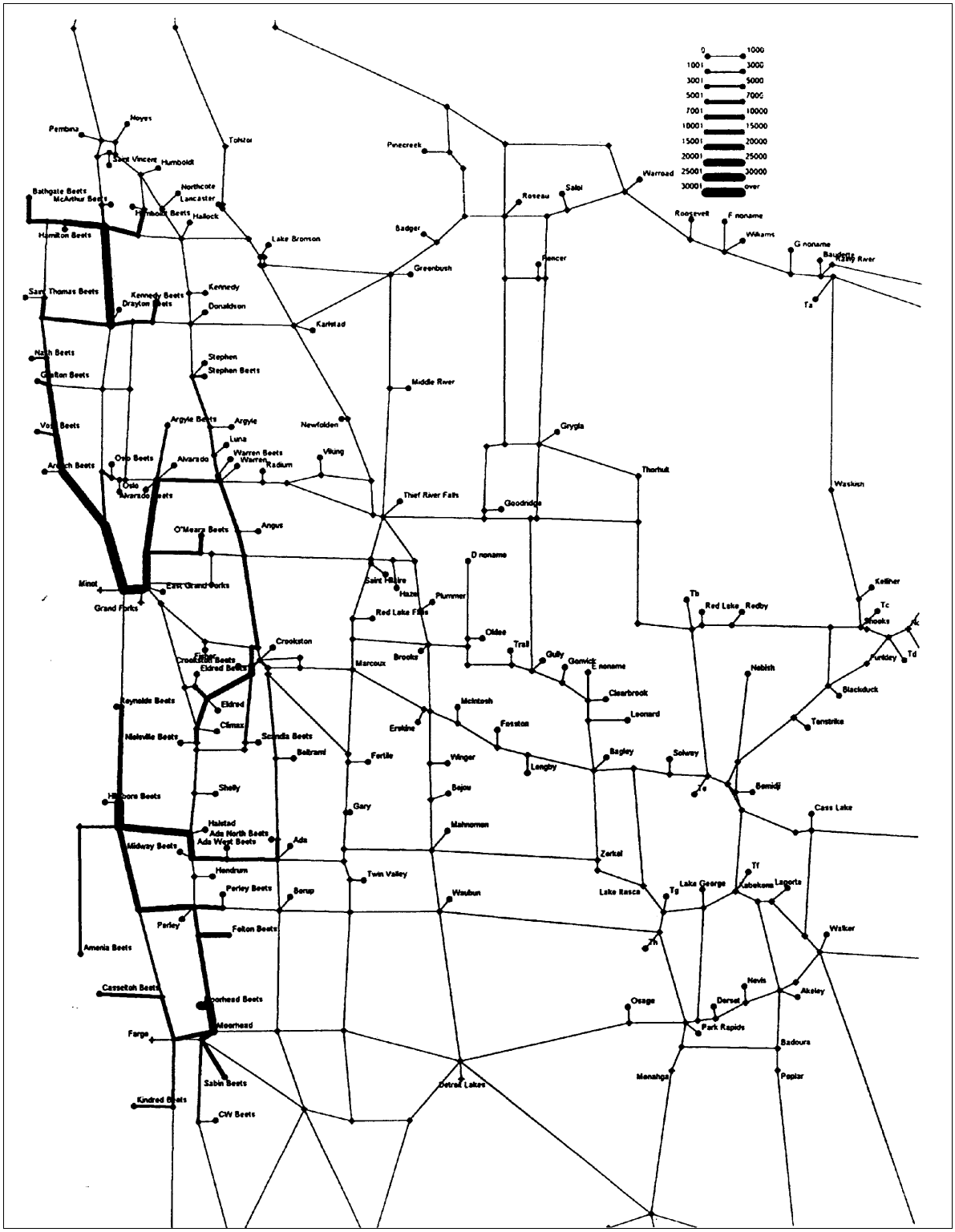


Figure D.38 Grain Movements in Northwest Minnesota

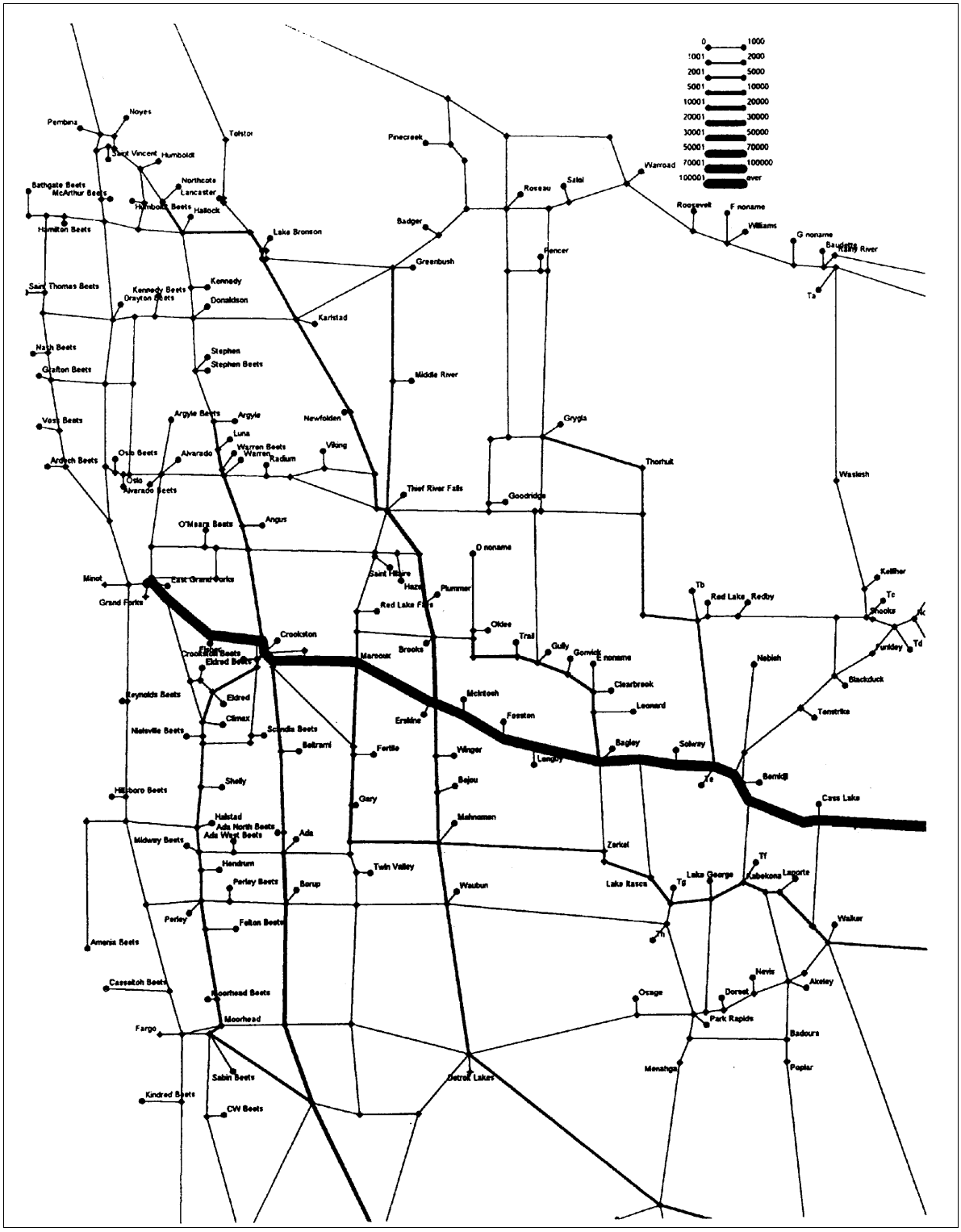


Figure D.39 Inbound Interstate Meat and Poultry Flows by Value

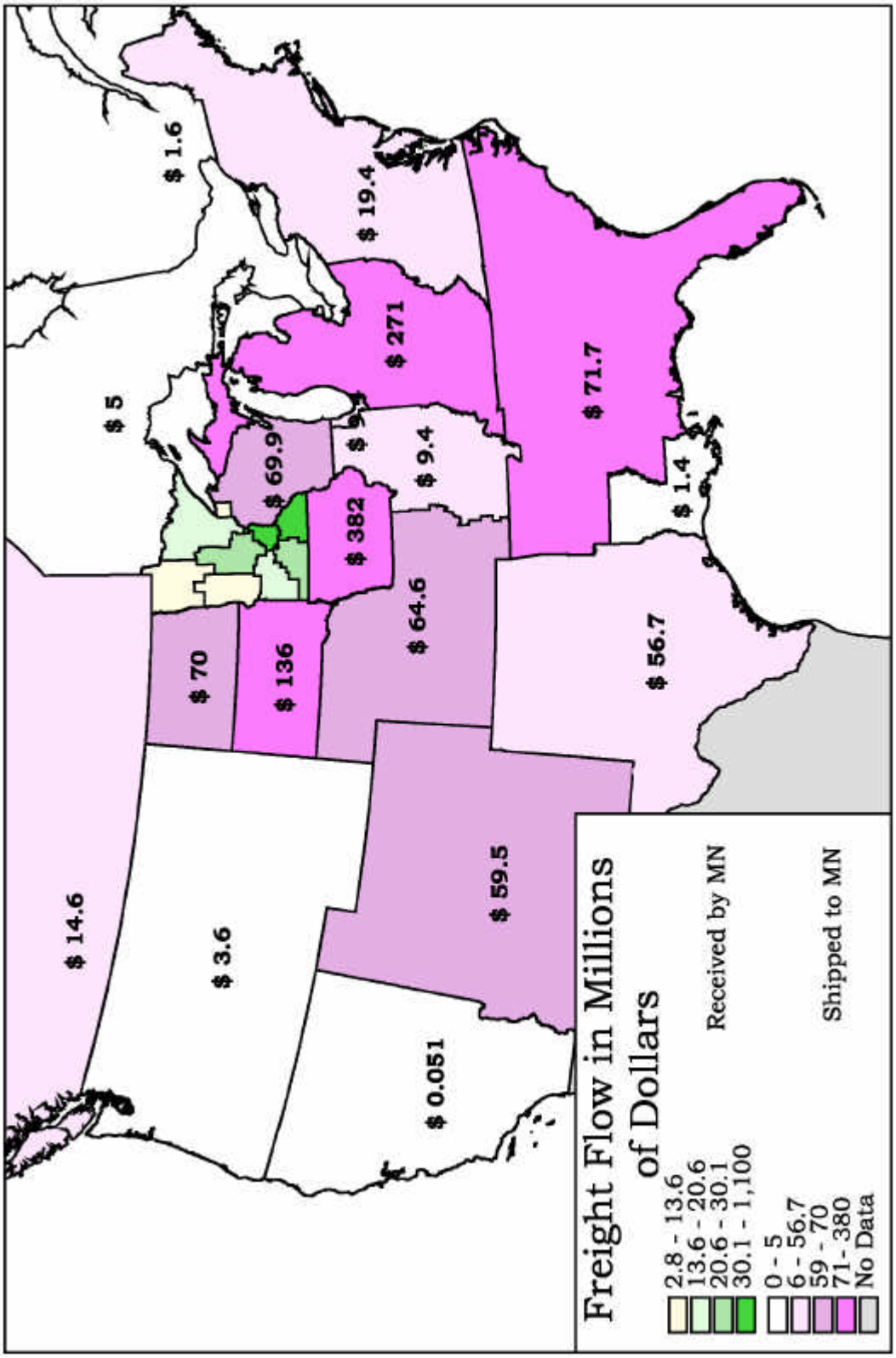


Figure D.40 Outbound Interstate Meat and Poultry Flows by Value

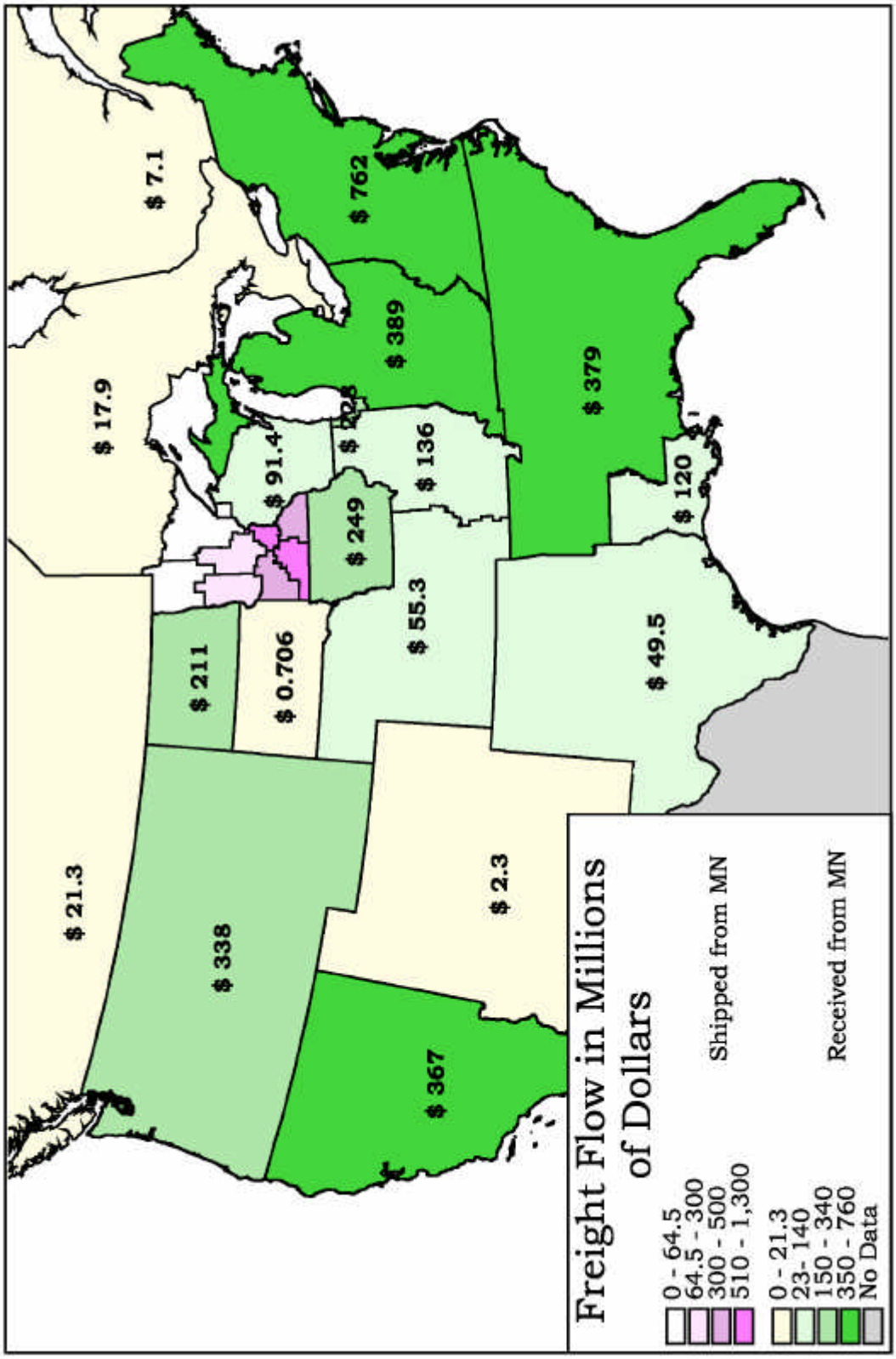


Figure D.41 Inbound Interstate Office Computers and Machines by Value

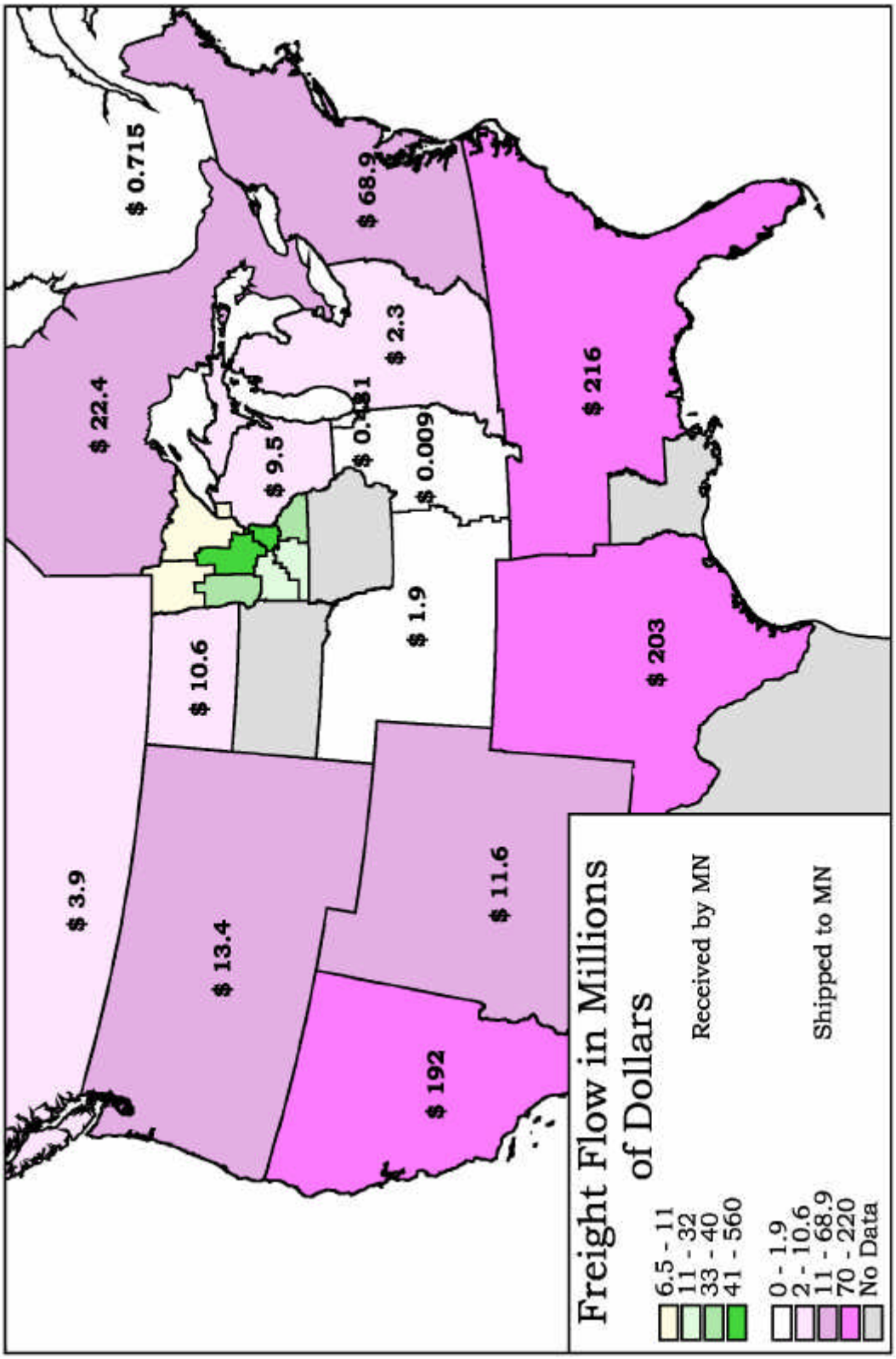


Figure D.42 Outbound Interstate Office Computers and Machines by Value

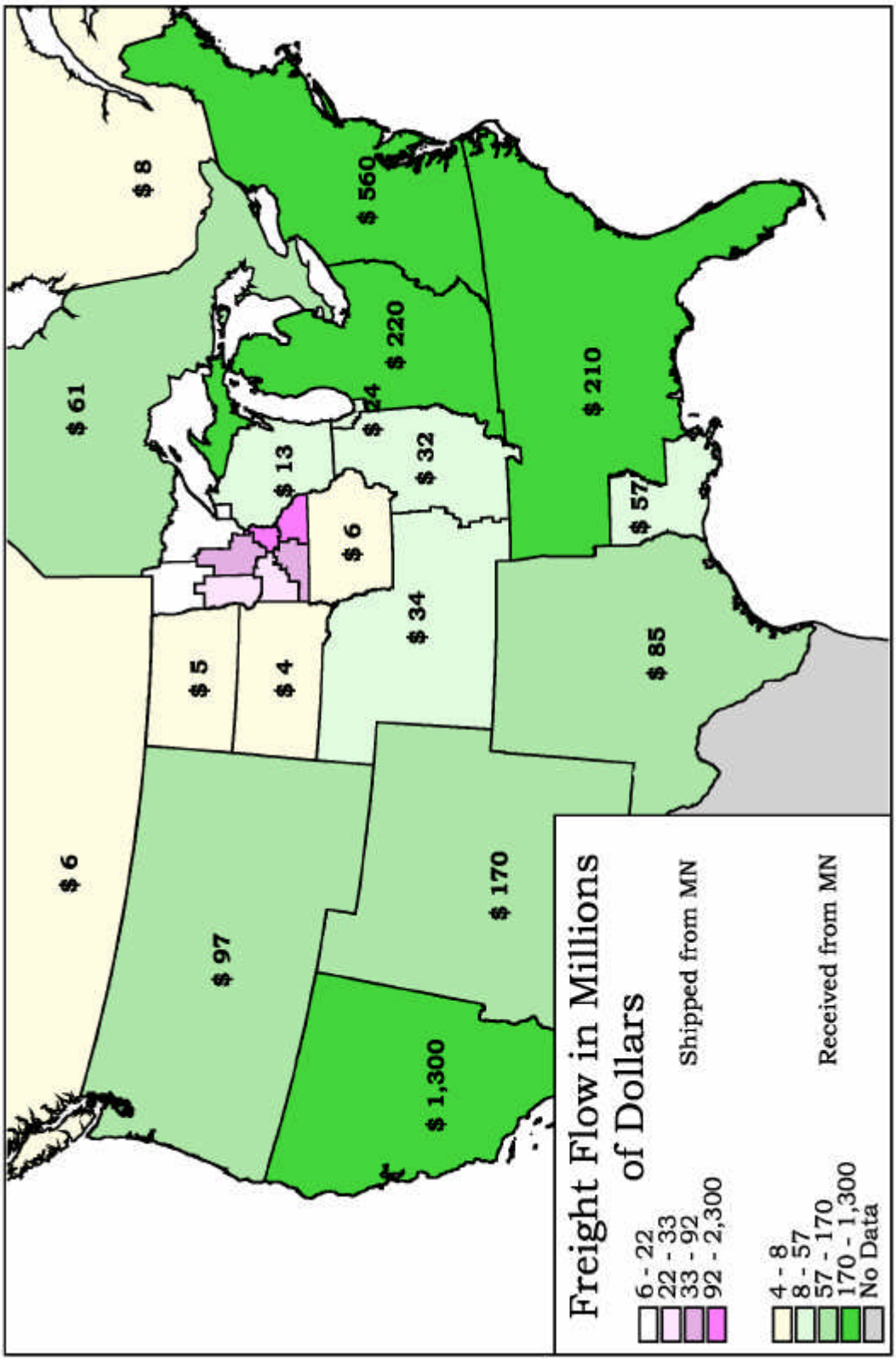


Figure D.43 Inbound Interstate Warehouse and FAK Flows by Value

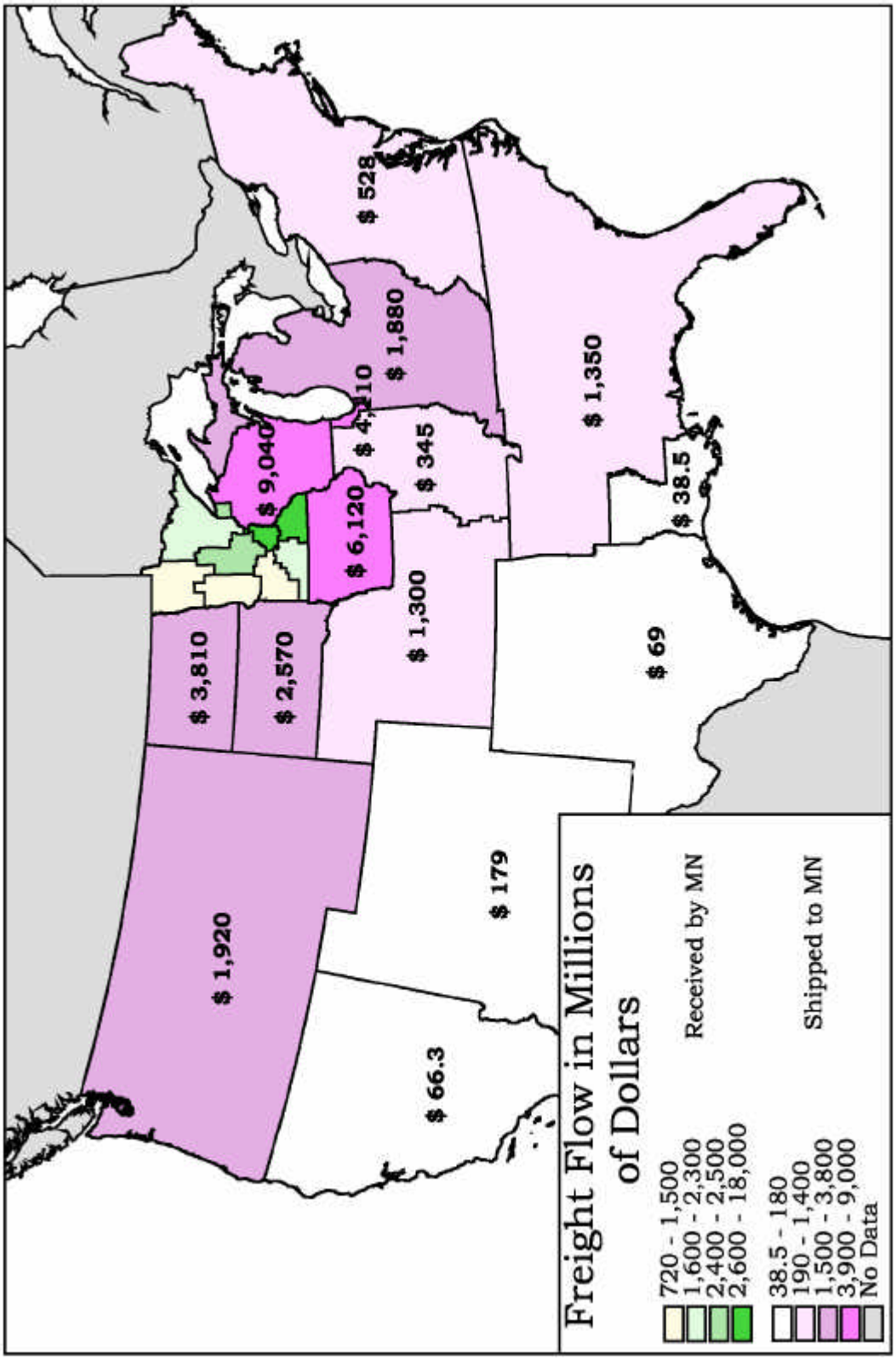


Figure D.44 Outbound Interstate Warehouse and FAK Flows by Value

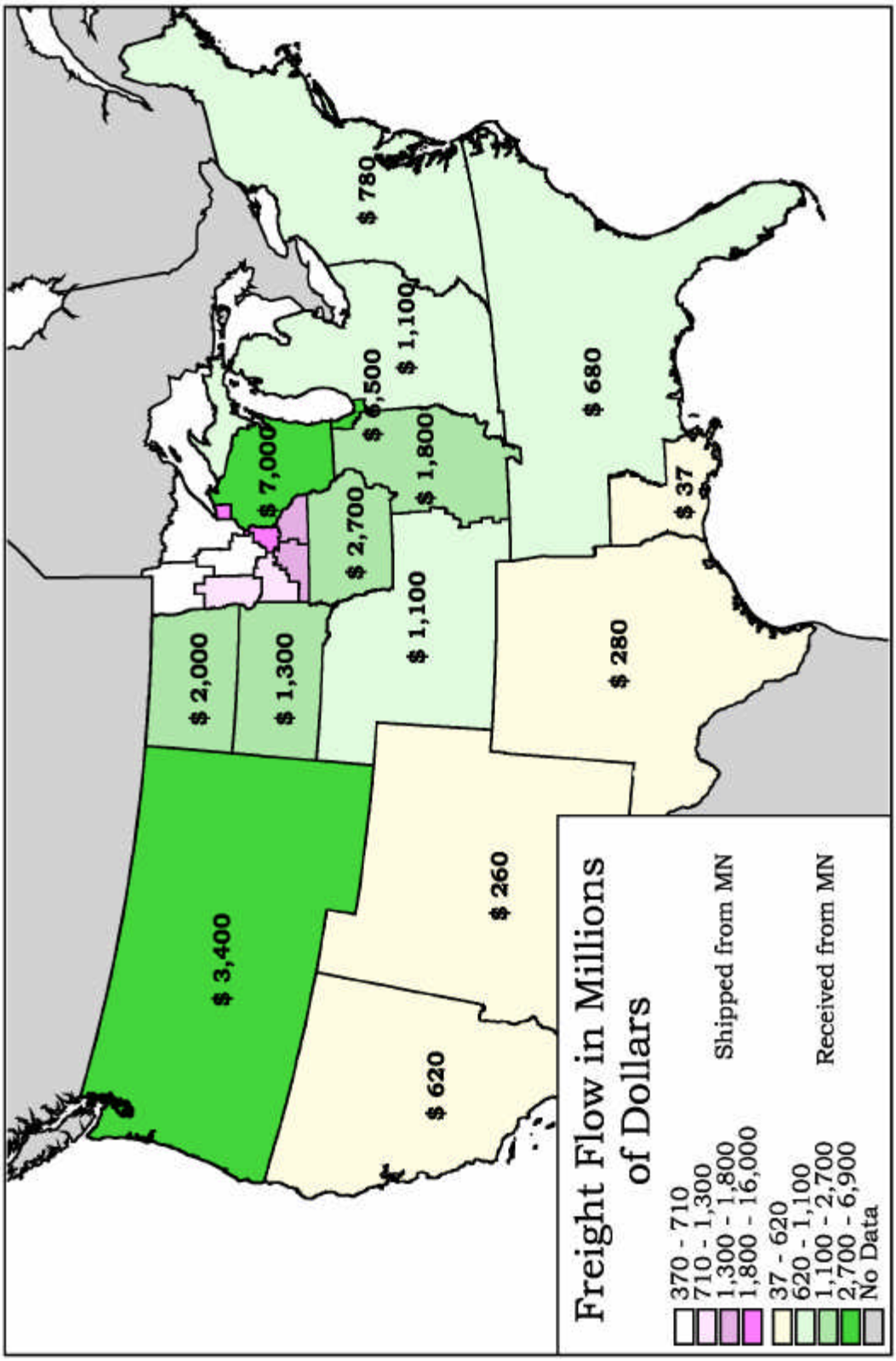


Table D.5 Interstate Commodity Flow Corridors

	Total	Truck		Rail		Water		Air	
Outbound Interstate by Weight									
Northwest	11,110,706	2,945,777	27%	8,147,288	73%	140	0%	17,501	0%
East	77,970,514	11,854,250	15%	20,232,114	26%	45,834,682	59%	49,468	0%
South	12,002,092	4,707,149	39%	7,070,573	59%	216,460	2%	7,910	0%
Southeast	18,868,708	2,318,139	12%	6,981,591	37%	9,555,427	51%	13,551	0%
Southwest	7,536,848	2,908,456	39%	4,602,253	61%	–	0%	26,139	0%
Northeast	6,209,472	383,574	6%	189,855	3%	5,628,077	91%	7,966	0%
	133,698,340	25,117,345	19%	47,223,674	35%	61,234,786	46%	122,535	0%
Inbound Interstate by Weight									
Northwest	51,096,891	5,464,643	11%	45,233,053	89%	398,433	1%	23,725	0%
East	14,587,025	8,358,140	57%	2,464,199	17%	3,761,632	26%	91,781	1%
South	9,261,397	6,523,110	70%	2,589,530	28%	148,757	2%	10,728	0%
Southeast	7,055,329	2,952,182	42%	1,730,988	25%	2,372,159	34%	65,416	1%
Southwest	3,606,613	1,903,183	53%	1,703,430	47%	–	0%	33,394	1%
Northeast	1,780,956	581,168	33%	580,224	33%	617,539	35%	2,025	0%
	87,388,210	25,782,425	30%	54,301,424	62%	7,298,520	8%	227,069	0%
Outbound Interstate by Value									
Northwest	$10,592,958,632	$ 5,291,502,717	50%	$ 4,376,419,393	41%	$ –	0%	$ 185,626,417	2%
East	31,613,547,210	28,805,362,963	91%	7,395,613,915	23%	2,486,408,507	8%	549,937,978	2%
South	14,284,768,352	12,300,944,023	86%	1,858,117,808	13%	110,920,861	1%	85,351,648	1%
Southeast	17,812,845,381	8,140,405,103	46%	1,950,450,376	11%	2,967,773,164	17%	149,225,128	1%
Southwest	11,934,210,179	8,128,198,796	68%	1,143,111,064	10%	–	0%	312,959,892	3%
Northeast	N/A	N/A		N/A		N/A		N/A	
	$86,238,329,753	$62,666,413,601	73%	$16,723,712,556	19%	$5,565,102,533	6%	$1,283,101,063	1%
Inbound Interstate by Value									
Northwest	$10,954,520,021	$6,973,097,740	64%	$4,099,451,395	37%	$ –	0%	$280,969,557	3%
East	33,962,874,731	27,833,961,261	82%	8,309,161,419	24%	224,985,586	1%	1,184,552,716	3%
South	17,077,030,077	15,827,072,656	93%	1,154,422,786	7%	84,583,786	0%	126,323,812	1%
Southeast	13,686,051,659	8,691,793,902	64%	1,164,860,107	9%	1,657,535,082	12%	754,602,635	6%
Southwest	7,818,374,853	6,981,402,783	89%	496,522,840	6%	–	0%	437,107,579	6%
Northeast	N/A	N/A		N/A		N/A		N/A	
	$86,282,407,640	$66,307,328,342	79%	$15,224,418,547	18%	$1,967,104,453	2%	$2,783,556,299	3%

Figure D.45 Top Inbound Interstate Commodity Flow Corridors by Value

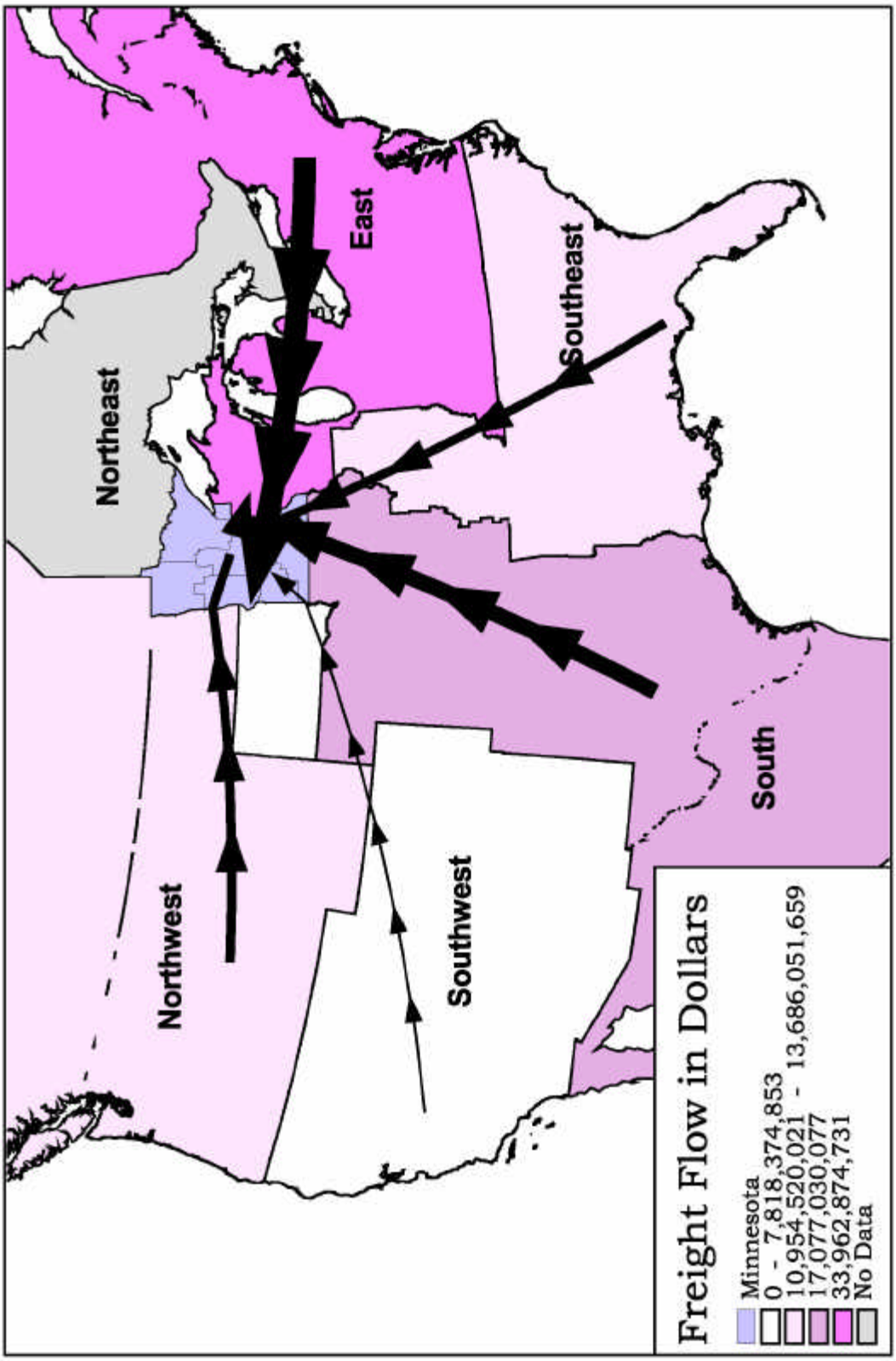
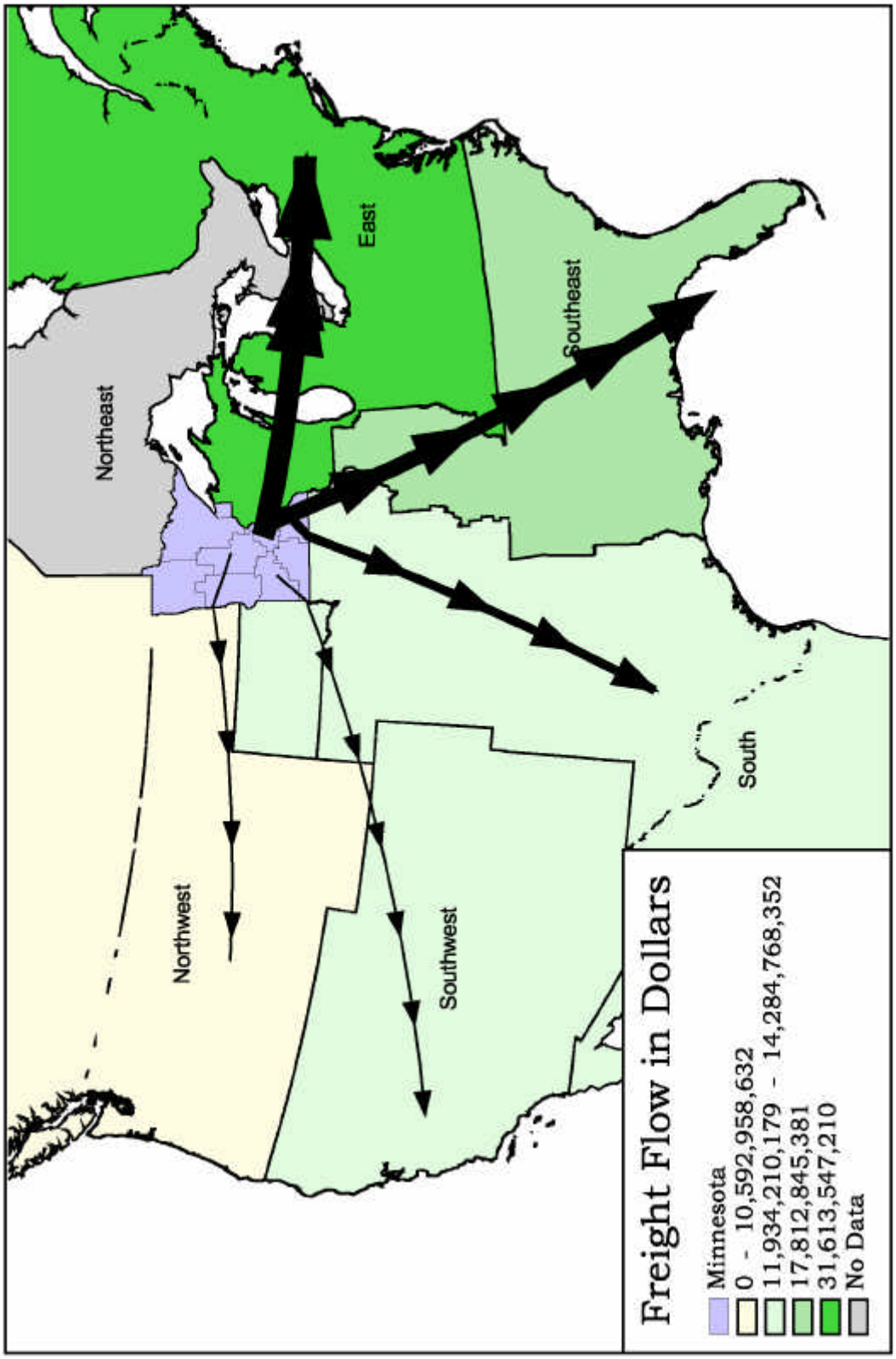


Figure D.46 Top Outbound Interstate Commodity Flow Corridors by Value



Appendix E

Interviews

Interviews

District	Company Name	City
metro	Allied Systems	Cottage Grove
8	Artesyn	Redwood Falls
	BNSF	Fort Worth, TX
1	Boise-Cascade Paper Division	International Falls
metro	C. H. Robinson Co.	Eden Prairie
metro	CAMAS Inc.	Eagan
	Canadian Pacific	
metro	Cargill	Minnetonka
metro	Cenex / Harvest States	Inver Grove Heights
	CN \ IC	
4	Dakota Growers & Sky Logistics	Fargo
	Dakota, Minnesota & Eastern (DM&E)	Brookings, SD
metro	Dart Transit	Eagan
metro	Dedicated Logistics Inc.	Roseville
4	Drayton Food Processors	Fargo
6	Fil-Mor Express, Inc.	Cannon Falls
3	Fingerhut	St. Cloud
metro	Ford Motor Company	St. Paul
metro	FreightMasters, Inc.	Eagan
3	Frigidaire Home Prod	St. Cloud
	Hub Group	Lombarg, IL
7	Hubbard Feeds Inc	Mankato
8	Hutchinson Technology Inc	Hutchinson
	Iowa & Minnesota Rail Link (IMRL)	Davenport, IA
	J.B.Hunt	Lowell, AR
8	Kraft Foods	New Ulm
1	Lake Superior Paper Industries	Duluth
metro	Land O' Lakes, Inc.	Arden Hills
3	Lofgren Trucking Service, Inc.	Rush City
1	Marvin Windows & Doors	Warroad
metro	Medtronic, Inc.	Minneapolis
metro	Metropolitan Airports Commission	Bloomington
metro	Metropolitan Council	Wayzata
8	Minnesota Corn Processors	Marshall
metro	Minnesota Department of Transportation	St. Paul
metro	Minnesota Department of Transportation	Roseville
metro	Minnesota Grain and Feed Assoc	Minneapolis
metro	Minnesota Trucking Association	St. Paul
metro	Murphy Warehouse Company	Minneapolis
metro	Northwest Cargo Sales	Minneapolis
1	Potlatch Corp	Cloquet
metro	Schanno Transportation, Inc.	West St. Paul

District	Company Name	City
8	Schwan's Sales Enterprises Inc	Marshall
1	Seaway Port Authority	Duluth
8	Seneca Foods Corp.	Glencoe
6	Sheldahl Inc	Northfield
1	Superior Midwest Energy Terminal	Superior
metro	Supervalu Stores Inc	Hopkins
metro	Target Stores	Minneapolis
metro	Transport Corporation of America, Inc.	Eagan
metro	TRANSX, LTD.	Eagan
	Twin Cities & Western (TC&W)	Glencoe
metro	Twin Modal, Inc.	Roseville
	Union Pacific	
metro	United Parcel Service	Minneapolis
metro	Upper River Services	St. Paul
metro	Vitran Express (formerly Quast)	Mounds View
4	West Central Turkeys Inc	Pelican Rapids
	Wisconsin Central (WC)	Rosemont, IL

Appendix F

Correlation of Commodity Flows to IRC Corridors

Correlation of Commodity Flows to IRC Corridors

An important step in evaluating freight flow corridors is correlating the freight flows to recorded traffic volumes. While freight needs to be carried in a vehicle, many freight vehicles travel partially full or empty a significant amount of time. Commodity flows therefore cannot be easily correlated to traffic counts, but an order of magnitude verification of commodity flow corridors with the actual transportation supply in those corridors helps validate the commodity flow data and encourages more reliance on the strengths of commodity flow information.

To conduct this analysis, interstate commodity flows to and from Minnesota by truck were correlated to truck counts at or near the State borders. Major commodity flows into and out of the state from different regions in the United States and Canada were distributed to Interregional Corridor (IRC) routes according to their regional destination within the state.

Methodology

The process of assigning trips to IRC roadways began with the development of the following rules/assumptions:

1. All truck movements were assumed to cross the border on Interstate or Trunk Highway routes.

2. Trips will only be assigned to Interregional Corridor routes.

3. The Interstate System will carry the majority of the heavy commercial average daily traffic volumes (HCADT), especially if trip origin is beyond the states abutting Minnesota (longer trips).

4. Non-interstate IRC routes were primarily assigned HCADT trips from adjacent states.

5. Regional destinations (within Minnesota) were used to determine which route/routes would be most likely to be utilized.

6. Because IRC routes account for 44 percent to 80 percent of all Interstate and Trunk Highway border crossings, the number of trips were factored to account for this percentage.

Process

The following five steps were utilized in assigning commercial vehicle flows.

Step 1

Estimates of out-of-state freight traffic bound to specific regions within the state of Minnesota were obtained. An origin-destination (O-D) matrix of annual truck tons was provided and subsequently converted to truck trips by dividing the annual amount of truck tons by a factor of 9.25[1]. To get daily truck volumes the data was then divided by 365. The destination regions correspond to the districts that the Minnesota Department of Transportation uses for its ATP process. Table F.1 shows the number of trips into the different regions.

[1] A standard factor used to divide tons of goods for trucks based on vehicle and payload data from the 1995 Truck Inventory and Use Survey.

Table F.1 Origin and Destination of Annual Freight Traffic Bound to Minnesota

Origin		Destination[1]								
		ATP 1	ATP 2	ATP 3	ATP 4	ATP 5	ATP 6	ATP 7	ATP 8	Total
ND	North Dakota	42	26	64	51	719	63	55	39	1,059
SD	South Dakota	11	4	17	10	221	18	14	9	304
IA	Iowa	45	10	68	27	1,178	69	46	30	1,473
WI	Wisconsin less Douglas County	35	12	47	19	745	49	39	27	973
CH	Chicago	3	1	5	2	83	5	3	2	104
LP	Lower Plains – Kansas and Nebraska	6	2	9	3	247	9	6	4	286
CM	Central Midwest – Illinois and Missouri	3	1	5	1	83	2	2	1	98
EM	Eastern Midwest – Indiana, Kentucky, Michigan and Ohio	20	8	30	11	711	28	18	12	838
NW	Northwest – Idaho, Montana, Oregon, Washington and Wyoming	4	1	1	1	159	5	13	8	192
SW	Southwest – Arizona, Colorado, Mew Mexico and Utah	3	1	3	1	77	4	3	2	94
SC	South Central – Texas and Oklahoma	5	2	5	2	108	5	6	5	138
SE	Southeast – Arkansas, Alabama, Mississippi, Georgia, North Carolina, South Carolina, Tennessee and Florida	14	5	20	7	629	22	20	13	730
NE	Northeast – Maine, New Hampshire, Vermont, New York, Pennsylvania, Mew Jersey, Massachusetts, Delaware, Connecticut, West Virginia, Maryland and Virginia	7	2	10	2	284	10	6	5	326
PS	Pacific Southwest – California and Nevada	4	1	3	2	88	9	35	25	167
LA	Louisiana	1	–	–	–	36	–	–	1	38
WC	Western Canada	58	11	12	8	218	30	14	8	359
CC	Central Canada	11	6	6	2	128	8	4	3	168
EC	Eastern Canada	3	1	1	1	33	2	1	1	43
MX	Mexico	–	–	–	–	26	–	–	–	26
DW	Douglas County, Wisconsin	1	1	2	1	18	2	1	1	27
TOTAL		**276**	**95**	**308**	**151**	**5,791**	**340**	**286**	**196**	**7,443**

[1] Matrix of origins and destinations based on Reebie data. Units were divided by 9.25 to obtain annual trucks, they were further divided by 365 to obtain number of trucks per day. Intrastate trips were not included in any route assignments.

Step 2

The second step in the process involved assessing which border of the state commercial trips would likely enter. For example, trips originating from the Northwest region of the United States would most likely enter Minnesota along the western border. Trips originating from Texas and Oklahoma would most likely enter the state along the southern border. Table F.2 shows the assigned borders.

Table F.2. Assigned Borders

	Origin	Assigned Border
ND	North Dakota	Western
SD	South Dakota	Western
IA	Iowa	Southern
WI	Wisconsin less Douglas County	Eastern
CH	Chicago	Eastern
LP	Lower Plains – Kansas and Nebraska	Western and Southern
CM	Central Midwest – Illinois and Missouri	Southern and Eastern
EM	Eastern Midwest – Indiana, Kentucky, Michigan and Ohio	Eastern
NW	Northwest – Idaho, Montana, Oregon, Washington and Wyoming	Western
SW	Southwest – Arizona, Colorado, Mew Mexico and Utah	Western and Southern
SC	South Central – Texas and Oklahoma	Southern and Western
SE	Southeast – Arkansas, Alabama, Mississippi, Georgia, North Carolina, South Carolina, Tennessee and Florida	Eastern
NE	Northeast – Maine, New Hampshire, Vermont, New York, Pennsylvania, Mew Jersey, Massachusetts, Delaware, Connecticut, West Virginia, Maryland and Virginia	Eastern
PS	Pacific Southwest – California and Nevada	Western and Southern
LA	Louisiana	Southern
WC	Western Canada	Western and Northern
CC	Central Canada	Eastern and Northern
EC	Eastern Canada	Eastern and Northern
MX	Mexico	Southern
DW	Douglas County, Wisconsin	Eastern

Based on the above border assumptions and information provided by the companion *Interregional Corridors Study*, the following routes (Table F.3) were identified for each border. The routes are shown with the corresponding number of truck trips assigned to each border based on flows identified by the *Minnesota Statewide Freight Flows Study*.

Table F.3 IRC Routes Used to Enter Minnesota

	Northern Border	Western Border	Southern Border	Eastern Border
Routes	TH 53	I-90	I-35	I-90
	TH 61	I-94	TH 60	I-94
		TH 2	TH 63	TH 36
		TH 212		TH 8
				TH 53
Total Trips	**235**	**3,220**	**1,885**	**6,300**

Step 3

Trips were assigned an entrance route based on the border that they entered and the region to which they were destined. For the most part, trips coming further than the adjacent state were assigned to the Interstate route closest to their destination. Trips from adjacent states were split among all of the IRC routes that entered the state at a particular border. Origin-destination matrices were developed to track trips for each of the IRC routes. These matrices were then factored as described in Step 4 to account for other HCADT on non-IRC routes. Tables F.4, F.5 and F.6 show the matrices that were created for the southern border.

Table F.4 Southern Border Matrix 1 – I-35

Origin	Destination[1]								
	1	2	3	4	5	6	7	8	T
IA	31	7	47	19	813	48	32	21	1,018
LP	6	–	9	–	247	9	6	1	278
CM	1	–	1	–	21	–	1	–	24
SW	3	–	3	–	77	4	3	1	91
SC	5	–	5	–	108	5	6	5	134
PS	4	–	3	–	88	9	35	8	147
LA	1	–	–	–	36	–	–	1	38
MX	–	–	–	–	26	–	–	–	26
T	51	7	68	19	1,416	75	83	37	1,756

[1] This matrix shows the trips that would use I-35 on the Southern border to enter Minnesota.

Table F.5 Southern Border Matrix 2 – TH 60

Origin	Destination[1]								
	1	2	3	4	5	6	7	8	T
IA	9	2	13	5	224	13	9	6	281

[1] This matrix shows the trips that would use TH 60 on the Southern border to enter Minnesota.

Table F.6 Southern Border Matrix 3 – TH 63

Origin	Destination[1]								
	1	2	3	4	5	6	7	8	T
IA	5	1	8	3	141	8	5	3	174

[1] This matrix shows the trips that would use TH 60 on the Southern border to enter Minnesota.

Step 4

Because trips are being assigned only to IRC routes, and the IRC routes represent only a percentage of the overall HCADT volumes crossing Minnesota borders, a final adjustment is needed to avoid assigning too many trips. A correction factor was calculated for each border by dividing the total HCADT trips for the IRC routes by the total HCADT found for all Trunk Highways and Interstates along each border. For example, a total of 1,885 HCADT trips enter southern Minnesota on IRC routes out of 3,258 HCADT total trips crossing into Minnesota on all Trunk Highways and Interstates. The IRC trips (1,885) were divided by the total trips (3,258) resulting in a factor of 0.58. This factor was then used to adjust all of the trips in the matrices for the southern border. A similar process was followed for each of the other borders. Tables F.7, F.8 and F.9 show the adjusted numbers for I-35, TH 60 and TH 63 on the southern border

Table F.7 Southern Border Matrix 1 – I-35

Origin	Destination[1]								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**T**
IA	18	4	27	11	472	28	19	12	591
LP	6	–	9	–	247	9	6	1	278
CM	1	–	1	–	21	–	1	–	24
SW	3	–	3	–	77	4	3	1	91
SC	5	–	5	–	108	5	6	5	134
PS	4	–	3	–	88	9	35	8	147
LA	1	–	–	–	36	–	–	1	38
MX	–	–	–	–	26	–	–	–	26
T	**38**	**4**	**48**	**11**	**1,075**	**55**	**70**	**28**	**1,329**

[1] This matrix shows the adjusted number of trips that would use I-35 on the Southern border to enter Minnesota.

Table F.8 Southern Border Matrix 2 – TH 60

Origin	Destination[1]								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**T**
IA	5	1	8	3	130	8	5	3	163

[1] This matrix shows the adjusted number of trips that would use I-35 on the Southern border to enter Minnesota.

Table F.9 Southern Border Matrix 3 – TH 63

Origin	Destination[1]								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**T**
IA	3	1	5	2	82	5	3	2	103

[1] This matrix shows the adjusted number of trips that would use I-35 on the Southern border to enter Minnesota.

Step 5

The next step in the process was to assign a particular destination to each region so those trips would have a route to follow within Minnesota. The Reebie data had destinations for the eight regions in the state; however, it did not specify any destinations within that region. Since the largest trade centers account for the majority of economic trade and goods movement, it was assumed that the largest centers were the primary destinations within the regions. Centers were selected based on their ranking as a Regional Trade Center and are shown below.

- ATP 1 (Northeast) – Duluth
- ATP 2 (Northwest) – Grand Forks / East Grand Forks and Bemidji
- ATP 3 (Central) – St. Cloud
- ATP 4 (West Central) – Fargo / Moorhead
- ATP 5 (Metro) – Metropolitan Minneapolis / St. Paul
- ATP 6 (Southeast) – Rochester
- ATP 7 (South Central) – Mankato
- ATP 8 (Southwest) – Hutchinson, Marshall and Willmar

After identifying the centers, trips were assigned to IRC routes that linked the border crossings to the various centers. Routes were chosen that would minimize travel time and travel distance between their origin and their destination city. Trip Maker software, developed by Rand McNally, was used to verify assumptions regarding the selection of routes. Other than the states bordering Minnesota, most trips entering the state were assigned to interstate routes (Figure F.1).

Where more than one large population center is located in the region (Grand Forks / East Grand Forks and Bemidji in ATP 2), trips were distributed proportionally among the cities based on the relative number of trucks on IRC routes adjacent to each city.

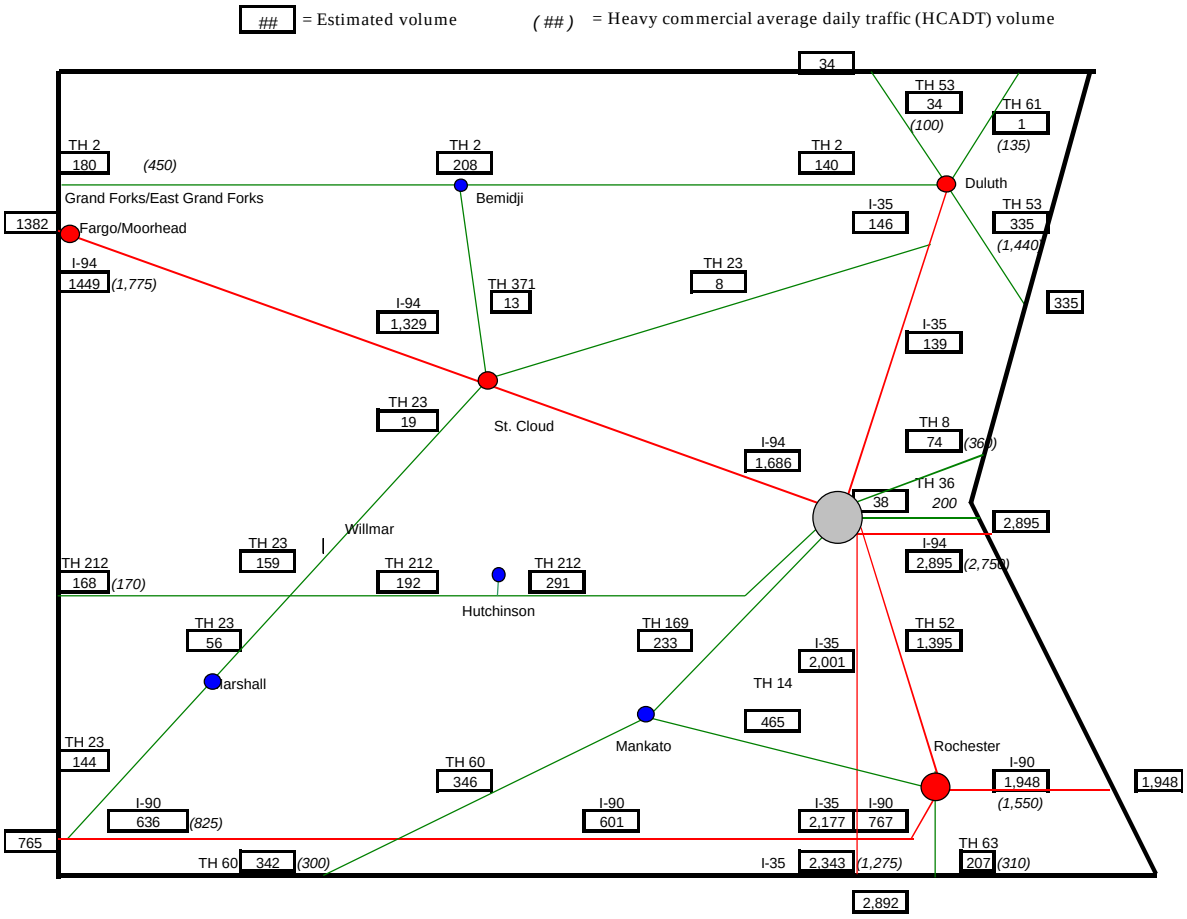
Step 6

In addition to calculating traffic bound to Minnesota, the trips leaving Minnesota to other regions of the United States were calculated. The process used to determine the inbound traffic was used in reverse to distribute trips for outbound goods, (trips leaving the state instead of entering the state). Routes that were chosen to bring goods into District 1 from Iowa were in turn used to ship goods from District 1 to Iowa.

Step 7

After trips were calculated for inbound and outbound movements they were added together to create a total HCADT trip number for each IRC roadway. This number only represents interstate trips, not intrastate or local trips.

Figure F.1 Comparison of Commercial Vehicle AADT to Estimated Truck Volumes*



* Truck Volumes are estimated from Reebie TRANSEARCH commodity flows by truck, based on an estimated 9.25 tons / truck derived from the average payloads and empty load factors for truck nationwide as reported by the 1992 Truck Inventory and Use Survey from the Bureau of the Census.

Source: SFP Consulting, 1999.

Appendix G

Freight Performance Measures