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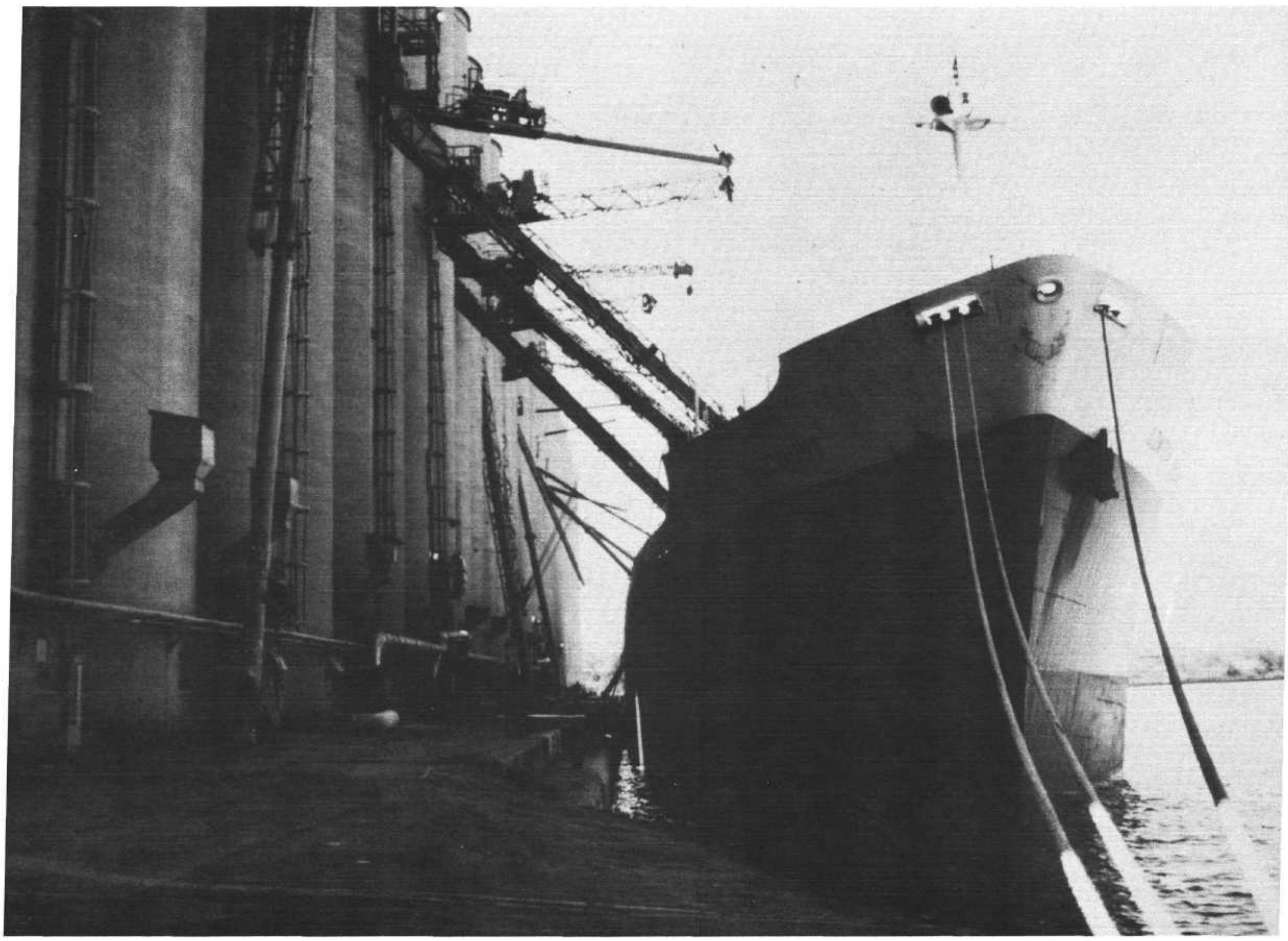
GRAIN TRANSPORTATION ON THE GREAT LAKES-ST. LAWRENCE SEAWAY



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GRAIN TRANSPORTATION ON THE GREAT LAKES-ST. LAWRENCE SEAWAY

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Cover photo of the London Viscount at Mid-States Terminals, Inc., Toledo, Ohio, courtesy of Dr. Albert G. Ballert, Great Lakes Commission.

GRAIN TRANSPORTATION ON THE GREAT LAKES-ST. LAWRENCE SEAWAY

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GRAIN TRANSPORTATION ON THE GREAT LAKES- ST. LAWRENCE SEAWAY

I. Introduction

The U.S. agricultural sector contributes significantly to both the national and world economies. Despite the fact that total agricultural exports represent only about 20 percent of total U.S. exports, they offset a substantial portion of the nonagricultural trade deficit (Table 1). For the first time in the last five years, 1981 net agricultural exports offset more than 50 percent of the nonagricultural trade balance.

Grains and oilseed exports account for some two-thirds of the total value of agricultural exports. For the U.S. agricultural sector, grain exports continue to provide an increasingly important market for farm products. In 1950, the output of one in ten harvested acres was exported. In recent years, however, one of every three harvested acres has been consumed abroad (Table 2) and by 1990, nearly 50 percent of total U.S. grain production can be expected to be exported.

The unprecedented volumes of grain moving into export markets have created considerable concern about the ability of the inland transportation system to meet future export demands. In 1979, the total of all grains handled at U.S. ports was 4.56 billion bushels while in 1980 a record 4.94 billion bushels was reached (Table 3). Exports of wheat, corn, and soybeans in 1981 are placed at 4.84 billion bushels and by 1985 over 5.0 billion bushels will be destined for export markets. By 1990, total grain exports from U.S. ports are expected to exceed 6.8 billion bushels. Since the demand for grain transportation services is clearly derived from the final demand for U.S. grains and oilseeds, substantial investments in the grain transportation and handling system will be required in the 1980s.

A recent analysis of the adequacy of the transportation and port system indicates that the total U.S. grain export capacity in 1980 would be 7.1 billion bushels per year.[1] Over the next decade, projected grain export volumes will approach current estimated capacity. Although the inland transport system has been able to handle historical demand, it could well be a constraining factor in effectively satisfying projected grain export by 1990.

The waterway and port facilities are not the only constraints that may inhibit the orderly flow of grain to export markets; the grain must first get to the export terminals. The nation's truck, rail, and barge system has played a dominant role in the movement of grain to port facilities--especially from production areas that do not have direct access to the waterways.

Increasing reliance upon rail use in the shipment of grain to export markets has occurred largely because of economies of unit train shipments. While periodic rail equipment shortages still occur, historically the rail system has adequately moved the nation's grain to export facilities. However, continued abandonment of rail lines could leave many grain shippers without rail service. While truck shipment generally involves higher transport costs to the export shipper than either rail or water, service quality is often superior. Although the current grain handling capacity of the nation's truck fleet is not known, truck capacity has not been a constraining factor in the movement of grain to export markets. Continued disinvestment in the rural road bridge system could severely hamper the movement of grain to export markets. Barge transportation has been increasingly used to move the Midwest's grain to the export ports in the Gulf. As with unit trains, economies have been realized in barge shipping, and the highly competitive barge industry ensures that those economies are passed on to the shipper.

The demand for commercial transportation services is derived from the final

[1]Gaibler, Floyd D., "The Transportation System's Capacity to Meet Grain Export Demand, 1979/80 Outlook," Working Paper, USDA-NED-ESCS, Washington, D.C., October 1979. (Capacity estimate for 1980 was obtained from personal correspondence.)

TABLE 1

Agricultural and Nonagricultural
Trade Balance Market Year Basis
(October/September)

	1975	1976	1977	1978	1979	1980	1981
Agricultural Exports	21,578	22,147	23,973	27,291	31,975	40,481	44,139
Nonagricultural Exports	81,280	87,242	94,311	103,905	135,501	169,563	184,320
Total Exports	102,858	109,389	118,285	131,196	167,476	210,044	228,459
Agricultural Imports	9,579	10,109	13,357	13,886	16,187	17,300	17,195
Nonagricultural Imports	91,482	95,774	129,291	150,905	178,464	200,857	234,700
Total Imports	101,000	105,881	142,648	164,792	194,651	238,157	251,895
Agricultural Trade Balance	11,999	12,038	10,616	13,405	15,788	23,181	26,944
Nonagricultural Trade Balance	-10,202	-8,532	-34,980	-47,000	-42,963	-51,294	-50,380
Total Trade Balance	1,777	3,506	-24,364	-33,595	-27,175	-28,113	-23,436

Source: USDA, ERS, Agricultural Outlook (various issues).

TABLE 2

U.S. Grain Production,
Consumption, and Exports

Selected Commodities and Years

	1950	1955	1960	1965	1970	1975	1980	1981
				- Millions of Bushels -				
Corn								
Production	2,764	2,873	3,907	4,084	4,152	5,829	6,648	8,021
Domestic Use	2,753	2,624	3,387	3,705	3,978	4,082	4,900	5,085
Exports	117	120	292	687	517	1,711	2,350	2,000
Wheat								
Production	1,019	937	1,355	1,316	1,352	2,123	2,370	2,793
Domestic Use	689	604	591	731	772	772	773	853
Exports	345	322	654	867	741	1,173	1,510	1,773
Soybeans								
Production	299	373	555	846	1,127	1,547	1,817	2,030
Domestic Use	271	307	445	589	824	935	1,111	1,148
Exports	28	68	135	251	434	555	720	930

Source: USDA, ERS/FAS, World Agricultural Supply and Demand Estimates (various issues).

TABLE 3

Total Monthly and Annual Grain Inspection for Export, 1973-1980[a]

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
							- Million Bushels -						
1973	239.9	260.8	312.1	251.4	264.7	350.4	263.7	354.1	275.9	267.7	378.9	271.1	3,495.8
1974	242.7	255.0	303.0	235.9	289.4	222.8	211.2	223.3	167.6	177.8	297.3	256.6	2,882.3
1975	321.9	248.1	226.4	212.3	197.0	161.2	213.1	285.2	222.3	402.6	343.3	279.6	3,113.0
1976	298.7	282.3	292.7	296.9	273.6	294.8	280.6	282.9	270.5	363.6	353.3	273.6	3,560.5
1977	257.9	260.4	299.5	300.8	278.3	245.7	257.0	267.6	298.7	264.2	320.2	313.2	3,367.4
1978	267.6	301.5	333.7	363.6	415.1	400.1	337.9	379.0	330.7	354.5	342.0	339.5	4,165.2
1979	292.2	270.0	335.5	339.2	351.2	378.4	424.3	411.4	356.3	466.5	490.6	445.8	4,561.4
1980	405.1	379.0	490.0	427.0	372.5	360.5	408.9	411.2	404.3	449.0	461.1	452.7	4,940.3
1981	465.2	393.9	429.2	400.0	342.3	328.6	340.0	363.2	437.4	475.6	455.3	407.3	4,838.0

[a]The data do not include sunflower seed shipments, nor export of grain from inland ports.

Source: Grain Market News, USDA.

demand for grain at various market locations. Perhaps the greatest force influencing the demand for grain transportation services is the quantities sold in export markets. Therefore, the ability of the U.S. transportation system to cope with future demands will be largely dependent upon future grain exports.

The future role that the Great Lakes-St. Lawrence Seaway will play in meeting projected export grain demands will depend upon many factors. The grain shipment demands placed upon the Great Lakes-St. Lawrence Seaway system will stem from variations in export sales as well as the competitive nature of trucks, railroads, and the Mississippi River. In addition, other factors that will influence the future role of the Great Lakes-St. Lawrence Seaway in the transport of grain include: the level and spatial shifts in grain production, the effects of changing real energy prices, the specific destination of grain exports, and the physical condition of the transportation system, including potential Great Lakes-St. Lawrence Seaway constraints.

The purpose of this report is to provide information on the current and future role of the Great Lakes-St. Lawrence Seaway in the transportation of grain. In this quest, the following objectives are established:

(1) Describe the nature of grain flows on the Great Lakes-St. Lawrence Seaway, including port of origin and country of destination;

(2) Project grain export levels to 1990 by major U.S. port area;

(3) Evaluate future grain exports relative to port capacities;

(4) Compare the relative competitiveness of Great Lakes ports in the shipment of grain through an examination of shipping rates;

(5) Comment on the effect of other selected factors on the competitiveness of the Great Lakes in the shipment of grain relative to other port areas.

The plan of development of this report will follow the same order as the above objectives.

II. GRAIN FLOWS, PORT OF ORIGIN AND COUNTRY OF DESTINATION

Grain traffic represents the single most important (in terms of volume) commodity group transported on the Great Lakes-St. Lawrence Seaway. An understanding of the current and potential importance of grain flows on the Seaway is necessary in order to better place in perspective the role of grain transportation in economic development.

This section will present some descriptive information on grain flows over the Great Lakes-St. Lawrence Seaway with a focus on the origin and destination of grain shipments. First, a brief overview of total commodity traffic on the Seaway will be presented. Next, a temporal view of Seaway grain shipments is provided. And finally, an examination is made of both U.S. and Canadian grain shipments by port and destination as well as the volume and destination of U.S. grain shipped from Canadian ports.

Specific information on grain flows by major port for the U.S. and Canada is contained in Appendix A and B, respectively.

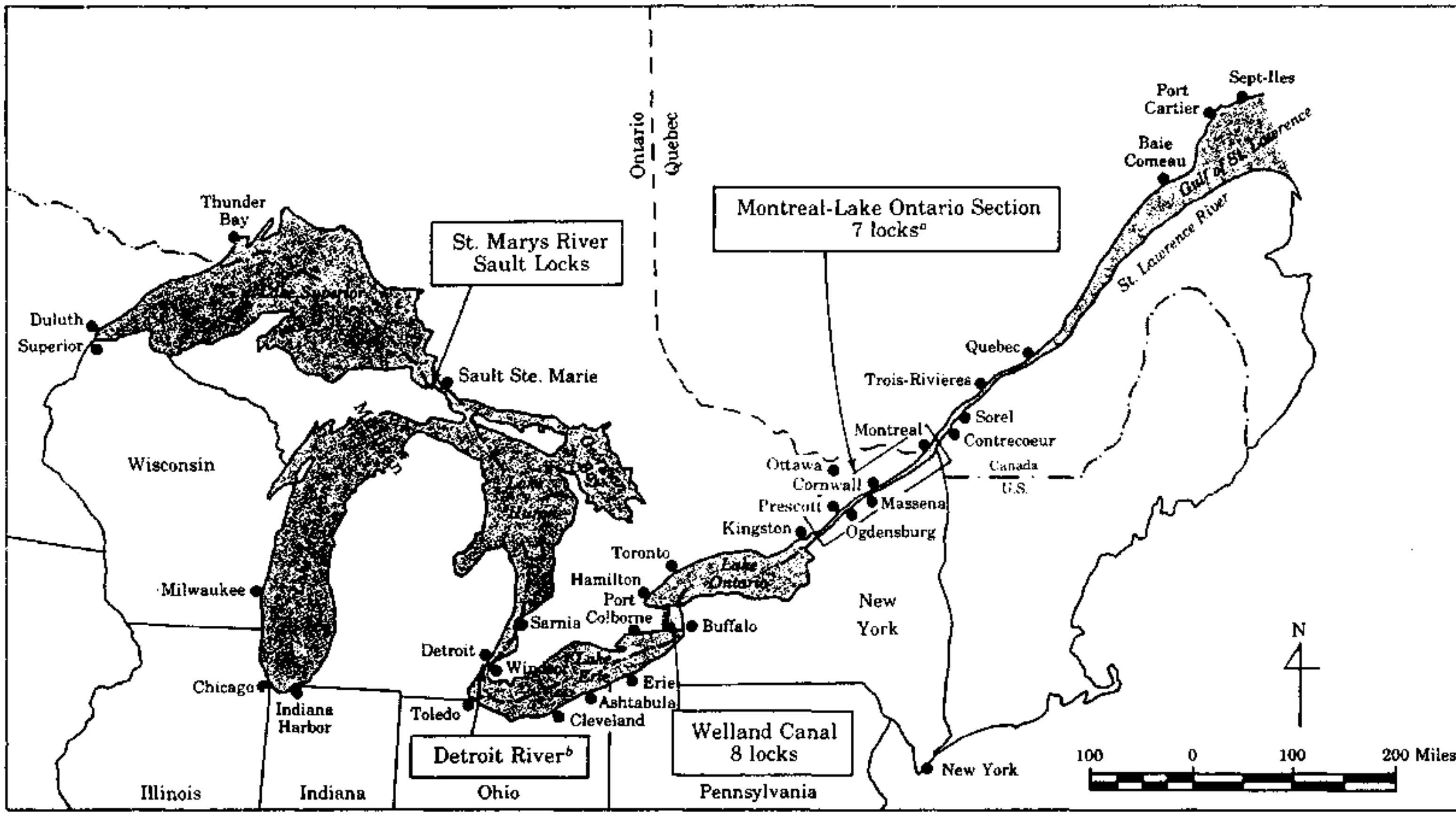
Commodity Traffic on the Seaway

A view of the Great Lakes-St. Lawrence Waterway and the location of the major ports is depicted in Figure 1. After the Seaway opened in 1959, substantial increases in traffic followed. The increase in traffic is largely attributed to the use of larger Laker vessels. The expanded lock sizes enabled the use of these larger Lakers which carry considerably more volume than the ocean-going salties.

During the first year the Seaway was in operation, the traffic volume of all commodities moving through the Montreal-Lake Ontario section of the Seaway more than doubled over that of the previous year (see Table 4). Increases were particularly high for iron-ore and agricultural products. Since 1959, the most rapid traffic growth took place during the period 1960-65. After 1965, a gradual increase in all commodity movements occurred reaching an apparent plateau during the 1977-79 period.

Figure 1

Great Lakes-St. Lawrence
Waterway and Ports



[a]St. Clair River, Lake St. Clair and the Detroit River.

TABLE 4

Traffic on the Seaway,
by Major Commodity Group, 1958-80

(Thousand Short Tons)

Commodity	Seaway Section[a]	1958	1959	1960	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Agricultural Products	W.C.	6,653	8,637	9,711	18,477	21,152	23,805	24,431	25,523	17,518	22,909	21,671	25,314	31,984	28,972	31,150
	M-LO	4,868	7,375	8,220	17,634	19,799	22,589	23,517	24,331	16,173	21,430	20.674	24,049	30,741	27,471	29,677
Iron Ore	W.C.	4,291	6,915	7,856	16,134	16,091	13,567	13,732	17,183	14,914	16,469	21,550	21,967	17,286	16,666	12,587
	M-LO	1,526	6,187	4,315	12,774	15,119	13,427	12,533	15,692	14,291	14,506	20,535	22,274	14,929	16,334	12,132
Coal and Coke	W.C.	4,460	4,896	4,500	7,389	11,174	9,743	10,511	8,791	6,975	9,374	9,359	9,740	8,746	11,374	9,622
	M-LO	1,071	1,183	1,111	1,227	824	852	864	1,093	1,505	1,357	2,167	2,472	3,778	3,109	1,794
Petroleum and Petroleum Products[b]	W.C.	1,921	1,444	1,431	1,632	1,871	1,584	1,795	2,631	1,818	1,535	1,282	1,475	1,431	2,295	2,229
	M-LO	1,009	1,692	1,880	2,565	3,985	3,041	3,935	5,061	3,704	2,651	2,148	2,615	2,612	3,024	2,240
Manufactured Iron and Steel	W.C.	301	734	1,232	3,219	5,331	6,351	5,851	5,059	3,416	2,342	3,531	5,589	4,398	3,786	1,454
	M-LO	196	629	1,448	3,721	5,725	6,602	6,343	5,450	3,741	2,601	3,809	5,866	4,662	4,063	2,324
Other	W.C.	3,648	4,911	4,520	6,569	7,344	7,859	7,874	8,008	7,659	7,220	6,947	7,656	8,551	9,847	8,668
	M-LO	3,092	3,527	3,336	5,462	5,719	6,437	6,465	6,007	4,732	5,465	5,064	6,064	6,052	6,986	6,351
All Commodities	W.C.	21,274	27,537	29,250	53,420	62,963	62,909	64,194	67,195	52,360	59,849	64,340	71,741	72,396	72,940	65,710
	M-LO	11,762	20,593	20,310	43,383	51,171	52,948	53,657	57,634	44,146	48,010	54,397	63,340	62,774	60,987	54,518

[a]W.C. is the Welland Canal and M-LO is the Montreal-Lake Ontario section.

[b]Including fuel oil.

Source: The St. Lawrence Seaway Authority, Economics and Planning Branch, Economics Section.

Since 1959, the traffic for all the commodity groups increased; however, some groups increased substantially more than others. In comparing volumes for the period 1960-61 to that in 1979-80, the increase in volume for all commodities was more than 150 percent. While during this 20-year period, volume increases in both iron-ore and agricultural products exceeded 200 percent, the following four major commodity groups experienced increases of less than 10 percent: coal and coke, petroleum and petroleum products, manufactured iron and steel, and the "other" category. While shipments of both iron-ore and agricultural commodities experienced rapid growth during the last five years (1976-80), the traffic volume for agricultural products has been particularly dramatic. In 1980, the only major commodity group that increased over the previous year was agricultural products.

Origin and Destination of Total Commodity Traffic

The relative use of the Seaway by Canada and the United States for 1980 is given in Table 5. Although the relative usage changes each year, the data for 1980 provide a picture of current traffic activity. In recent years, however, there has been an apparent shift in products destined for Canada. During the five-year period of 1976-80, the percent of total traffic unloaded in Canada increased from an estimated 45 to 63.1 percent, while the total cargo destined for U.S. ports decreased from an estimated 41 to 20.4 percent. One reason for the increase in shipments to Canada during this time is the increased use of Canadian lakers operating on feederships between upper Great Lakes ports and transshipment ports along the St. Lawrence River. The design of the lakers allows them to carry out more cargo than an ocean-going vessel and therefore to get a greater return to fixed costs. At the same time, the deeper ports at the transshipment points allow large ocean vessels to load there and shippers can gain even further on the charge per ton.

During this same 1976-1980 period, products originating from Canadian ports decreased from an estimated 62 percent in 1976 to 52.9 percent in 1980, while the U.S. share increased from an estimated 29 percent in 1976 to 43.2 percent in 1980. The percentage of cargo directly destined to foreign markets has remained relatively constant during this five-year period, while the relative share of shipments originating in foreign markets for shipments to the U.S. and Canada has declined.

In summary, some 53 percent of the cargo tons moving over the Seaway originate in Canada, while 43 and 4 percent originate in the U.S. and foreign markets, respectively. Of the total tonnage originating in the U.S., over two-thirds is destined for Canadian ports. However, much of this tonnage is ultimately transshipped to foreign markets. A discussion of the volume and destination of U.S. grain shipped from Canadian ports is presented later in this section.

Grain Shipments, Welland Canal

Grain shipments through the Welland Canal section of the St. Lawrence Seaway are shown in Table 6. Despite fluctuations in the total volume of grain shipped from year to year, the percent of total traffic composed of grain has remained relatively stable. Since the opening of the Seaway in 1959, grain shipments have accounted for about 33 percent of the total Seaway shipments. During the three-year period 1978-80, however, this percentage increased to an average of 43 percent. In 1980, grain shipments were 43.7 percent of total Seaway shipments--the greatest percentage in the history of the Seaway.

During the three-year period 1978-80, the combined grain shipments of the U.S. and Canada averaged 28,237,000 short tons. At this same time, the allocation of total grain shipments averaged 52 percent for the U.S. and 48 percent for Canada. Prior to the 1978-80 period, the U.S. and Canadian shares tended to be 45 and 55 percent, respectively.

Grain Shipments, Variety and Port

U.S. grain shipments by major port area from 1972 to 1981 are shown in Figure 2. The dominant role of the Gulf ports in the

TABLE 5

Combined Domestic and Foreign Traffic
on the Montreal-Lake Ontario
and Welland Canal Sections, 1980

(000 Cargo Tons)

Destination	Origin: Canada	Origin: United States	Origin: Foreign	Total	Percent
Canada	3,681 up[a] 17,133 down[a]	87 up 20,826 down	492 up --	42,219	63.1
United States	10,734 up 363 down	77 up 397 down	2,128 up --	13,681	20.4
Foreign	3,527 down	7,534 down	--	11,061	16.5
	35,438	38,903	2,620	66,961	100.0
	52.9%	43.2%	3.9%		

[a]Downbound traffic moves toward the sea; upbound moves inland.

TABLE 6

Grain[a] Shipments Through the Welland Canal Section of the St. Lawrence Seaway, 1958-80

(Thousand Short Tons)

Origin & Destination	1958	1959	1960	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
U.S. Grain:															
U.S.-U.S.	396	131	151	25	40	39	34	22	14	24	24	25	77	31	31
U.S.-Canada[b]	636	1,408	1,570	3,874	5,946	3,031	2,639	5,850	4,354	4,457	3,891	4,030	6,331	7,408	8,807
U.S.-Overseas	19	1,860	2,355	4,068	2,992	5,783	6,778	6,725	2,837	4,609	4,621	6,282	9,552	7,341	4,452
Total[c]	1,051	3,398	4,076	7,967	8,978	8,853	9,451	12,597	7,205	9,090	8,536	10,337	15,960	14,780	13,290
% of Total Grain Traffic	16.0	42.2	44.2	46.0	46.0	40.4	42.0	53.2	43.4	41.8	41.9	43.5	53.6	56.3	46.3
Canadian Grain:															
Canada-Canada[b]	N/A	4,236	4,552	8,637	10,479	12,265	12,227	10,633	8,488	12,110	11,116	12,440	12,889	10,849	13,699
Canada-Overseas	N/A	398	57	708	493	817	819	453	899	539	734	966	921	606	1,716
Total[c]	N/A	4,634	5,131	9,348	10,972	13,082	13,046	11,086	9,396	12,649	11,850	13,406	13,810	11,455	15,415
% of Total Grain Traffic	84.0	57.4	55.7	53.9	55.0	59.6	58.0	46.8	56.6	58.2	58.1	56.5	46.4	43.7	53.7
Total Combined	N/A	8,032	9,207	17,315	19,950	21,935	22,497	23,683	16,601	21,739	20,386	23,743	29,770	26,235	28,705
% of All Commodity Traffic[d]	N/A	29.2	31.5	32.4	31.7	34.9	35.0	35.2	31.7	36.3	31.7	33.1	41.1	36.0	43.7

[a]Includes wheat, oats, barley, rye, flaxseed, corn and soybeans.

[b]Mainly shipments to St. Lawrence elevators for export; some for domestic consumption.

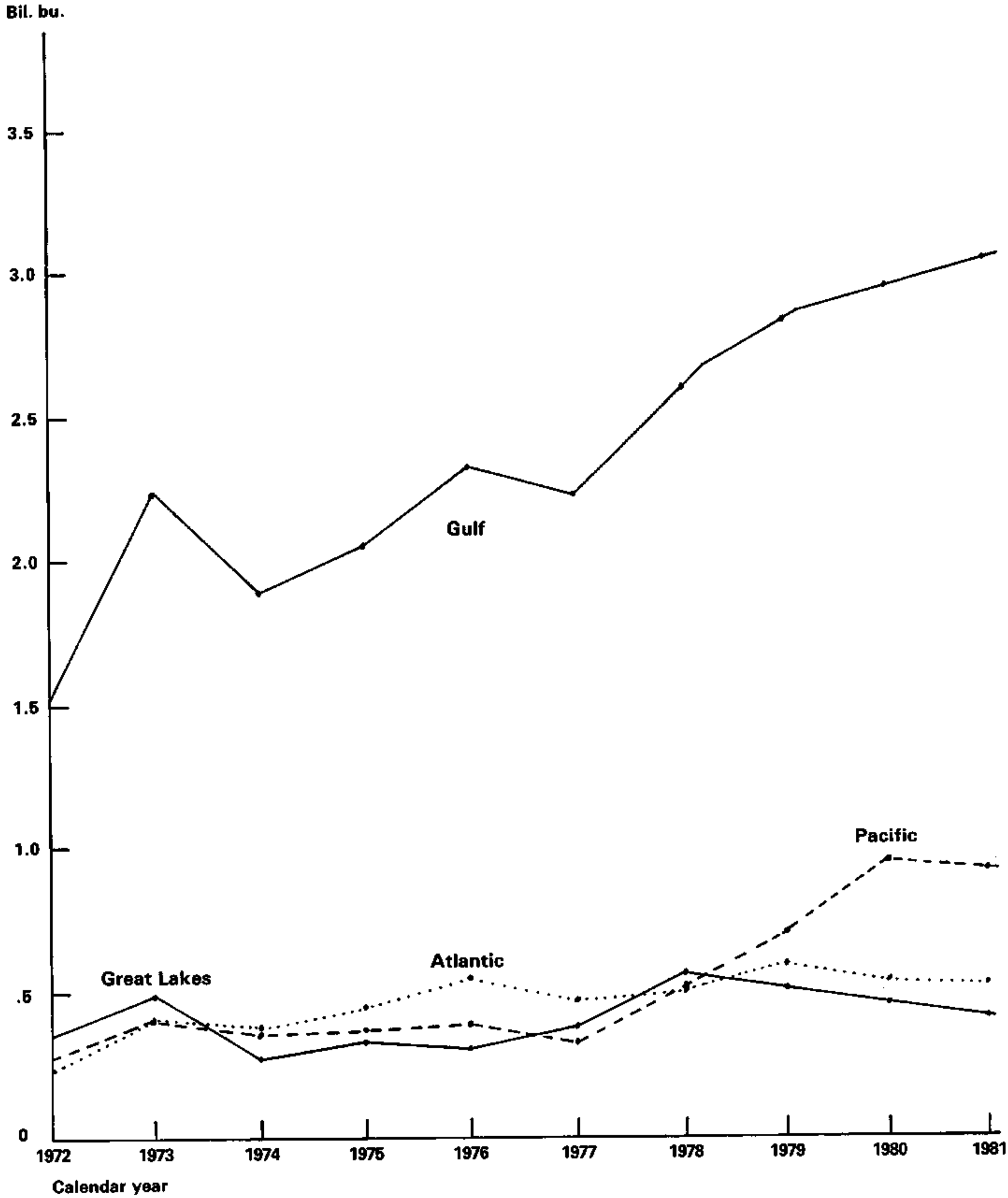
[c]Canada-U.S. shipments are intermittent and of minimal size. They are included in totals where relevant.

[d]All commodity traffic is from Table 4.

Source: The St. Lawrence Seaway Authority, Economics and Planning Branch, Economics Section.

Figure 2

U.S. Grain Exports by Major Port Area, 1972-81



export of U.S. grain is conspicuous. The data presented in this figure are for the U.S. and do not include Canadian shipments. Hence, total grain moving over the Great Lakes is considerably larger than that depicted in Figure 2. Canadian shipments are shown in Table 6.

In Table 7, grain exports are disaggregated by variety of grain for each port and expressed in percentage terms. Again, the dominant role of the Gulf ports in total grain exports is evident.

In Figure 3, total U.S. grain exports of corn, soybeans, and wheat are given for all Great Lake ports. This information is disaggregated by individual Great Lake ports in Table 8. In recent years, the bulk of the corn export originates at Toledo and Chicago/Milwaukee ports. A majority of the U.S. Great Lake soybean exports originate at Toledo, and the Duluth/Superior ports dominate in the export of wheat.

U.S. Great Lakes Grain Shipments, 1980[2]

In 1980, a total of 936 cargoes representing 634.0 million bushels of grain were shipped from U.S. Great Lakes ports (see Table 9). The largest volume commodity shipped on the Lakes in 1980 was corn--representing 38 percent of total grain volume. Wheat shipments rank second in volume. Corn and wheat shipments combined represent two-thirds of the total volume.

Duluth-Superior is the largest volume U.S. grain port on the Great Lakes. Over 360 million bushels of grain were shipped from Duluth-Superior in 1980. At Duluth-Superior, wheat shipments represented the greatest volume commodity followed by corn and sunflower seeds.

[2]The information presented in this subsection is for 1980 only and was obtained from grain exchanges and elevators by the Great Lakes Commission. Since the source of these data are not from the same secondary sources cited elsewhere in this study, some differences can be expected to exist.

The second most active U.S. lake port is Toledo, Ohio. Over 160 million bushels of grain were shipped from Toledo area elevators in 1980. Corn shipments accounted for nearly two-thirds of the volume of grain shipped from Toledo. The third most active port in 1980 was Milwaukee, Wisconsin followed by Chicago, Illinois; Huron, Ohio; and Saginaw, Michigan.

Information on the specific country of destination for each port by type of grain is reported in Appendix Tables A.1 to A.6.

U.S. Grain Shipped From Eastern Canada, 1980[3]

Approximately 50 percent of all grain shipped from U.S. Lake ports is destined for Eastern Canadian ports. The final destination of most of this grain, however, is not Canada, but rather it is transshipped at Eastern Canadian ports before it moves to its ultimate foreign destination.

The quantities of U.S. grain that are shipped from Eastern Canadian elevators are shown in Table 10. The volume shipped by type of grain is provided for 1980. There are some reasons why the volume of U.S. grain shipped to Eastern Canada is not exactly equal to the quantity of U.S. grain shipped from Canada. For example, in 1980, U.S. grain shipments to the St. Lawrence (Eastern Canada) ports totaled 287.5 million bushels (see Table 9), while U.S. grain shipments from Canada totaled 261.1 million bushels. This differential can be attributed to a variety of factors such as: (1) some U.S. grain destined for Eastern Canada may have been loaded in one year, but not reach its Canadian destination until the next year; (2) some grain may have been received at Canadian elevators, but was not shipped the same year and was in storage at the end of the season; or (3) a small amount of U.S. grain is used domestically in Canada.

The specific country of destination for U.S. grain from Eastern Canadian ports is also shown in Table 10. Although the

[3]Ibid.

TABLE 7

Grain Inspections for Export
by Port, 1976-1981

Year/Commodity	Lakes	Atlantic	Gulf	Pacific	Total
			- Percent -		
1976					
Wheat	5.9	6.7	50.7	36.7	100.0
Corn	8.9	23.2	67.5	0.4	100.0
Soybeans	10.7	11.5	77.8	0.0	100.0
Total[a]	8.7	15.0	65.4	10.9	100.0
1977					
Wheat	12.2	4.2	53.0	30.6	100.0
Corn	9.0	22.7	67.3	1.0	100.0
Soybeans	10.6	11.0	78.2	0.2	100.0
Total[a]	10.9	13.7	66.0	9.4	100.0
1978					
Wheat	16.4	3.7	50.2	29.7	100.0
Corn	12.0	19.2	62.8	6.0	100.0
Soybeans	12.1	11.2	76.7	0.0	100.0
Total[a]	13.2	12.1	62.4	12.3	100.0
1979					
Wheat	12.5	2.1	52.8	32.6	100.0
Corn	11.9	19.4	58.1	10.6	100.0
Soybeans	8.1	13.7	78.2	0.0	100.0
Total[a]	11.1	12.9	60.9	15.1	100.0
1980					
Wheat	10.4	5.0	49.1	35.5	100.0
Corn	9.7	15.3	59.8	15.2	100.0
Soybeans	7.7	11.6	80.7	0.0	100.0
Total[a]	9.9	11.0	60.1	19.0	100.0
1981					
Wheat	8.0	6.3	54.2	31.5	100.0
Corn	7.3	15.5	64.4	12.8	100.0
Soybeans	8.6	10.5	79.5	1.4	100.0
Total[a]	8.1	10.6	62.7	18.6	100.0

[a] Includes: wheat, rye, corn, oats, barley, sorghum, and soybeans.

Source: Grain Market News, USDA.

Figure 3

U.S. Grain Exports: Corn,
Wheat, and Soybeans, 1972-81

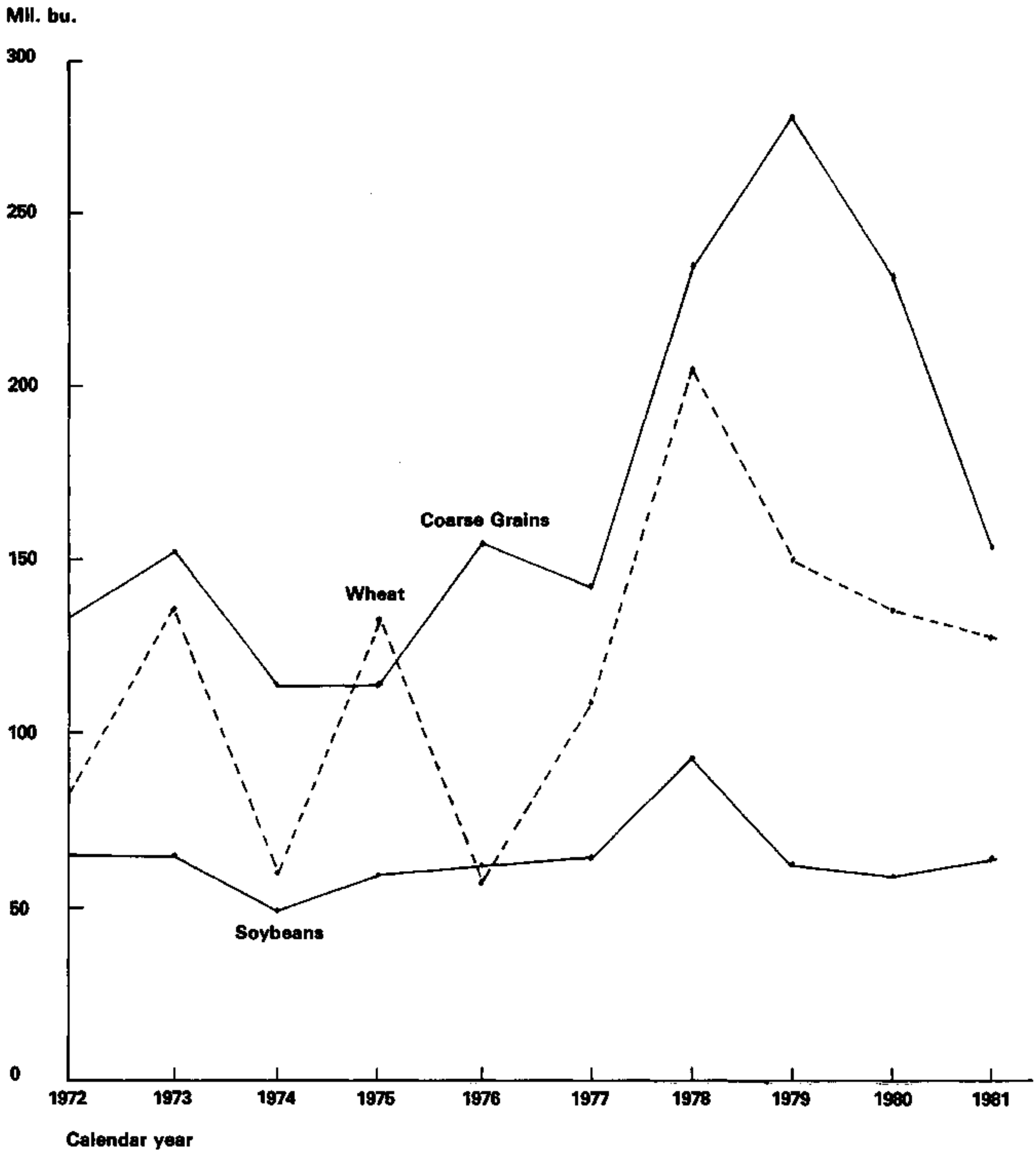


TABLE 8

Corn, Soybean, and Wheat Inspections for Export By Great Lake Ports, 1975-1981

Item	1975	1976	1977	1978	1979	1980	1981
				- Million Bushels -			
Corn							
Chicago Area	49	61	48[a]	75[a]	119	72	60
Duluth/Superior	11	13	5	56	51	42	8
Toledo Area	49	78	85	98	102	116	86
Saginaw Area	4	3	4	4	6	5	1
Total	113	155	142	235	278	235	155
Soybeans							
Chicago Area	13	15	14	20	19	5	14
Duluth/Superior	0	0	0	0	5	1	1
Toledo Area	44	44	47	65	38	52	49
Saginaw Area	1	1	1	3	2	2	2
Total	58	60	62	93	62	60	66
Wheat							
Chicago Area	1	3	2	14	b	--	3
Duluth/Superior	115	48	89	169	134	121	104
Toledo Area	13	5	16	18	14	12	17
Saginaw Area	3	1	2	3	2	2	4
Total	132	57	109	204	150	135	129
All Grain[c]							
Chicago Area	3	9	64	110	138	77	77
Duluth/Superior	143	96	147	252	206	210	153
Toledo Area	105	129	148	182	153	180	152
Saginaw Area	9	6	7	12	11	9	8
Total	320	310	366	556	508	476	390

[a]Chicago area includes Milwaukee. Milwaukee exported 17.9 million bushels in 1977 and 37.6 million in 1978, 37 and 50 percent, respectively, of total for Chicago and Milwaukee. After 1978, separate information for Chicago and Milwaukee is not reported.

[b]Less than 1/2 million.

[c]All grain includes: wheat, rye, corn, oats, barley, flaxseed and soybeans.

Source: Grain Market News, USDA.

TABLE 9

U.S. Great Lakes Grain Shipments, 1980

(000 Bushels)

Ports & Destinations	No. of Cargoes	Total	Wheat	Corn	Barley	Soybeans	Oats, Rye[b] & Flaxseed	Sunflower[c] Seed
U.S. Great Lakes - Total	936	633,971	185,546	238,139	41,931	60,407	9,997	97,949
Direct Overseas	357	256,042	61,150	51,070	17,925	21,425	4,523	97,949
St. Lawrence[a]	358	287,476	72,605	167,274	18,621	25,089	3,887	--
Great Lakes - Canada	107	35,645	907	19,795	--	13,893	1,050	--
U.S. Great Lakes	114	54,808	48,886	--	5,385	--	537	--
Duluth/Superior - Total	498	362,745	169,878	41,943	41,931	1,047	9,997	97,949
Direct Overseas	261	200,947	61,973	17,530	17,925	1,047	4,523	97,949
St. Lawrence	123	106,504	60,492	23,504	18,621	--	3,887	--
Great Lakes - Canada	3	1,959	--	909	--	--	1,050	--
U.S. Great Lakes	111	53,335	47,413	--	5,385	--	537	--
Toledo, Ohio - Total	263	166,555	12,536	105,558	--	48,461	--	--
Direct Overseas	62	35,154	1,177	18,004	--	15,973	--	--
St. Lawrence	144	111,967	9,521	80,177	--	22,269	--	--
Great Lakes - Canada	55	18,503	907	7,377	--	10,219	--	--
U.S. Great Lakes	2	931	931	--	--	--	--	--
Chicago, Illinois - Total	41	30,849	--	26,385	--	4,464	--	--
Direct Overseas	17	9,833	--	6,046	--	3,787	--	--
St. Lawrence	24	21,016	--	20,339	--	677	--	--
Milwaukee, Wisconsin - Total	66	49,091	--	49,091	--	--	--	--
Direct Overseas	12	7,036	--	7,036	--	--	--	--
St. Lawrence	47	38,793	--	38,793	--	--	--	--
Great Lakes - Canada	7	3,262	--	3,262	--	--	--	--
Huron, Ohio - Total	44	15,568	1,150	10,495	--	3,923	--	--
Direct Overseas	5	3,072	--	2,454	--	618	--	--
St. Lawrence	3	1,802	608	1,194	--	--	--	--
Great Lakes - Canada	35	10,152	--	6,847	--	3,305	--	--
U.S. Great Lakes	1	542	542	--	--	--	--	--
Saginaw R., Michigan - Total	24	9,163	1,984	4,667	--	2,312	--	--
St. Lawrence	17	7,394	1,984	3,267	--	2,143	--	--
Great Lakes - Canada	7	1,769	--	1,400	--	369	--	--

Port Totals in Metric Tons

	Cargoes	Total	Wheat	Corn	Barley	Soybeans	Oats, Rye & Flaxseed	Sunflower Seed
U.S. Lake Ports	936	15,108,805	5,049,841	6,049,071	912,949	1,644,025	208,981	1,244,018
Duluth/Superior	498	8,083,144	4,623.369	1,065,412	912,949	28,495	--	1,244,018
Toledo	263	4,341.408	341,178	2,681,324	--	1,318,906	--	--
Chicago	41	791,708	--	670,217	--	121,491	--	--
Milwaukee	66	1,246,982	--	1,246,982	--	--	--	--
Huron	44	404,653	31,298	266,588	--	106,767	--	--
Saginaw River	24	240,910	53,996	118,548	--	68,366	--	--

[a]St. Lawrence and Eastern Canada are used interchangeably.

[b]Oats: Total - 4,137; Direct Overseas - 2,361; St. Lawrence - 549; Great Lakes - Canada - 1,050; U.S. Great Lakes - 177.

Rye: Total - 5,773; Direct Overseas - 2,075; St. Lawrence - 3,338; U.S. Great Lakes - 360; Flaxseed - Direct Overseas - 87.

[c]Sunflower Seed - Converted from metric tons (2,204.62 lbs.) to bushels at 28 lbs./bushel.

Source: Obtained from grain exchanges and elevators by Great Lakes Commission.

TABLE 10

U.S. Grain Shipped From
Eastern Canadian (St. Lawrence)
Elevators and Country of
Destination, 1980

(000 Metric Tons)

	Total	Wheat	Corn	Oats	Barley	Rye	Soybeans
Total							
Metric Tons	6,746.8	1,944.5	3,773.6	8.0	319.2	66.9	634.7
Bushels	261,083.2	71,444.5	148,559.1	464.1	14,660.6	2,633.7	23,321.2
			- (000 Metric Tons) -				
Destination							
Algeria	83.9	83.9	--	--	--	--	--
Belgium	129.9	80.4	41.0	--	--	--	8.5
Brazil	7.7	7.7	--	--	--	--	--
Bulgaria	45.1	--	45.1	--	--	--	--
China	310.9	251.8	--	--	--	--	59.1
Denmark	7.1	--	--	--	--	--	7.1
Europe	27.4	27.0	--	--	--	--	.4
Finland	49.4	49.4	--	--	--	--	--
France	93.7	58.2	7.2	--	--	--	28.3
Ghana	42.9	42.9	--	--	--	--	--
Greece	5.9	--	--	--	--	--	5.9
Iraq	11.1	2.0	3.0	--	6.1	--	--
Israel	182.0	35.0	--	--	--	--	147.0
Italy	866.5	167.6	579.2	--	119.7	--	--
Japan	98.7	--	13.6	8.0	--	--	77.1
W. Germany	346.1	50.2	283.2	--	12.5	--	0.2
E. Germany	342.6	--	294.6	--	48.0	--	--
Lebanon	25.6	--	--	--	25.6	--	--
Morocco	64.4	64.4	--	--	--	--	--
Malaya	21.1	--	--	--	--	--	21.1
Malta	11.8	11.8	--	--	--	--	--
Norway	34.1	26.7	--	--	--	--	7.4
Netherlands	371.4	327.3	28.5	--	--	15.6	--
Portugal	29.1	29.1	--	--	--	--	--
Nigeria	27.5	27.5	--	--	--	--	--
Rumania	124.3	33.1	1.4	--	38.5	51.3	--
Spain	2,048.5	78.1	1,759.9	--	--	--	210.5
Togo	11.1	11.1	--	--	--	--	--
Tunisia	64.5	56.0	7.0	--	1.5	--	--
United Kingdom	362.8	294.4	21.0	--	--	--	47.4
USSR	675.9	12.3	663.6	--	--	--	--
Venezuela	13.4	13.4	--	--	--	--	--
Unknown	210.4	103.1	25.3	--	67.3	--	14.7

composition of the countries receiving U.S. grain shipped from Canadian ports can vary considerably from year to year, in 1980 the following countries received the greatest volume in thousand metric tons: Spain (2,048.5); Italy (866.5); USSR (675.9); Netherlands (371.4); United Kingdom (362.8); West Germany (346.1); and East Germany (342.6). These seven countries received approximately three-quarters of the total U.S. grain shipped from Eastern Canadian ports.

Canadian Great Lakes Grain Shipments, 1980[4]

In 1980, a total of 14.8 million metric tons of grain was shipped from Canadian Great Lake ports (see Table 11). This compares to a U.S. Great Lake total of 15.1 million metric tons (see bottom of Table 9).

Nearly 95 percent of the grain shipped from all Canadian Great Lake ports originates at Thunder Bay. In 1980, 13.9 million metric tons of grain was shipped from Thunder Bay which makes it the largest volume Great Lake port. By comparison, the largest volume U.S. grain port, Duluth-Superior, shipped 8.1 million metric tons, or only about 60 percent of the volume handled at Thunder Bay.

By volume, wheat is the most important Canadian grain shipped. In 1980, wheat shipments accounted for roughly 78 percent of the total Canadian grain volume. Barley shipments ranked second in volume and represented some 10 percent of total volume. The volume of the remaining commodities listed in Table 11 was small relative to the total shipments.

Information on the specific country of destination for each Canadian Lake port by type of grain is reported in Appendix B. Of the direct overseas shipments from Thunder Bay (Canada's largest grain port), the following countries received the majority of grain and sunflower seeds (in metric tons): USSR (294,139); Brazil (259,729); Holland (226,945); Poland (92,240); and West Germany (87,048). These five countries received over three-quarters of the total direct overseas shipments from Thunder Bay. Although Eastern Canadian ports received 75 percent of the total Canadian Great Lakes grain shipments in 1980, the specific country of destination of this grain is unknown.

In Summary

The volume of grain traffic over the Great Lakes-St. Lawrence Seaway exceeds that of any other major commodity group. During the 1978-80 period, grain shipments averaged 43 percent of the traffic moving through the Welland Canal section of the Seaway. In 1980, grain shipments were 43.7 percent of total Seaway traffic--the greatest percentage in the history of the Seaway. During the same three-year period (1978-80), the allocation of total grain shipments averaged 52 percent for the U.S. and 48 percent for Canada.

In 1980, 634.0 million bushels of grain were shipped from U.S. Great Lake ports. Corn was the largest volume U.S. commodity shipped on the Lakes and when combined with wheat they accounted for some two-thirds of the total volume. Duluth-Superior was the most active port with over 363 million bushels (57 percent of total U.S. Lake shipments) shipped, followed by Toledo with over 167 million bushels shipped (26 percent of total U.S. Lake shipments). The ports of Milwaukee, Chicago, Huron, and Saginaw accounted for the bulk of the remaining originating grain shipments.

In 1980, the two largest U.S. ports shipped directly overseas to the following countries (000 bu.): Spain (23,936); Italy (21,679); Holland (15,946); Venezuela (8,032); United Kingdom (7,851); France (7,824); Japan (6,367); and Belgium (5,633). These eight countries received over 70 percent of the total grain shipments from Duluth-Superior and Toledo in 1980.

Approximately 50 percent of all grain shipped from U.S. Lake ports moves to Eastern Canadian elevators. Virtually all of the U.S. grain shipped to Eastern Canadian (St.

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[4]Ibid.

TABLE 11

Canadian Great Lakes Grain Shipments, 1980

(Metric Tons)

Ports & Destinations	No. of Cargoes	Total	Wheat	Corn	Oats	Barley	Rye	Flaxseed	Rapeseed	Soybeans	Sunflower
Canada Great Lakes - Total	943	14,795,987	11,565,843	528,044	299,055	1,528,203	355,905	242,941	172,113	47,062	56,721
Direct Overseas	170	1,602,063	380,118	332,250	109,223	84,245	315,159	187,322	126,060	10,965[a]	56,721
Great Lakes - Canada		2,166,995	1,588,047	172,704	69,465	298,823	1,759	--	--	36,197	--
St. Lawrence		11,026,929	9,597,678	23,090	120,367	1,145,135	38,987	55,619	46,053	--	--
Thunder Bay - Total	836	13,896,927	11,241,989	--	299,055	1,528,203	355,905	242,941	172,113	--	56,721
Direct Overseas	121	1,258,848	380,118	--	109,223	84,245	315,159	187,332	126,060	--	56,721
Great Lakes - Canada		1,685,095	1,315,048	--	69,465	298,823	1,759	--	--	--	--
St. Lawrence		10,952,984	9,546,823	--	120,367	1,145,135	38,987	55,619	46,053	--	--
Windsor, Ontario - Total	26	204,634	78,762	114,916	--	--	--	--	--	10,965[a]	--
Direct Overseas	18	107,338	--	96,373	--	--	--	--	--	10,965[a]	--
Great Lakes - Canada	8	97,305	78,762	18,543	--	--	--	--	--	--	--
Wallaceburg, Ontario - Total	9	33,748	10,658	23,090	--	--	--	--	--	--	--
St. Lawrence	9	33,748	10,658	23,090	--	--	--	--	--	--	--
Sarnia, Ontario - Total	42	406,161	194,237	175,727	--	--	--	--	--	36,197	--
Direct Overseas	16	128,455	--	128,455	--	--	--	--	--	--	--
Great Lakes - Canada	26	277,706	194,237	47,272	--	--	--	--	--	36,197	--
Goderich, Ontario - Total	30	254,508	40,197	214,311	--	--	--	--	--	--	--
Direct Overseas	13	107,422	--	107,422	--	--	--	--	--	--	--
Great Lakes - Canada[b]	12	106,889	--	106,899	--	--	--	--	--	--	--
St. Lawrence[c]	5	40,197	40,197	--	--	--	--	--	--	--	--

[a] Includes 7,500 tons of soybean meal.

[b] Includes: 9 cargoes to St. Lawrence - Canada; 1 cargo to St. Lawrence - U.S.; and 2 cargoes to Newfoundland, N.S.

[c] Includes 5 cargoes (total amount) to Georgian Bay, Ontario.

Lawrence) ports ultimately moves to foreign country destinations. In 1980, Spain, Italy, USSR, Netherlands, United Kingdom, West Germany, and East Germany received approximately three-quarters of the total U.S. grain shipped from Eastern Canadian ports.

In Canada, a total of 14.8 million metric tons of grain was shipped from Canadian Lake ports. This compares to 15.1 million metric tons shipped from U.S. Great Lake ports. Of the direct overseas shipments from Thunder Bay, the following countries received the major portion of grain and sunflower seeds (in metric tons): USSR (294,139); Brazil (259,729); Holland (226,945); Poland (92,240); and West Germany (87,048). These five countries received over three-quarters of the total direct overseas shipments from Thunder Bay. The greatest volume of Canadian grain exports originates from Eastern Canadian ports (St. Lawrence), but the specific country of destination of this grain is unknown.

Although the main interest of this section was to present descriptive data on the volume, origin, and destination of grain flows on the Great Lakes-St. Lawrence Seaway, some important observations are apparent. Both Canada and the U.S. constitute roughly equal grain traffic on the Seaway. The shipment of grain from both U.S. and Canada is the single most important (in terms of volume) commodity shipped on the Seaway. The relative importance of grain traffic has continued to increase over the years and a simple extrapolation of historical traffic data suggests that the future economic role of grain shipments on the Seaway will become increasingly important.

III. GRAIN EXPORT PROJECTIONS TO 1990

In this section annual trend projections by major port area are made to the year 1990.[5] The accuracy of projections beyond 1990 can be seriously influenced by unforeseen changes in the factors affecting grain exports. These trend projections are based on the assumption that future grain flows will correspond to growth trends established during the period 1974-81. Data prior to this period was considered to be not indicative of current conditions.

In many cases, grain export growth trends in the various ports have shown either significant increases or decreases. In other cases, substantial year-to-year variations have occurred with no apparent trend established. Regardless of the nature of the data, linear projections may tend to misrepresent the future. Alternatively, nonlinear projections were considered to better reflect grain shipment trends and, hence, were implemented in this section.

Projection Methodology

The volume of grain flowing through U.S. port facilities is derived from the total volume of U.S. grain exports. Therefore, changes in the expected level of U.S. grain exports and the location of the importing countries will be the major factors affecting the future quantities of grain handled at individual ports.[6]

A market share approach is used to project the quantities of grain handled at each of four major U.S. ports: Lakes, Atlantic,

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[5]Annual forecasts are made in full recognition that seasonal variations in export volumes exist. An implicit assumption made here is that the historical seasonal patterns are expected to obtain in the future despite absolute changes in the annual shipments.

[6]Grain is defined to include: wheat, rye, corn (yellow and white), oats, barley, sorghum, soybeans, and flaxseed. The projected market shares do not include sunflower seeds.

Gulf, and Pacific.[7] Total U.S. grain export projections have been made to the year 1990[8] (see Table 12). These figures are based on a wealth of information regarding the world agricultural supply and demand situation. However, these figures include some exports which move across inland borders and therefore are not relevant to this study. In order to adjust these figures to reflect only exports from ports, the historical relationship between the four port totals of Table 13 and the total exports of Table 12 was examined. The percentage of the total that is made up of port exports (i.e., four port total/total exports) was regressed against time so that this percentage could then be projected to 1990. The projected percentages were then applied to the figures in Table 12 to produce the projected four port total in Table 13.

Individual port shares of the four port total were projected to the year 1990 based on a nonlinear relationship between port share (PS) and time (t). Data from 1974 to 1981 were used to statistically estimate the parameters of the relationship, $PS = \alpha t^{\beta}$.[9] The resulting equation was then used to project port share for each port to 1990. The

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[7]Data source for grain exports by port: USDA, Grain Market News.

[8]Data source for total U.S. grain export projections: MSU Agriculture Model, "A Forecast of Grain and Soybean Exports to the Year 2000," Department of Agricultural Economics, Michigan State University, Special Report, July 1981.

[9]The statistical model selected for projecting port shares was based on a comparison of the following three functional forms: linear $PS = \alpha + \beta\ t$; nonlinear $PS = \alpha t^{\beta}$; and logarithmic-reciprocal $\ln PS = \alpha + \beta\ (1/t)$. Although minor differences were observed in the statistical significance of the estimated parameters, some notable differences occurred in the projections. Based on the authors' knowledge of the problem and the ability of the models to explain recent shipment volumes, the nonlinear or log linear model was selected to best represent the future.

TABLE 12

U.S. Exports of Wheat, Coarse Grains, and Soybeans with Forecasts to 1990

Crop Year[a]	Wheat	Coarse Grains[b] (Million Bushels)	Soybeans[c]
1970	728.3	718.2	433.8
1971	598.3	937.5	416.8
1972	1115.3	1507.5	479.4
1973	1213.9	1591.8	539.1
1974	1015.5	1394.4	420.7
1975	1170.9	1951.6	555.1
1976	947.8	1979.5	564.1
1977	1121.4	2203.4	700.5
1978	1193.3	2357.5	739.0
1979	1373.0	2806.2	875.0
1980	1510.0	2719.6	724.0
1981	1798.6	2581.8	887.8
1982	1704.6	2499.2	892.4
1983	1631.0	2711.7	890.5
1984	1588.0	2912.4	908.6
1985	1592.8	3038.4	912.0
1986	1700.0	3203.7	950.3
1987	1778.1	3447.7	978.6
1988	1869.4	3778.3	1015.2
1989	1956.4	4097.1	1058.6
1990	2051.2	4439.5	1118.2

[a]Crop year: wheat and corn, July-June; and soybeans, October-September.

[b]Coarse grains include: corn, oats, barley, and sorghum.

[c]Does not include soybean oil or soybean meal.

Source: "A Forecast of U.S. and World Agriculture to the Year 1990," MSU Agricultural Model, Quarterly Report, Dept. of Ag. Econ., Mich. State Univ. (Spring 1982), p. 106.

TABLE 13

Annual Grain and Sunflower Exports
by Port Area with Forecasts to 1990

Year	Lakes				Atlantic		Gulf		Pacific		Total (Including Sunflowers)	
	Grain Mil. Bu.[b]	Sunflowers Mil. Bu.[c]	Total Grain & Sunflowers	% Including Sunflowers	Mil. Bu.	%	Mil. Bu.	%	Mil. Bu.	%	Mil. Bu.	%
1970	319.5	NA	319.5	17.50	102.4	5.61	1,147.1	62.81	257.2	14.08	1,862.2	100
1971	304.3	NA	304.3	17.84	94.3	5.53	1,114.3	65.33	192.8	11.30	1,705.7	100
1972	336.9	NA	336.9	14.53	226.9	9.79	1,500.9	64.73	254.0	10.95	2,318.7	100
1973	474.7	NA	474.7	13.52	389.1	11.08	2,250.3	64.07	398.0	11.33	3,512.1	100
1974	271.9	13.0	284.9	9.85	362.4	12.53	1,884.9	65.15	360.9	12.47	2,893.1	100
1975	320.4	16.3	336.7	10.60	430.8	13.57	2,041.8	64.29	366.4	11.54	3,175.7	100
1976	309.1	22.6	331.7	9.26	534.5	14.92	2,329.0	65.00	387.9	10.82	3,583.1	100
1977	366.1	42.0	408.1	11.97	462.1	13.55	2,222.5	65.19	316.8	9.29	3,409.5	100
1978	555.0	91.5	646.5	15.07	507.8	11.84	2,617.3	61.03	517.1	12.06	4,288.7	100
1979	510.5	98.2	608.7	13.05	585.8	12.56	2,779.7	59.61	689.1	14.78	4,663.3	100
1980	476.9	98.3	575.3	11.67	528.8	10.72	2,909.6	59.00	917.9	18.61	4,931.5	100
1981	389.8	83.5	473.3	9.62	515.6	10.48	3,034.4	61.65	898.2	18.25	4,921.5	100
1982	477.2	115.1	592.3	12.44	538.0	11.30	2,864.0	60.13	768.4	16.13	4,762.7	100
1983	489.3	123.3	612.6	12.54	543.9	11.13	2,918.2	59.75	809.6	16.58	4,884.3	100
1984	505.2	130.9	636.1	12.62	554.3	10.99	2,995.0	59.40	856.7	16.99	5,042.1	100
1985	517.2	138.1	655.3	12.69	560.7	10.86	3,049.5	59.07	897.2	17.38	5,162.7	100
1986	545.6	144.8	690.4	12.68	585.1	10.75	3,201.2	58.81	966.7	17.76	5,443.4	100
1987	557.7	151.1	708.8	12.35	613.2	10.68	3,373.9	58.78	1,043.8	18.19	5,739.7	100
1988	619.9	157.2	777.1	12.59	651.7	10.55	3,604.3	58.38	1,140.7	18.48	6,173.8	100
1989	661.2	162.9	824.1	12.53	688.8	10.47	3,828.5	58.19	1,237.7	18.81	6,579.1	100
1990	706.8	168.4	875.2	12.45	730.2	10.39	4,077.0	58.02	1,344.8	19.14	7,027.2	100

[a]Source: Grain Market News, USDA.

[b]Does not include sunflower seed shipments.

[c]Sunflower seeds weight 28 lbs./bu.

four port total was allocated to each of the four ports based on this estimated market share.

Historical Export Volumes

During the period 1974-81 (post Soviet grain deal), the average port shares of grain exports (including sunflower seeds) were: 11.4 percent Lakes; 12.5 percent Atlantic; 62.6 percent Gulf; and 13.5 percent Pacific (see Table 13). Some interesting trends in port shares during the last decade are apparent in Table 13. While the Lake share of total exports declined during the early 1970s, during the period from which projections were made (1974-81), the Lakes share of total U.S. exports remained relatively stable at about 11.5 percent. On the other hand, the Atlantic share of total exports approximately doubled during the early 1970s and then remained relatively constant at about 12.5 percent during the period from which projections were made. The Gulf ports also experienced a very modest increase in market share during the early 1970s, but experienced a gradual decline in its market share during the late 1970s. Finally, the Pacific coastal port market share declined somewhat during the early 1970s, but experienced a greater gain in market share during the late 1970s than any of the four coastal ports. The recent increase in the Pacific coastal port market share seems to be at the expense of each of the other three port areas with perhaps the Gulf port experiencing the greatest effects of the rapidly escalating Pacific coast export volumes.

The importance of sunflower seed shipments as a component of total Great Lake grain shipments is apparent from the information presented in Table 13. Since 1974, sunflower seed shipments have increased over 600 percent, from 13.0 mil. bu. to 98.3 mil. bu. in 1980. This extraordinary growth in the export of sunflower seeds from Lake ports has contributed substantially to the total volume of agricultural exports from Lake ports. During the last five years, sunflower seeds have constituted some 15 percent of total grain and sunflower Lake exports. Expected rates of growth in sunflower seed shipments at Lake ports are expected to exceed the rates of growth of grain shipments during the coming decade.

Future Export Levels

In the future, some interesting growth projections are observed. For all port areas, absolute levels of increase in grain exports are expected through 1990. However, the relative market share of each port differs as the future develops (Table 13).

As a baseline for comparison, the most recent three-year average (1979-81) is used. For grain and sunflower seeds, these baseline figures are: total, 4,838 million bushels; Lakes, 552 million bushels (11.4 percent); Atlantic, 543 million bushels (11.2 percent); Gulf, 2,908 million bushels (60.1 percent); and Pacific, 835 million bushels (17.3 percent). By the year 1990, total grain exports are projected to increase by 45.2 percent to 7,027.2 million bushels. In the four coastal ports, expected percentage increases in grain shipments by 1990 are: Lakes, 58.0 percent; Atlantic, 34.4 percent; Gulf, 40.2 percent; and Pacific, 61.0 percent. The greatest percentage increase in grain exports can be expected at the Pacific ports followed by the Lake ports. The smallest percentage increase can be expected to occur at the Atlantic ports. Notwithstanding the greatest absolute volume increase occurring at the Gulf ports, their percentage increase is expected to be 40.2 percent. All ports will experience substantial growths in grain volumes, but a relatively larger share of total U.S. grain exports can be expected to move through the Pacific and Lake ports.

Projected sunflower seed exports contribute substantially to the expected increase in agricultural exports through the Lake ports. With the addition of sunflower seed export projections, the Lake ports will challenge the Pacific ports in achieving the most rapid growth in exports. Clearly, the Lake ports can expect a sizable growth in grain and sunflower exports over the next decade.

It should be borne in mind that the projected shares of total U.S. grain exports are based upon nonlinear projections of historical patterns. Inherent in these historical patterns are changes in the country of final destination that may have occurred during the 1974-81 period. Notwithstanding projected growth in total U.S. grain exports, the global location of final demand for these exports has important implications for future U.S. port growth. A discussion of the destination of grain exports will be given in Section VI.

Another possible factor that may affect the port shares of future exports is the deregulation of rail rates. Since the Staggers Rail Act didn't pass until 1980, the effect of deregulation is not captured in the sample period used here. If unit trains to the Atlantic coast ports become more economical, the projection here for the Lakes ports may be overly optimistic. Any unforeseen institutional change will have an effect on port shares that can't be predicted by the projection method used here.

IV. PORT CAPACITIES

Projected grain exports for each of the four major port areas were shown in the previous section (Table 14). The shares of exports for the Pacific and Great Lakes ports are projected to increase through 1990, while the shares for the Gulf and Atlantic ports are projected to decrease. In absolute terms though, the volume of exports passing through all the ports will be increasing over the next few years. This prediction leads one to ask whether the ports have the capacity to handle the increased traffic and still maintain an acceptable level of performance.

Port capacity is difficult to assess and even harder to predict. It depends on a variety of factors which are influenced by both private and public actions. Predicting future port capacities would require knowledge of port development policies of public agencies as well as private sector responses to anticipated economic conditions. In the absence of reliable predictions of future port capacities, an attempt will be made here to assess current port capacities and how they compare to grain export projections.

Port capacity can be defined in a number of ways. There is a limit to the rate at which grain can be unloaded from inland carriers at the port and a limit to the rate at which grain can be loaded onto ships. There is also a storage capacity constraint in elevators. Dezik and Fuller (1979) have compiled port storage capacities and found them to be greatest on the Great Lakes and least on the Atlantic:

TABLE 14

Grain Storage Capacity by Major Port

Port	Port Storage Capacity (Million Bushels)
Great Lakes	131.2
Gulf	112.5
Pacific	52.2
Atlantic	40.3

Source: Dezik, Jack and Stephen Fuller, U.S. Grain Ports: Location and Capacity, Texas Agricultural Experiment Station, PR-3593, October 1979.

Port storage capacity, however, is not usually the limiting factor. Other factors include ship loading rates, draft at elevator, ability to handle more than one ship simultaneously, unloading facilities at the port, and number of shifts that are worked. When all of these factors are taken into consideration, the estimates of throughput capacity differ greatly from the elevator storage capacities. In 1975, the U.S. Maritime Administration estimated the average practical throughput capacities as follows:

TABLE 15

Grain Throughput Capacity by Major Port Area

Port	Average Practical Throughput Capacity (Million Bushels)
Great Lakes	554
Gulf	2,274
Pacific	765
Atlantic	523

Source: U.S. Maritime Administration, National Port Assessment, 1980-1990, U.S. Dept. of Commerce, June 1980.

When these were combined with their 1975 forecasts of exports to 1990, it indicated a need for three new grain terminals in the Great Lakes area and seven additional facilities in the Gulf area (U.S. Maritime Administration, 1980). Alternatively, using the forecasts of grain exports previously presented (Table 13) and the above estimates of throughput capacity (Table 15), there would appear to be a need for additional capacity at all the ports by 1990. However, a later study by Gaibler (1979) gives a different indication of port throughput capacity. Gaibler estimated capacity in two ways. The first is an indication of capacity based on peak export volumes in the past, i.e., what we know is a possible capacity. The second is an engineering estimate based on ship loading rates of port elevators, or what is technically a possible capacity. Both estimates are given as follows:

TABLE 16

Grain Export Capacity Based on Peak Volumes and Technical Considerations by Major Port Area

Port	Capacity Based on Peak Export Volumes	Engineering Capacity Based on Aggregate Loading Rate/Year
	(Million Bushels)	
Great Lakes	552	1,824
Gulf	2,964	2,856
Pacific	828	1,464
Atlantic	696	984
Total	5,040	7,128

Source: Gaibler, Floyd D., The Transportation System's Capacity to Meet Grain Export Demand, 1979/80 Outlook, ESCS, USDA, October 1979.

The engineering capacity of the Great Lakes port area is well above what the peak volumes indicate (Table 16). The Gulf port areas, though, show less engineering capacity than what has actually existed during peak times. This seemingly erroneous result is due to the fact that the engineering capacity in Table 16 does not consider the possibility of multiple shifts by workers, which is often done in the Gulf area during times of peak export volume. Therefore, it is possible that the engineering capacities above are understated. However, these figures are also based on manufacturers' estimates of equipment capacity operating under ideal conditions (Gaibler, 1979), which may overstate the true capacity under more realistic conditions. In light of both of these factors, the engineering capacities from Table 16 should be regarded as rough estimates. Nevertheless, it is felt that these engineering estimates are more appropriate for the purposes of this report than the estimates based on past peak volumes. In order to know if port capacity is going to be a problem in the future, one needs to know the potential capacities of each port. Therefore, the engineering capacities of Table 16 are used as an indication of port throughput capacity, with the understanding that they can be expanded by multiple shifts, at least in the short-run.

When the export projections of Table 13 are compared to the engineering capacities of the ports at the present time, only the Gulf port will need additional capacity. Some of the additional capacity is being provided at the present time by working multiple shifts. If we allow for even modest growth in port capacities over time and assume that multiple shifts will continue to be a practice, it does not appear that port capacity will be a serious constraint through 1990. The Gulf port, however, will be operating closest to capacity levels and any disruptions in the system (e.g., labor strikes or vessel shortages) could lead to overflow conditions and diversions through other ports.

While Great Lakes port capacity is generally acknowledged to be adequate, the Lewis Dreyfus Corporation has questioned the capacity of the St. Lawrence River deep water ports to handle future increases of exports (Seaway Review, 1981). Their estimate of capacity for these ports is 845 million bushels and they reported that some of these ports are operating at capacity already. The Dreyfus Corporation, however, predicts a much larger export volume for the Great Lakes than the 1990 export projection made here of 875.2 million bushels. Of this volume, only a portion will be transshipped through the St. Lawrence River ports. The 168.4 million bushels of sunflowers which are included in this total would be shipped directly from Duluth/Superior to the overseas destination, without any use of the St. Lawrence River ports. This is due to the fact that sunflowers have a high bulk to weight ratio and can fill a ship at a Great Lakes port without exceeding the shallow draft limitation of the Seaway. Of the remaining 706.8 million bushels of grain projected for 1990, a portion will go directly to overseas destinations and the remainder will be transshipped. In 1981, the portion which was transshipped was 58 percent of the total U.S. Great Lakes exports. While this portion varies from year to year, the highest it has been since 1970 is 67 percent of total grain exports. The average portion which was transshipped through St. Lawrence ports since 1970 is 49 percent.

If we apply a 50 percent factor (to reflect the average) to the total projected grain exports going through the Seaway in 1990, we would predict that a capacity for 353.4 million bushels of U.S. grain will be needed at St. Lawrence River ports. To this must be added the capacity that will be needed for Canadian grain which will be transshipped through the deepwater St. Lawrence ports. The Dominion Marine Association (March 1978) projected that 394.7 million bushels of Canadian grain would move by laker to the Atlantic (Seaway) ports for export. If these are added together, the resulting 748.1 million bushels of grain leaves a relatively large margin for error when compared to the Dreyfus estimated throughput capacity of 845 million bushels. However, there exists an institutional constraint which may limit throughput capacity at the St. Lawrence ports. The Canadian Wheat Commission requires that only 40 percent of Canadian St. Lawrence elevator storage capacity be used for U.S. grain at any one time (U.S. Maritime Administration, 1982). The interdependence between U.S. and Canadian exports cannot be ignored when attempting to project exports through the St. Lawrence Seaway.

In summary, port capacity does not appear to be a major obstacle to increasing exports of grain through any of the ports in the near future. It is clear that the Gulf port is operating nearest to capacity levels and is therefore more sensitive to any stresses in the system. However, Gulf port elevator managers do not feel that capacity will be a major problem in the near future. The port facilities themselves appear to be adequate. We expect most obstacles in the future movement of grain exports to come from other sources, as discussed in following sections.

V. SHIPPING RATES

Exports of grain can be shipped from Great Lakes ports by a variety of transportation modes and routes. Relative prices and terms of contracts will determine the combination of modes chosen from any point of origin to the overseas destination. There are three major ways to transport grain from the upper Midwest ports for export by ocean vessels. Grain can be transported by rail to either Atlantic or Gulf ports. It can also go by barge to Gulf ports. Finally, grain can move by lakers, through the Great Lakes and St. Lawrence Seaway, to ocean ports on the St. Lawrence River. All of these routes require reloading onto an ocean vessel for the overseas shipment. A fourth alternative, which does not require reloading, is the ocean vessel which can pass through the St. Lawrence Seaway and the system of locks to the Great Lakes ports, and take grain from these ports directly overseas. There is a maximum size of ship that can be used for this alternative (730' length, 76' beam), and even then, most ships cannot take a full load out through the Seaway, but instead, must "top-off" once they get through the shallow lock system (Sussman, 1978). Nevertheless, about 48 percent of the grain moving out of the St. Lawrence Seaway in 1981 was moved by ocean vessels and the remainder was transported by laker (The St. Lawrence Seaway Authority, 1982).

In order to compare the economic viability of the Great Lakes transportation route with the alternative routes, some selected rates for transporting grain overseas were examined. The major Great Lakes grain exporting ports of Duluth/Superior, Chicago, and Toledo were chosen for analysis.

There are various other studies which have done similar analyses of transportation rates for grain going from Great Lakes ports to European destinations. In 1978, the U.S. Maritime Administration examined the relative shipping costs of the same three ports considered here. Their results showed that in all three cases the route through the St. Lawrence Seaway by laker, then ocean vessel, was the most economical (U.S. Maritime Administration, 1978, pp. 47-57). The barge route through the Gulf ports was the next most attractive alternative.

In 1981, the Great Lakes Commission funded a study which included an analysis of grain transportation rates (Great Lakes Commission, 1981). Their study, using rates from August 1981, showed different results for each of the three ports. From the Minneapolis/Duluth area, the most economical route was by barge to the Gulf and then by ocean vessel to Europe. A saltie[10] which would take grain directly from Duluth to Europe was the next best alternative. For the Chicago area, grain could most economically go by rail to Baltimore and then across to Europe. The second best alternative for Chicago was the barge route through the Gulf. From Toledo, the laker route through the St. Lawrence ports was the most attractive alternative, while the barge route was again second best. It is apparent that the three years that lapsed between the two studies resulted in a substantial change in relative rates. It is also possible that the methods used for deriving the rates varied between the two studies.

In 1980, the USDA conducted a study which compared grain transportation rates for various modes going from Readlyn, Iowa and Cottage Grove, Wisconsin to overseas ports. The port of Milwaukee was assumed to be the Great Lakes port that would be used. This study differed from the other two in that elevator handling charges and transportation to the Great Lakes port were included.[11] The results showed that grain moving from Readlyn, Iowa to Rotterdam could most economically move by unit train to the Gulf,

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[10]A "saltie" is a vessel designed for ocean travel while a "laker" has a hull designed for the smaller waves of the Great Lakes.

[11]In the other studies, only rates for shipping the grain from the major port area to the overseas destination were included. Because of the high volume of grain that goes through the ports of Duluth, Chicago, and Toledo, it is useful to compare rates only from these major ports, abstracting from the actual origin of the grain.

then be loaded onto ocean vessels. The second best alternative was to transport the grain by barge to the Gulf ports. When the final destination was the Russian Black Sea ports, the most economical route was through the St. Lawrence Seaway, using a direct ocean vessel that topped off at the St. Lawrence ports. This was nearly $2.00/ton cheaper than going by unit train to the Gulf. For grain originating at Cottage Grove, Wisconsin, the cheapest route to Rotterdam was through the St. Lawrence Seaway again, using a topped ocean vessel. The next best alternative would have been to use a laker to move the grain to the St. Lawrence ports and then transship by ocean vessel. When the Russian Black Sea ports were the final destination, the topped ship rates were still the lowest, with the laker alternative next.

While it is interesting to compare the results of these studies with other results which follow in this report, the most important point to bear in mind is the variability of the rates. Part of this variability stems from the competitive nature of the system, but part of the apparent variability comes from the many possible sources of information on rates. These previous studies have different assumptions and sources and therefore it is not legitimate to compare the results directly.

For the following analysis, rates quoted or actually charged since the opening of the Seaway season (April-May) through September 1982 are used to make comparisons. Due to different terms of contracts and other variables, rates are not always directly comparable, even within the same transportation mode (e.g., rail rates from Chicago may have different minimum carloads than the rates cited from Toledo). The terms and minimums accompanying the rates should be noted carefully. It also should be stressed that grain transportation rates fluctuate constantly and are subject to the pressures of a competitive market. When an excess number of cars, barges, and ships are present, rates can be bid down quite low. Also, if a large shipment can be guaranteed, the shipper will be able to contract for a better rate than that which is quoted for smaller shipments. In general, it is not possible to find a single rate which applies to all shipments by a particular mode of transportation. The rates used here should be viewed as representative rates for grain shipments in 1982.

Duluth/Superior Rates

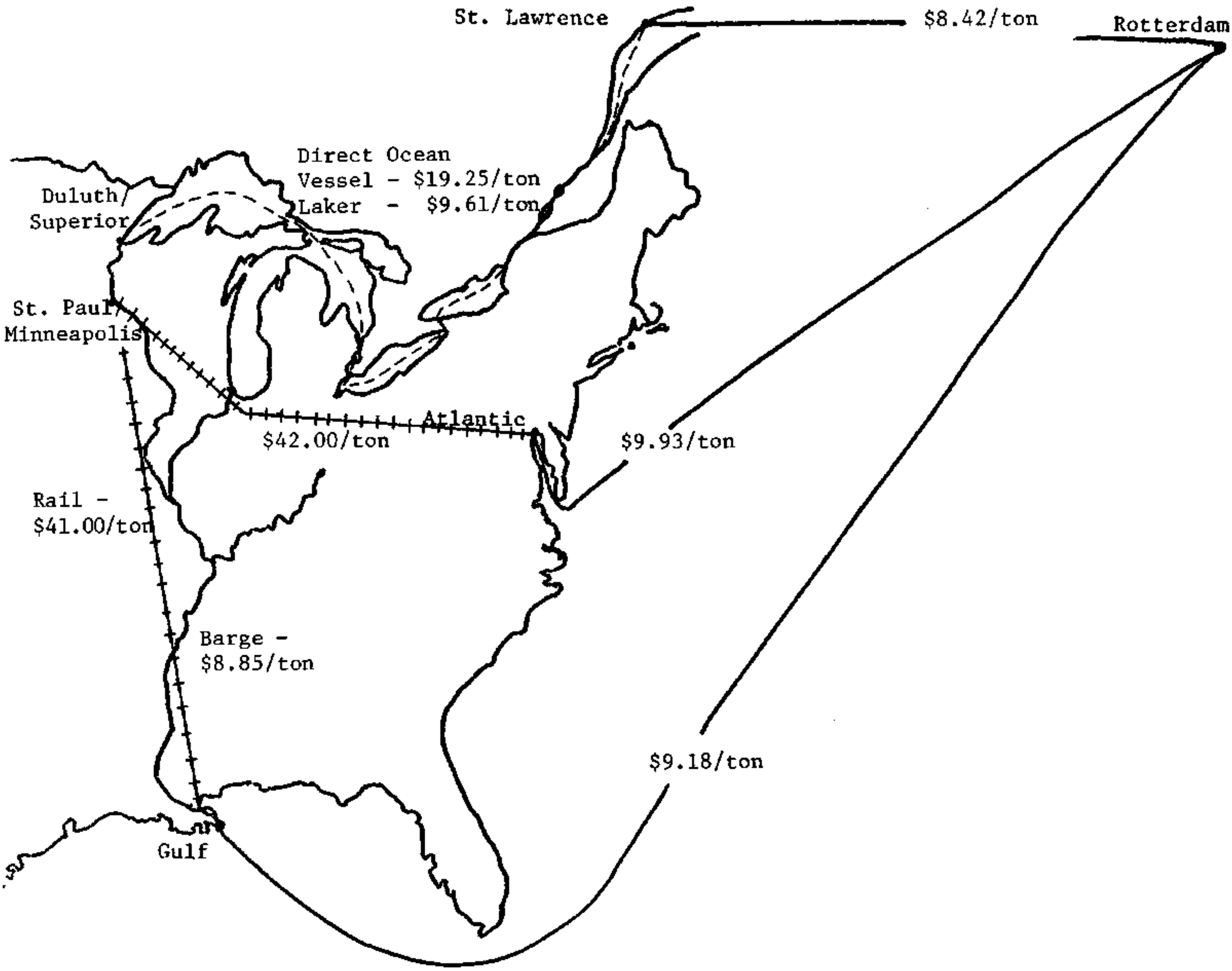
The water route from the Duluth/Superior port can be compared to the rail and barge routes from Minneapolis/St. Paul. The grain coming into the terminal facilities at Duluth/Superior could alternatively go to the facilities on the Mississippi River at Minneapolis/St. Paul for about the same inland rate (U.S. Maritime Administration, 1978, p. 22). Therefore, there are four possible ways for the grain to be exported. It can go by rail to the Atlantic ports, by rail to the Gulf ports, by barge to the Gulf ports, or by vessel through the Great Lakes and Seaway. Figure 4 shows the alternative routes and the rates associated with each. Rotterdam was used as the final destination point from all three ports and 1982 rates are cited.

The rail rates from Minneapolis/St. Paul are $41.00/ton to the Gulf and $42.00/ton to the Atlantic ports. Figure 4 shows that these rates are quite high relative to the barge and vessel rates. This finding is in agreement with the 1978 study (U.S. Maritime Administration, 1978) and shows that the rail route in this case would be unattractive except in winter when the water routes are closed.

The barge rate from Minneapolis/St. Paul is based on a benchmark that is used on the Merchants Exchange of St. Louis where barge contracts are traded. The benchmark rate of $6.19/ton has been in effect for many years and barge owners can no longer run a profitable business at this rate (Grain Transportation Situation, July 26, 1982). However, due to the extreme overcapacity conditions that are now present, barge rates have been running anywhere between 110-180 percent of the benchmark. For comparison, in September of 1980, barge rates were around 300 percent of tariff. While we would expect to see much higher barge rates in the future, due to either increased traffic or fewer operators, we have used an average rate for March through August of $8.85/ton to reflect the 1982 situation.

Figure 4

Grain Shipment Rates From
Duluth/Superior to Rotterdam



Sources:
Laker Rates: Vessel Agents
Ocean Rates: MarAd Office of Trade Studies, Vessel Agents, and Grain Transportation Situation
Rail Rates: Minneapolis Grain Exchange, for grains, 1,000 ton minimum
Barge Rates: Consolidated Grain and Barge Company

The laker rate is quoted by vessel agents for a laker which transports the grain from Duluth/Superior through the "Soo" locks, through the Welland Canal and the Montreal-Lake Ontario locks, and finally to one of the deep water ports on the St. Lawrence River. Some of this grain is then used to top-off ocean vessels coming from the Great Lakes, and some is loaded onto the larger ocean vessels that come into these ports. The laker rates tend to be more stable than the barge rates (U.S. Maritime Administration, 1978), but they are still relatively low due to over-capacity at this time. The rate used here of $9.61/ton does not include the Seaway toll of $0.79/ton that is charged for passage through the combined sections of the Welland Canal and Montreal-Lake Ontario locks. Table 17, which compares the total charges for alternative routes, includes this toll.

The rates above must be added onto the ocean rates which are for the transport of grain overseas to Rotterdam. Like the other rates, the ocean rates are currently depressed due to overcapacity at the ports. In the Gulf area, there have been more ships arriving with cargo than leaving with exports, and a build-up of ships there has led to rates as low as $5.00/ton (USDA, Grain Transportation Situation, July 12, 1982). These rates vary widely, however, and a weighted average from April to October 1982 of $9.18/ton has been used here.[12] A similar average was used for the Atlantic ports, which was $9.93/ton, although rates as low as $5.00/ton were also recently cited there. The ocean rate from the St. Lawrence Seaway to Rotterdam was more difficult to calculate, since there is a top-off rate as well as a rate for vessels which load completely at these ports. The top-off rates, however, were not averaged in here since they apply to much smaller ships which go through the Seaway. It should also be noted that most ocean vessels leaving the St. Lawrence Seaway ports are smaller than those using the Gulf or Atlantic ports, although some are in the 60,000+ DWT (Dead Weight Tons) category. In spite of this, the weighted average of $8.42/ton is still less than either the Gulf or Atlantic rates.

The final shipping alternative for Duluth/Superior is to transport grain directly overseas in an ocean vessel through the Seaway. An ocean vessel can carry out a maximum of around 23,000 tons to the lower St. Lawrence River where it can top-off to capacity (St. Lawrence Seaway Development Corporation, 1981). Again, the rate charged will depend on the size of the vessel and the availability of vessels. The number of ocean vessels which are available at the Great Lakes ports have historically been a function of the amount of manufactured steel products that the Great Lakes area is importing. The two-way trade possibility of steel products for grain has been what attracts the ocean vessels to the Great Lakes ports (U.S. Maritime Administration, 1978). The amount of steel products imported has varied over the years, especially in response to the steel price triggering mechanism designed to prevent dumping of steel products in the U.S.

TABLE 17

Grain Shipment Rates from Duluth/Superior to Rotterdam

Laker, then ocean vessel	$19.01/ton[a]
Ocean vessel through Seaway	$20.04/ton[a]
Rail to Atlantic, then ocean vessel	$51.93/ton
Rail to Gulf, then ocean vessel	$50.18/ton
Barge to Gulf, then ocean vessel	$18.03/ton

[a]With toll.

[12]The rates were weighted by vessel size. By using a weighted average like this, the result can be interpreted as the rate which was most likely to have been charged for the shipment of a ton of grain during this period.

Depending on the situation in other markets (e.g., steel), the availability of ships may be a constraint on the amount of grain that can be shipped via the Seaway.

Almost all rates quoted for ocean vessel transport of grain from Duluth/Superior to Rotterdam were for between 15,000-20,000 ton basis vessel size. The weighted average of these rates was $19.25/ton.

Combining all of the above rate information for the Duluth/Superior port, the five alternative means of transporting grain to Rotterdam are compared in Table 17. The barge to the Gulf route is the most economical, while the two Great Lakes alternatives have the next lowest rates. The rail routes are considerably higher through either port, and would predominantly be a winter route. It should be stressed, however, that these rail rates can vary substantially depending on the terms of the contract.

While the barge route appears most economical, the Great Lakes routes must be considered as competitive alternatives. The barge rates are likely to fluctuate much more than the laker or ocean rates, and a return to the 300 percent of tariff rate for barges would increase the cost of this route substantially. The time in transit for these two alternatives should also be considered. Barges usually take about three weeks to go from Minneapolis/St. Paul to the Gulf, while an ocean vessel might make the entire trip to Rotterdam from Duluth/Superior in slightly less than that time. Unit trains can also save time over the barge route, but the extra cost must be considered.

Chicago Rates

A similar analysis of rates was conducted for the Port of Chicago. The rail rate to the Atlantic of $13.06/ton and the rate to the Gulf of $12.69/ton are based on different minimums which are detailed in Figure 5. The barge rate is again an average for 1982 of $8.05/ton from Chicago to the Gulf. The laker rate was quoted by vessel agents in dollars per bushel and it is assumed that most shipments from Chicago are corn. The ocean vessel rate through the Great Lakes is based on actual rates quoted by vessel agents during 1982. The ocean rates from the deep water ports are the same as before and Figure 5 summarizes the rate information. The combined rates in Table 18 show a much more competitive rail route from Chicago than that from Minneapolis/St. Paul. In fact, all the routes except the barge route are reasonably similar in terms of their rates. The barge route is still the cheapest, but again, the stability of this rate and the seasonality of this route and the St. Lawrence Seaway route must be considered. The rapid transit time of unit trains for transporting grain to the Atlantic ports adds to the attractiveness of that alternative. The Great Lakes route would also show good transit time relative to the barge route.

TABLE 18

Grain Shipment Rates from Chicago to Rotterdam

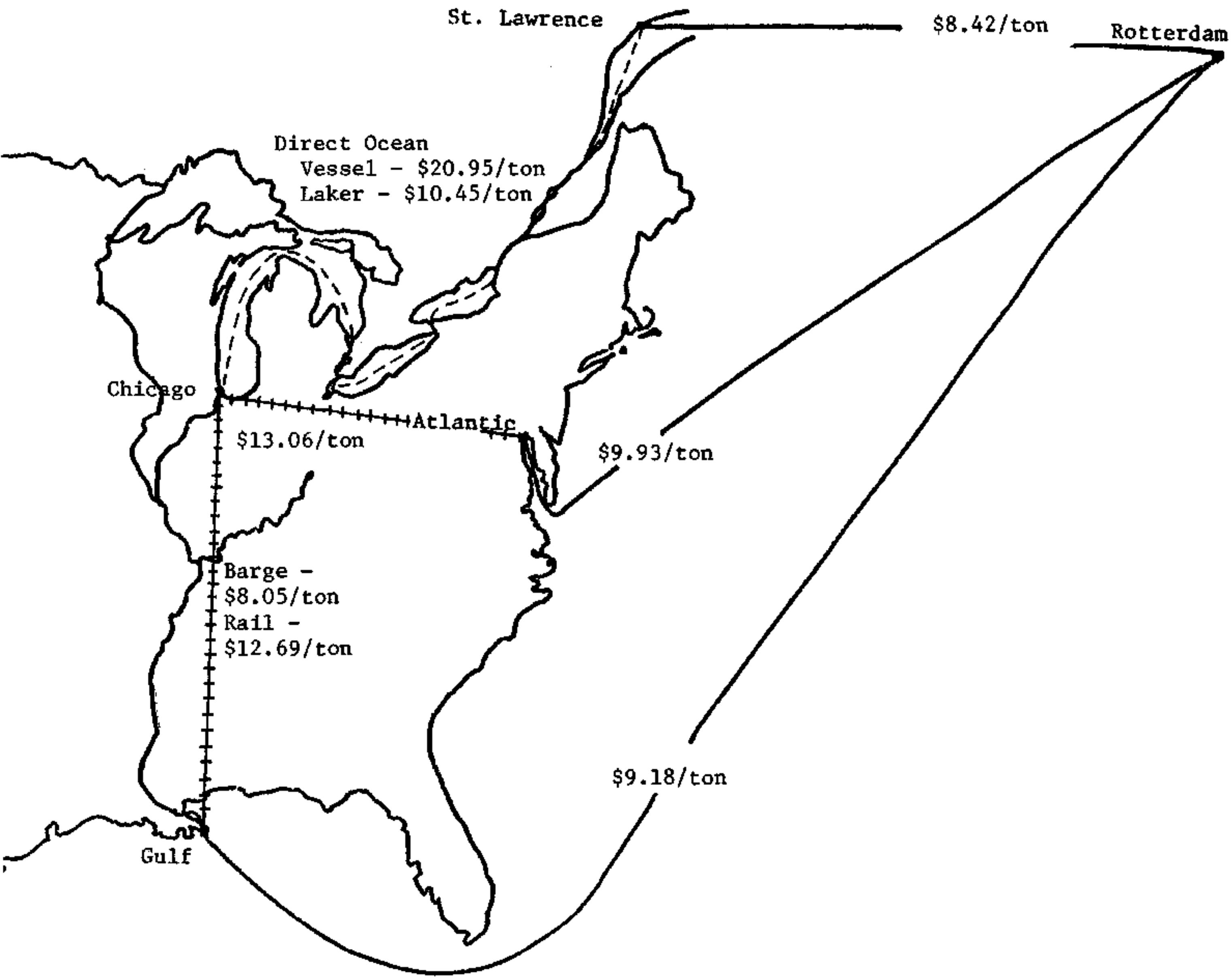
Laker, then ocean vessel	$19.66/ton[a]
Ocean vessel through Seaway	$21.74/ton[a]
Rail to Atlantic, then ocean vessel	$22.99/ton
Rail to Gulf, then ocean vessel	$21.87/ton
Barge to Gulf, then ocean vessel	$17.23/ton

[a]With toll.

The grain transportation situation in Chicago appears to be one of good competition between the alternative modes of transportation, although the barge mode enjoyed an advantage in 1982. Small changes in the structure of rates or terms of contracts for any of these modes could affect the relative competitive position of each. If the domestic transportation system were operating near capacity, there is every reason to believe that the Great Lakes route would be a competitive alternative for the export of grain from Chicago.

Figure 5

Grain Shipment Rates From
Chicago to Rotterdam



Sources:

Laker Rates: Vessel Agents

Ocean Rates: MarAd Office of Trade Studies, Vessel Agents, and Grain Transportation Situation

Rail Rates: Chicago Board of Trade; Atlantic rate for grains and soys, 45 consecutive shipments, 9,800 tons/shipment, not more than 100 covered hoppers/shipment, shipper-owned equipment; Gulf rate for grains and soys, 5 consecutive shipments, min. 11,500 tons/shipment, annual shipments of 598,000 tons. min., shipper-owned

Barge Rates: Consolidated Grain and Barge Company

Toledo Rates

The situation in Toledo is similar to that in Duluth/Superior in the sense that the port facilities can compete with inland facilities at Cincinnati for grain shipments. The Cincinnati to the Gulf route uses the Ohio and Mississippi Rivers and is also experiencing depressed barge rates. The barge rate of $5.95/ton is again an average for 1982. The rail rate from Toledo is $11.14/ton and the laker and ocean rates are from the same sources as the Chicago rates, see Figure 6. The four alternative routes shown in Table 19 show that the Toledo situation is very similar to that of Chicago. The rail rate is again somewhat competitive, due to the short distance to the Atlantic ports. The barge route is still the cheapest and the Seaway routes next. The rail route could easily become very competitive if the overcapacity that exists results in depressed rail rates, as it has done for barge rates. The Lakes route would become a more attractive alternative if some of the overcapacity conditions on the inland transportation system were to ease, thereby raising those rates.

TABLE 19

Grain Shipment Rates from Toledo to Rotterdam

Laker, then ocean vessel	$17.97/ton[a]
Ocean vessel through Seaway	$19.12/ton[a]
Rail to Atlantic, then ocean vessel	$21.07/ton
Barge to Gulf, then ocean vessel	$15.13/ton

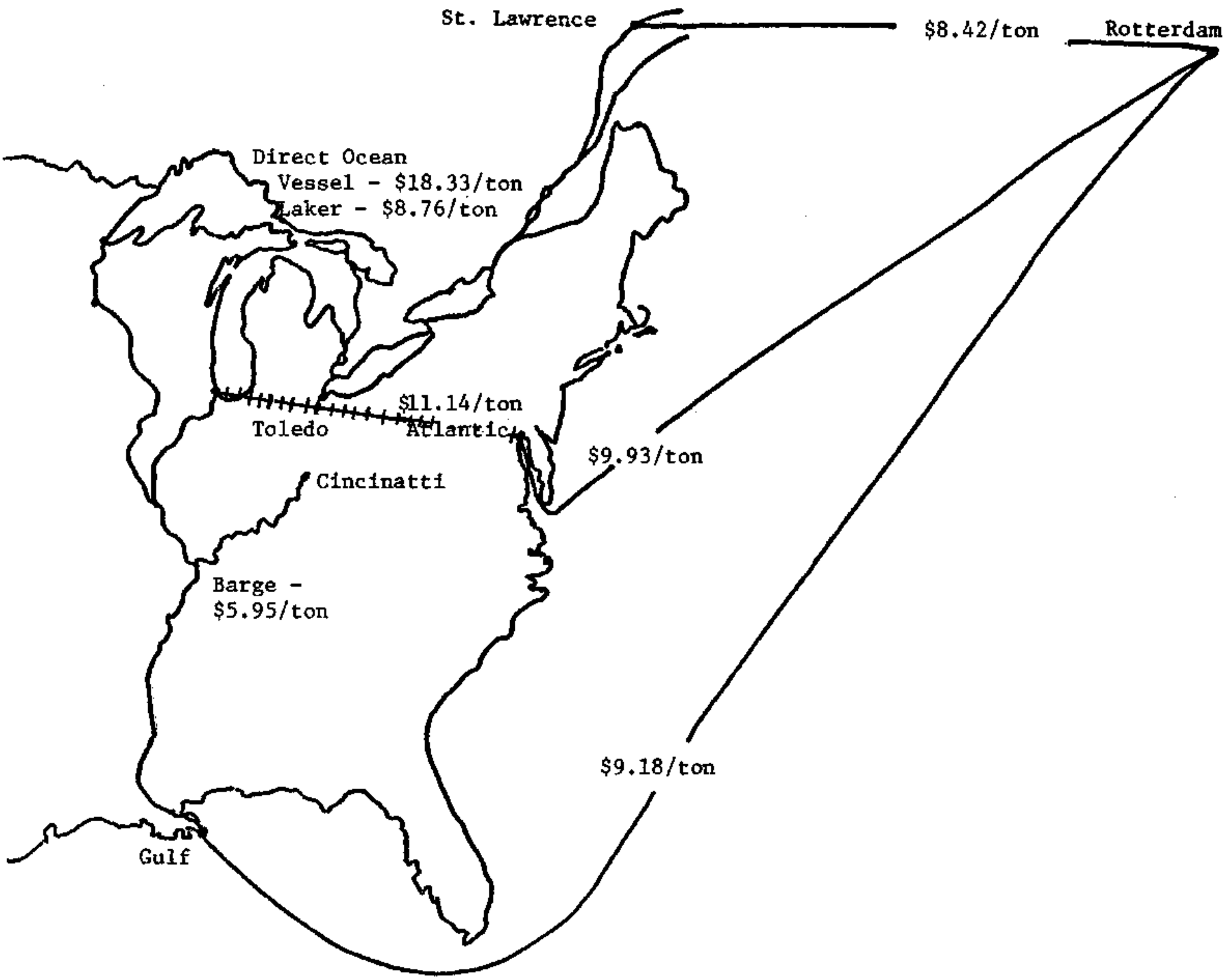
[a]With toll.

Shipping Rate Summary

The results presented in this section indicate that grain exports from Great Lakes port areas to Rotterdam can most economically be shipped by barge to the Gulf, then by ocean vessel to Rotterdam. However, this result can be attributed to the extremely low barge rates which exist as a result of overcapacity on the Mississippi River system. These rates cannot remain in effect for long before some barge operators begin to go out of business. As barge rates rise, the Great Lakes route will become an attractive alternative for the export of grain, especially from the Duluth/Superior port. The Lakes route will also be competitive from the Chicago and Toledo ports, although rail routes must be considered as viable alternatives from these ports. The results from this study can be compared to the results of the 1978 study by the U.S. Maritime Administration. That study showed the Great Lakes route to be the most economical in all three cases, while the barge routes were the second alternative. The difference in results between the two studies shows the impact that changing capacity conditions (from possible overinvestment in the inland transportation system) can have on the relative competitiveness of the alternatives in this system. In light of the variability of transportation rates for grain export, no firm conclusion can be reached as to which transportation mode or route will be most economical in the future. It is clear that the barge to the Gulf routes have been the most economical for the first half of 1982, and the volumes of grain which have moved through the Gulf already in 1982 indicate that shippers are taking advantage of this savings (Grain Transportation Situation, September 27, 1982). It can be concluded, however, that the Great Lakes route has the potential to be a competitive transportation alternative during most of the year and any improvements in this route should lead to an increased share of the grain export traffic for the Great Lakes.

Figure 6

Grain Shipment Rates From
Toledo to Rotterdam



Sources:

Laker Rates: Vessel Agents and Toledo Port Authority
Ocean Rates: MarAd Office of Trade Studies, Vessel Agents and Grain Transportation Situation
Rail Rates: Chicago Board of Trade, for grains and soys, 45 consecutive shipments, 9,800 tons/shipment, not more than 100 covered hoppers/shipment, shipper-owned equipment
Barge Rates: Consolidated Grain and Barge Company

VI. OTHER FACTORS AFFECTING THE RELATIVE COMPETITIVENESS AMONG GRAIN SHIPPING PORTS

There are many other variables besides relative rates and port capacities which affect the movement of grain to export markets. Some of these are constraints on the Seaway system and some are constraints on competitive routes which could lead to increased volume for the Seaway route. A few of these factors will be briefly introduced here, since considerable study and analysis would be necessary to evaluate the actual impact of each. Some references where such analysis has been done will be cited.

Comparison of Energy Efficiency Among Transportation Modes

Sharp increases in fuel prices during the 1970s has brought increasing concern about the energy efficiency of the transportation system. Given that interest in this area is expected to continue through the 1980s, it is useful to compare the energy efficiencies of rail, barge, and Great Lakes vessel transportation of agricultural commodities.

Numerous studies are available on the fuel efficiency of the domestic transportation system. The findings of these studies vary widely, especially with respect to barge transportation. For example, a Department of Transportation study published in 1976 (Eastman, 1980) reported that a lower Mississippi barge traveling downstream could get 1,347 ton-miles per gallon.[13] In contrast, a study from 1973 (Schenker, et al., 1976) states that an average barge can get 250 ton-miles per gallon. It is clear that there are a number of variables which can affect the fuel efficiency of barges, and comparison across studies is difficult. In order to arrive at one figure of fuel efficiency that could be compared to the efficiency of other modes, the ton-miles per gallon for barges reported since 1979 were averaged.[14] The resulting average fuel efficiency for barges was 460 ton-miles per gallon (see Table 20).

TABLE 20

Energy Efficiency Across Modes

Mode	Ton-Miles per Gallon	Ton-Miles per Gallon Adjusted for Circuity[a]
Rail	228	153
Unit Train	350	235
Barge	460	286
Great Lakes Vessel	600	476

[a]The adjustments are based on factors from Eastman (1980). The rail factor is an average based on 10 routings from Minneapolis to the Gulf.

The reported fuel efficiency for rail does not vary as widely as that for barge transportation. The average of figures reported since 1979 was 228 ton-miles per gallon. It should be noted, however, that unit trains could expect to have a much better fuel efficiency than this, around 350 ton-miles per gallon (Congressional Budget Office, 1981; and SRI International, 1980). Grain shipments from major cities to ports for export are more likely to move by unit train, and therefore, the figure of 350 ton-miles per gallon may be more relevant than the overall average.

The fuel efficiency for Great Lakes vessels has been reported at 600 ton-miles

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[13]Ton-miles per gallon refer to the number of miles one ton of cargo can be moved per one gallon of diesel fuel.

[14]This included 19 observations, some which were upstream or downstream, and some which were overall figures. Sources were Congressional Budget Office (1982), Eastman (1980), and Beaulieu (1982).

per gallon by Schenker, et al. (1976).[15] This means that strictly in terms of fuel efficiency, Great Lakes vessels have a substantial advantage over either rail or barge transportation. However, circuity of each transportation route must also be considered. Great Lakes vessels must follow a very indirect route to get from either Duluth/Superior or Chicago to the St. Lawrence River. Barges also are forced to follow indirect courses, especially on narrow, winding rivers. In order to account for circuity, some studies have adjusted their figures downward, depending on the route which must be followed by each transportation mode. Eastman (1981) did this for both rail and barge movements of grain for export from the upper Midwest to ports on the Gulf of Mexico. He states, ". . . after circuity has been taken into account on both sides, barge is considerably more fuel efficient than rail" (p. 13). Schenker, et al. have done a similar analysis which shows that, despite less circuity by rail from Chicago to Atlantic ports, a Great Lakes vessel uses less fuel to ship a ton of grain from Chicago to overseas ports. While neither study compares Great Lakes vessels directly with barges, the circuity factors in Eastman can be used to revise the ton-miles per gallon, as shown in Table 20.[16] This shows that Great Lakes vessels still have a considerable advantage over either rail or barge transportation in terms of energy efficiency.

Destination of Grain Exports

One of the variables which was considered only briefly before is the destination of future exports. Figures 7, 8 and 9 show the origins and destinations of corn, soybean, and wheat exports during 1977. As Figure 7 indicates, Western Europe is a major demand source for corn moving out of the Great Lakes. The future imports of Western Europe will have a direct impact on the future grain traffic of the Great Lakes.

At the present time, projections of grain imports from the U.S. are not available on a country or regional basis. However, historical data on grain imports from the U.S. are available.[17] In examining U.S. grain shipments to Western Europe since 1974, no apparent trends were observed. Unless one assumes significant decreases in population or personal income in Western Europe, there is no reason to expect decreased grain shipments from Lake ports to Western Europe. The greatest increase (over 100 percent) in net grain imports by 1990, regardless of originating country, are expected to occur in the less developed market economies, especially South America, Middle (Latin) America and Indian Ocean countries. Asia, Africa and the Mideast can also expect substantial increases (over 50 percent) in net grain imports by 1990. Small to moderate increases in net grain imports can be expected in the Soviet Bloc, China, Japan and the Republic of South Africa.[18]

Evidence of the impact of destination on the port chosen for export was reported in the Grain Transportation Situation (August 2, 1982). There, it was noted that 43 percent of the 1981 export crop of hard red spring wheat from North Dakota was exported through the Pacific ports, even though Great Lakes ports were closer to the production area. This was due to the fact that Japan and the Philippines were major customers for this wheat. In contrast, durum wheat, which was exported mainly to Europe, relied heavily on the Great Lakes ports, even though it was produced in roughly the same area as the hard red spring wheat.

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[15]This figure was confirmed by Dave Buchanon of the Lake Carrier's Association, 9/8/82.

[16]The barge and rail routes are from Minneapolis to the Gulf, while the Lakes route is from Duluth/Superior to the lower lakes. The results from Schenker, et al., confirm that Great Lakes vessels are still more fuel efficient than rail when the rail route goes through the Atlantic ports.

[17]U.S. Department of Agriculture, Foreign Agriculture Service, Foreign Agricultural Circular (various issues).

[18]"A Forecast of U.S. and World Agriculture to the Year 1990," MSU Agriculture Model, Department of Agricultural Economics, Spring 1982.

Figure 7

Corn Movements to Points
of Export
By All Modes: 1977

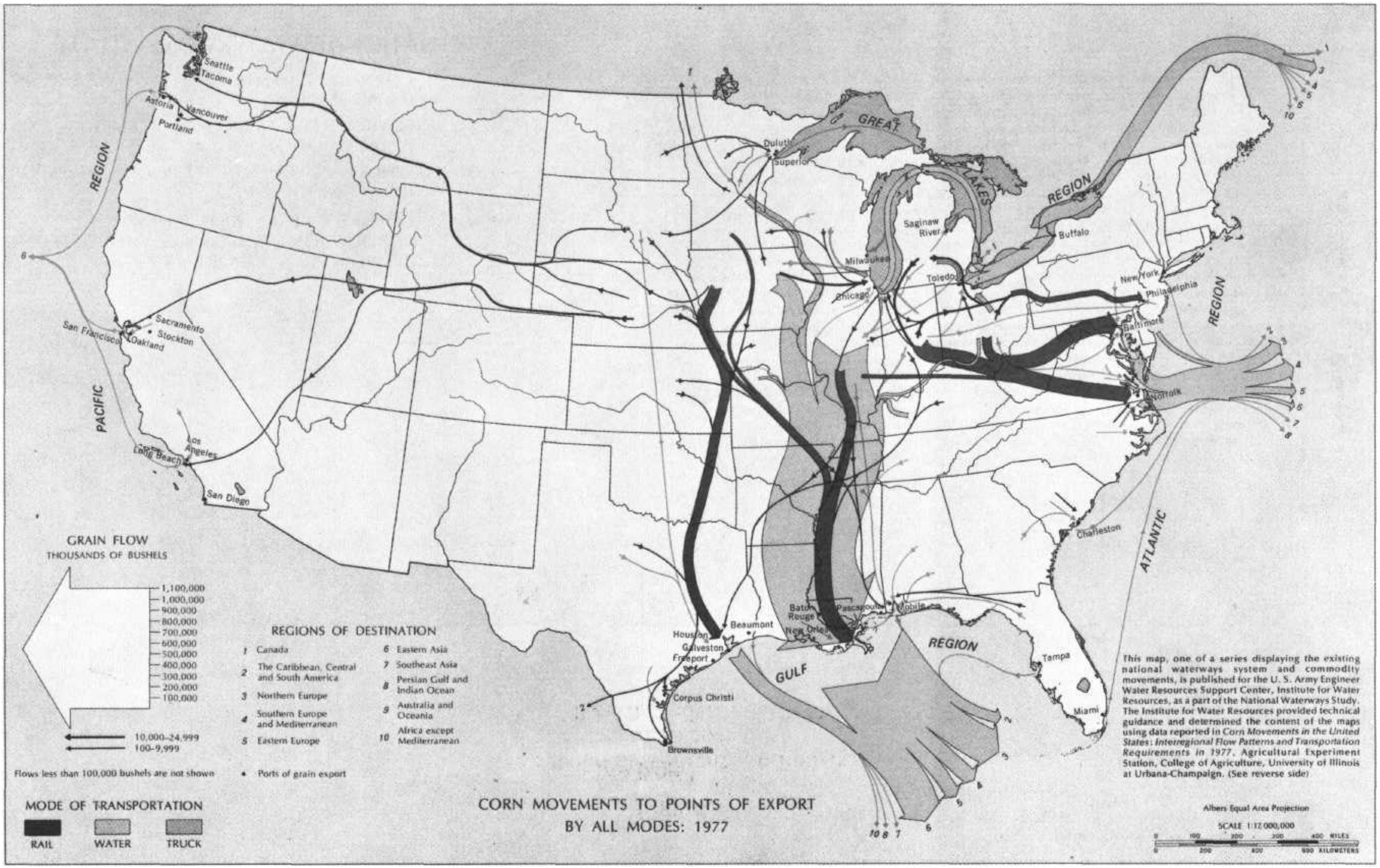


Figure 8

Soybean Movements to Points of Export By All Modes: 1977

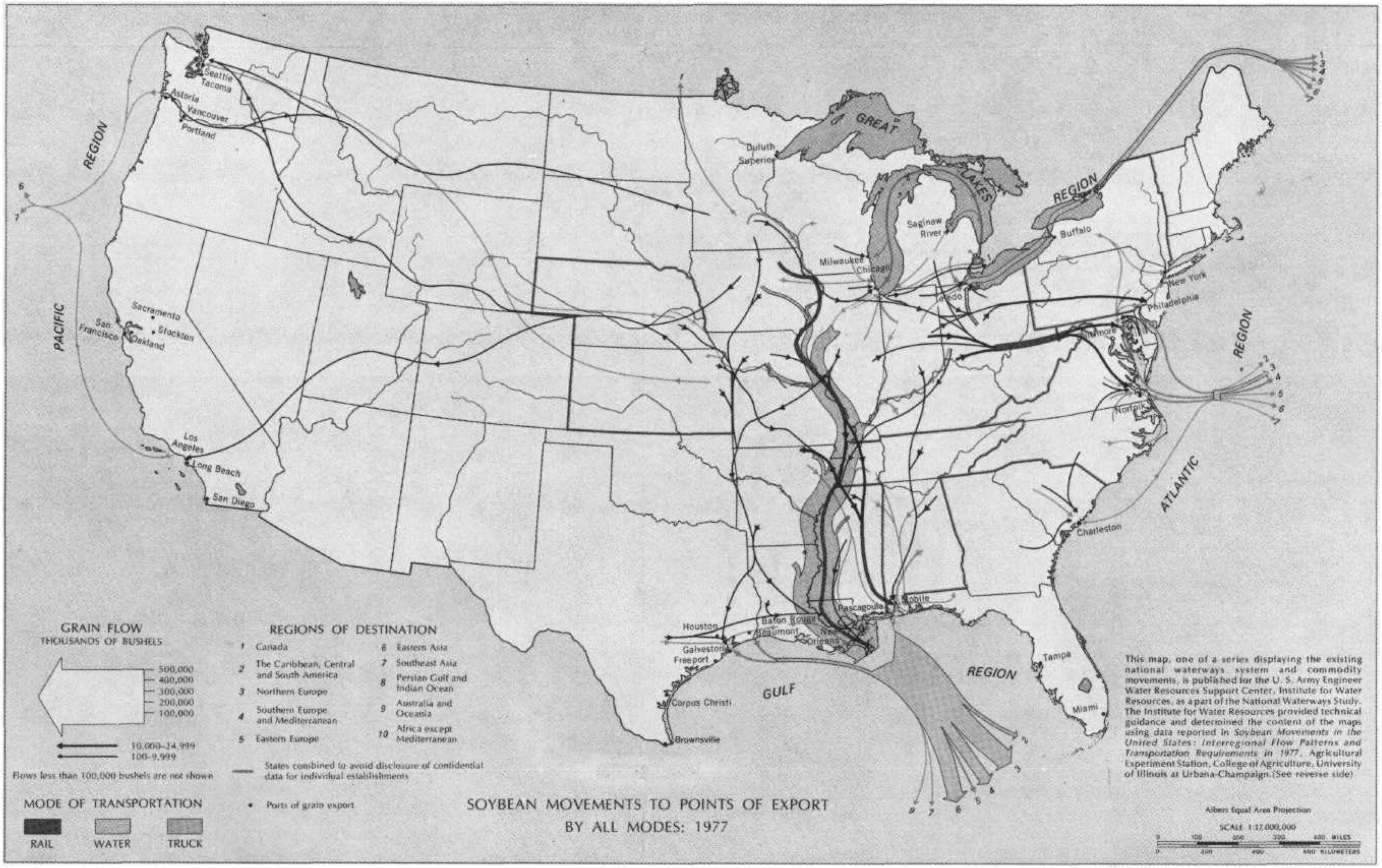
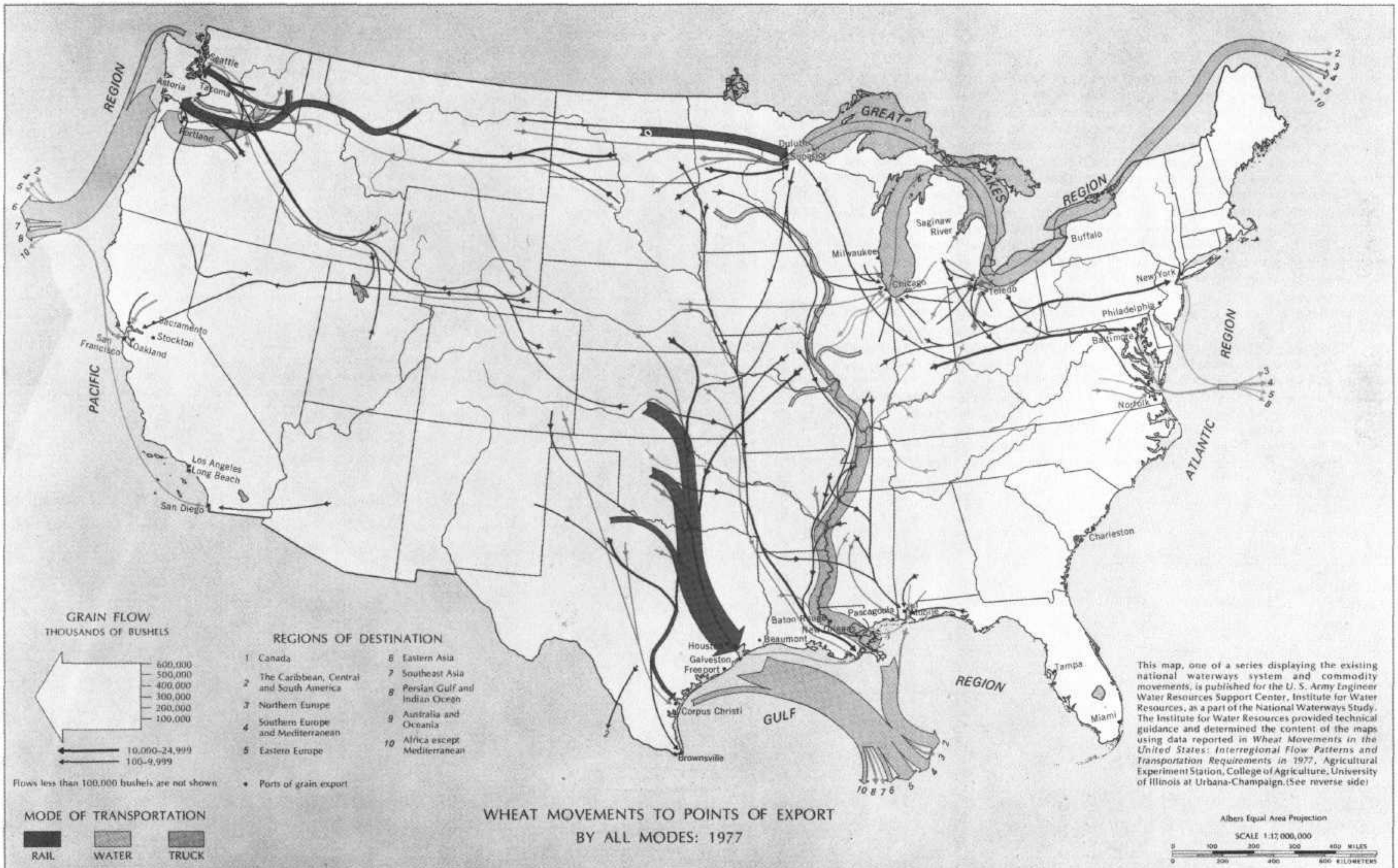


Figure 9

Wheat Movements to Points
of Export
By All Modes: 1977



The Lewis Dreyfus Corporation (Seaway Review, 1981) has asserted that the greatest increase in future exports will go to Asian countries which are best served by the Pacific ports. For this reason, they predict the Pacific ports will be over capacity by 1990 and will have to divert some of their shipments to other ports. Gallimore (1981) also foresees an increase in the imports of grain by the petroleum exporting countries and China in the 1980s. In particular, he predicts an increased quantity of wheat moving through the West Coast ports. However, he does not foresee any capacity problems as a result of this. It is not clear whether the growth in exports out of the Pacific Coast ports will be higher than that which was predicted here. Most of the trends cited above began in the 1970s (O'Brien, 1981) and should be incorporated into the projections made in this study. Port capacity problems on the West Coast are not anticipated through 1990. It is true that the centrally planned economies such as China and Russia can have the most disrupting effects on the export situation of the U.S., due to their abrupt and erratic entrances into the international market. Predicting their impact is therefore difficult. Large Russian grain purchases directly affect Seaway volumes just as large purchases by China affect Pacific ports. Any major changes in trade policies between the U.S. and these two countries alter the relationships reported here.

Lock and Dam No. 26

Other factors which need to be considered are constraints at particular points in other portions of the U.S. transportation system. One of these is the bottleneck at Lock and Dam 26 on the Mississippi River. Gaibler (1979) expects this facility to reach its maximum capacity by 1982 (p. 7). Construction is currently underway to build a new facility at this location, but the work won't be completed until nearly 1990. In the meantime, shippers have found alternatives, such as moving grain by rail to points south of St. Louis where it is then loaded onto barges, thereby bypassing Lock and Dam 26. The Lewis Dreyfus Corporation (Seaway Review, 1981) estimates this rail movement at 100 to 150 million bushels yearly. If laker rates were competitive with these rail-barge combination rates, the Great Lakes ports may be able to pick up some of the overflow shipments that exceed the capacity of Lock and Dam 26.

Panama Canal

Another constraint in the system at the present time is the capacity of the Panama Canal. Gaibler (1979) reports that the Canal has been operating at or above capacity levels recently. If the predicted increase in exports to Asia, Japan, and China are realized in the future, the Panama Canal will undergo added pressure from exports originating at the Gulf ports. If remedies are not found to alleviate the backlog of ships, more grain than anticipated may be diverted to the Pacific ports.

Other Seaway Constraints

There are three constraints on the Great Lakes-St. Lawrence Seaway system that need to be considered.

Size of Vessel: The first is the constraint on ship size. The current restrictions on the Seaway's locks are lengths of 730 feet, widths of 76 feet, and drafts of 26 feet. These rule out any ocean-going ships larger than 35,000 DWT. Most ocean vessels over 25,000 DWT cannot navigate the Seaway due to the size restrictions (U.S. Maritime Administration, 1982). The Maritime Administration (1980) has predicted that the average vessel size by 1990, for dry bulk vessels, will be larger than seaway size. However, H.P. Drewry, shipping consultants in London, have contradicted this opinion (Helberg, 1981). They have found that "the most commonly-used ocean grain carriers through the next decade will continue to be ships in the 25,000 to 40,000 DWT range" (Helberg, 1981, p. 19). Some ships of this size can load partially at Great Lakes ports and then top-off at the deep water ports of the St. Lawrence River. Binkley and Revelt (1981) have similar findings as Drewry, and feel that the explanation lies in the nature of grain trading. International grain movements often involve ports with poorly developed facilities, and the volume of trading tends to be relatively unstable. Both of these characteristics are unsuited to larger ships which "require well-developed ports and a fairly reliable volume of cargo (to operate efficiently)" (Binkley and Revelt, p. 4). Nevertheless, the following table shows that the trend in vessel size for grain trading is increasing and can be expected to increase in the future. In particular, the drastic decline in the number of 25,000 DWT vessels will have an impact on the Seaway trade. The use of laker feeders to the St. Lawrence elevators will have to increase to make up for the decline in the use of salties.

TABLE 21

Shares of World Grain Trade
by Vessel Size

Vessel (DWT Range)	1975	1980 (Percent)	1990
25,000	34	17	12
25,000-40,000	35*	35	31
40,000-60,000	15	20	22
60,000-100,000	9	19	23
100,000	7	9	12
	100	100	100

*Estimated.

Source: Helberg, Davis. 1981. "Agricultural Exports and Economic Development," in Seaway Review, Vol. 11, No. 1, Autumn 1981.

It is apparent that eventually the Seaway's locks will have to be expanded to facilitate the larger ships if the Great Lakes ports are to continue to expand their share of the export market.

Capacity of Welland Canal: The second constraint on the Seaway is the capacity of the Welland Canal. Part of this capacity constraint is related to the restriction on ship size noted above. If larger ships could pass through the Canal, the throughput capability would be greatly enhanced. The other part of the capacity constraint is simply the number of ships that can pass through the Welland in a given time period. Combining these two factors, Gelston (1980) predicts that the limit of the Welland will be reached around 1986. This takes into account movements of all cargo through the Canal, not just grain. Expanding the capacity of the Welland would require a major construction effort and, unless it is undertaken in the very near future, the capacity of the Welland may limit future grain exports from the Great Lakes ports.

Length of Navigation Season: The third constraint on the Seaway is the length of the navigation season. The Seaway currently closes around mid-December and reopens when weather permits, about April 1st, plus or minus one week. There have been numerous studies done on the benefits and costs of extending the navigation season of the St. Lawrence Seaway (see references of St. Lawrence Seaway Authority, Seaway in Winter: A Benefit-Cost Study, 1978). A particular benefit would accrue to those in the grain shipping industry, since even a small lengthening of the season would help to relieve the harvest period congestion that builds up on the other modes of transportation after the Seaway closes (Gelston, 1980). The magnitude of the benefits of an extended navigation season is widely disputed. The report prepared for the St. Lawrence Seaway Authority states that the benefits would be insignificant. However, there are so many variables that could change under a scenario of year-round navigation that it is difficult to predict the net effect.

Ability to Attract Vessels: The possibility of the two-way trade of steel and grain was mentioned previously as being important for ocean-going ship availability at Great Lakes ports. In the absence of this in-bound steel cargo, the Great Lakes ports will have to bid ships away from the Gulf and Atlantic ports where two-way cargoes are more readily available. This, of course, raises rates and puts the Great Lakes ports at a competitive disadvantage. The Great Lakes area needs to develop an importing infrastructure that can attract in-bound cargoes to Great Lakes ports.

The possibility for backhauls is an important consideration for the feedership operations of lakers as well. The lakers must basically compete with the barge and rail industries for moving grain to export ports. The barge industry has had successful backhaul operations from the Gulf, in particular with fertilizers. Increased U.S. fertilizer imports (from countries such as Canada, Mexico, and Russia) provide an additional opportunity for the St. Lawrence ports to attract backhaul cargo for the lakers.

VII. SUMMARY

The use of the Great Lakes-St. Lawrence Seaway for transportation purposes provides an important contribution to the U.S. economy. Although many different commodities move over the Seaway, the single largest volume commodity moving through the Welland Canal is grain. In recent years, grain has represented some 40 to 50 percent of volume of traffic on the Seaway. Not only is the grain the single largest volume commodity shipped on the Seaway, but its importance relative to other commodities continues to increase. The historical traffic data suggest that the future economic role of grain on the Seaway will become increasingly important.

The general purpose of this report was to provide an overview of the economic importance of the shipment of grain on the Great Lakes-St. Lawrence Seaway. Accordingly, information was provided on the current and future role of the Seaway in the transportation of grain. In so doing, a brief description of the nature of grain flows on the Great Lakes-St. Lawrence Seaway was given. Next, projections of grain exports to 1990 were made and evaluated relative to port capacities. Next, an indication of the relative competitiveness of the Great Lakes ports in the shipment of grain was obtained through an examination of shipping rates. Finally, some brief information was presented on other selected factors affecting the competitiveness of grain shipments on the Great Lakes-St. Lawrence Seaway.

In 1980, 15.1 million metric tons of grain were shipped from U.S. Great Lake ports. This compares to a total of 14.8 million metric tons shipped from Canadian Lake ports. In general, both Canada and the U.S. contribute roughly equal traffic on the Great Lakes-St. Lawrence Seaway.

Corn is the largest volume U.S. commodity shipped on the Lakes and when combined with wheat they represent some two-thirds of the total volume. Duluth-Superior is the largest volume U.S. port with over one-half of the total U.S. lake shipments. The ports of Milwaukee, Chicago, Toledo, Huron, and Saginaw account for the bulk of the remaining grain shipments.

For Canadian ports, over three-quarters of the grain shipped is wheat. In 1980, Thunder Bay accounted for nearly 94 percent of the total grain shipped from Canadian Lake ports. The Ontario ports of Windsor, Wallaceburg, Sarnia, and Goderich accounted for the bulk of the remaining shipments.

During the period 1974-81, the average shares of total U.S. grain exports by major port area were: 11.4 percent Lakes; 12.5 percent Atlantic; 62.6 percent Gulf; and 13.5 percent Pacific. Since 1974, sunflower seed shipments on the Lakes increased from 13.0 million bushels to 98.3 million bushels in 1980. This rapid growth in the export of sunflower seeds from Lake ports has contributed substantially to the total volume of agricultural exports from Lake ports.

Total U.S. grain exports are projected to increase 45 percent by 1990 over the 1979-81 average levels. Disaggregation of the projected level of total U.S. exports by major port area results in the following percentage increases: Lakes, 58 percent; Atlantic, 34.4 percent; Gulf, 40.2 percent; and Pacific, 61.0 percent. The greatest percentage increase in grain exports can be expected at the Pacific ports followed by Lake ports. All ports will experience substantial growths in grain volumes, but a relatively larger share of total U.S. grain exports can be expected to move through the Pacific and Lake ports. Projected sunflower seed exports contributed substantially to the expected increase in agricultural exports through the Lake ports.

Next, the projected levels of grain exports for each port were evaluated relative to their respective port capacity. The results showed that port capacity will likely not be a binding constraint at any of the ports throughout the 1980s. It does appear, however, that the Gulf port is approaching capacity levels and therefore is likely to be more sensitive to potential stresses in the system. Nevertheless, the port facilities themselves appear to be adequate. Expected obstacles in the future movement of grain exports are likely to come from other sources, such as large unexpected export grain-purchases in a particular region of the world, rapidly increasing real energy prices, or bottlenecks occurring in other parts of the transportation system.

In order to obtain a better view of the relative competitiveness of the Great Lake ports, vis-a-vis, other transportation routes, a cursory examination of relative shipping rates was made. Various traffic routes from Duluth/Superior, Chicago, and Toledo to Rotterdam were evaluated. Given the 1982 rate structure, grain exports from Great Lakes port areas to Rotterdam can most economically be shipped by barge to the Gulf, then by ocean vessel to Rotterdam. Great Lake routes, however, provide an attractive, "second best" alternative.

These results, however, are very sensitive to grain supplies in the U.S. and the level of export demand for various grains. In 1982, extremely low barge rates were in existence as a result of over-capacity on the Mississippi River system. As barge rates rise, the Great Lakes route will become increasingly attractive for the export of grain, especially from the Duluth/Superior port. Rail rates will have an important influence on the relative attractiveness of the Lakers for the Chicago and Toledo ports. It should be stressed, however, that the competitive relationships among the traffic routes at the various ports are highly sensitive to changing economic conditions. The relationships presented here are valid only during the period in which the rate data were analyzed.

Large increases in real energy prices can have important implications for modal selection. An examination of energy efficiencies across transportation modes shows substantial advantages to Great Lakes vessels, vis-a-vis, rail or barge. Rapidly escalating fuel prices would tend to favor Great Lake ports for the export of grain, holding all other factors constant.

The likely changes in the final destination of U.S. grain exports was also considered. The greatest percentage increases are expected in the less developed market economies, especially South America, Latin America, and Indian Ocean countries. Asia, Africa, and the Mideast can also expect to increase substantially, but to a somewhat lesser extent. Small to moderate increases in net grain imports can be expected in the Soviet Bloc countries, China, Japan, and the Republic of South Africa. Western Europe demand is expected to experience moderate growth. Hence, there appears to be no compelling reason to believe that grain exports from the Lake ports will be adversely affected by locational mix of importing countries.

Other sources of possible constraints on the export of grain include potential bottlenecks at Lock and Dam No. 26 on the Mississippi River and the Panama Canal. On the Seaway, vessel size limitations, Welland Canal capacity and length of navigation season are potential limitations, especially in the long-run.

In general, the Great Lakes-St. Lawrence Seaway is an attractive means, relative to other ports, of moving U.S. grain to export markets. With adequate long-range planning the Seaway will continue to serve as an important contributor to the well-being of both the national and Lake State economies.

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Appendix A

Lake Shipments of Grain From U.S. Ports

Table

Lake Shipments of Grain From Duluth-Superior, 1980
(000 Bushels)

	Cargoes	Total	Wheat	Corn	Oats	Barley	Rye	Flaxseed	Soy	Sunflower
U.S. Ports	111	53,335	47,413	--	177	5,385	360	--	--	--
St. Lawrence	123	106,504	60,942	23,504	549	18,621	3,338	--	--	--
Great Lakes Canada	3	1,959	--	909	1,050	--	--	--	--	--
Overseas	195	102,997	61,973	17,530	2,361	17,925	2,075	87	1,047	--
Total Great Lakes	432	264,799	169,878	41,944	4,137	41,933	5,774	87	1,047	--
Overseas Sunflowers	66	97,949	--	--	--	--	--	--	--	1,244,017
Total:	498	362,744	169,878	41,944	4,137	41,933	5,774	87	1,047	1,244,017
M.T.		8,083,213	4,623,369	1,065,438	60,049	912,993	146,642	2,210	28,495	1,244,017

Direct Overseas Grain Destinations, Duluth-Superior, 1980
(000 Bushels)

		Grain								Sunflower Seed*/	
Destination	Cargoes	Wheat	Corn	Oats	Barley	Rye	Flaxseed	Soybeans	Total Grain	Cargoes	Metric Tons
Holland	35	11,925	2,444	1,075	--	502	--	--	15,946	26	570,451
Italy	34	11,092	267	172	6,580	--	--	1,046	19,157	5	127,618
Spain	18	4,055	2,404	--	5,546	--	--	--	12,005	--	--
Venezuela	16	8,032	--	--	--	--	--	--	8,032	--	--
France	11	5,839	695	--	--	--	--	--	6,534	--	--
Belgium	10	4,220	1,413	--	--	--	--	--	5,633	3	36,836
Tunisia	7	2,821	--	--	--	--	--	--	2,821	1	46,128
Algeria	6	2,311	551	537	--	--	--	--	3,399	--	--
East Germany	6	--	--	1,462	--	--	--	--	1,462	--	--
Iraq	6	430	--	2,993	--	--	--	--	3,423	--	--
Nigeria	6	2,259	--	--	--	--	--	--	2,259	--	--
Norway	5	1,249	--	--	--	1,573	--	--	2,822	--	--
USSR	5	--	3,237	--	--	--	--	--	3,237	--	--
United Kingdom	5	2,273	502	--	--	--	--	--	2,775	--	--
Poland	4	--	2,364	--	--	--	--	--	2,364	--	--
West Germany	4	621	157	--	--	--	87	--	865	10	150,110
Finland	3	1,777	--	--	--	--	--	--	1,777	--	--
China	1	566	--	--	--	--	--	--	566	--	--
Ecuador	1	--	--	339	--	--	--	--	339	--	--
Mexico	0	--	--	--	--	--	--	--	--	6	83,077
Portugal	0	--	--	--	--	--	--	--	--	13	201,461
South Africa	0	--	--	--	--	--	--	--	--	2	28,336
Other	N/A	2,503	3,496	775	807	--	--	--	7,581	--	--
Total	195	61,973	17,530	2,361	17,925	2,075	87	1,046	102,997	66	1,244,017

*The number of cargoes of sunflower seeds represent those shipments of entirely sunflowers. Mixed shipments of both grain and sunflower seeds were counted as grain shipments.

A.2

Lake Shipments of Grain From Milwaukee, Wisconsin, 1980
(000 Bushels)

Destination	Cargoes	Total	Corn
Great Lakes			
Canada	7	3,262,077	3,262,077
St. Lawrence	47	38,792,760	38,792,760
Overseas	12	7,035,691	7,035,691
Total:	66	49,090,531	49,090,531

Direct Overseas Grain Destinations,
Milwaukee, Wisconsin, 1980

Destination	Cargoes	Total	Corn
Poland	5	2,895,931	2,895,931
West Germany	2	1,358,130	1,358,130
USSR	3	1,823,695	1,823,695
Spain	2	957,935	957,935
Total:	12	7,035,691	7,035,691

A.3

Lake Shipments of Grain From Chicago, Illinois, 1980
(000 Bushels)

Destination	Cargoes	Total	Corn	Soybeans
St. Lawrence	24	21,016	20,339	677
Overseas	17	9,833	6,046	3,787
Total:	41	30,849	26,385	4,464

Direct Overseas Grain Destinations, Chicago, Illinois, 1980
(000 Bushels)

Destination	Cargoes	Total	Corn	Soybeans
United Kingdom	2	1,191	1,191	--
Spain	1	544	--	544
Japan	2	1,189	--	1,189
Denmark	3	1,504	--	1,504
Poland	4	2,397	2,397	--
Belgium	1	623	623	--
West Germany	2	1,214	1,214	--
Greece	1	550	--	550
USSR	1	621	621	--
Total:	17	9,833	6,046	3,787

A.4

Lake Shipments of Grain From Saginaw, Michigan, 1980
(000 Bushels)

Destination	Cargoes	Total	Wheat	Corn	Soybeans
Great Lakes Canada	7	1,769	--	1,400	369
St. Lawrence	17	7,394	1,984	3,267	2,143
Overseas	--	--	--	--	--
Total:	24	9,163	1,984	4,667	2,512

A.5

Lake Shipments of Grain From Toledo, Ohio, 1980
(000 Bushels)

Destination	Cargoes	Total	Corn	Soybeans	Wheat
Great Lakes Canada	55	18,503	7,377	10,219	907
St. Lawrence	144	111,967	80,177	22,269	9,521
Overseas	62	35,154	18,004	15,973	1,177
Domestic - U.S.	2	931	--	--	931
Total:	263	166,555	105,558	48,461	12,536

Direct Overseas Grain Destinations, Toledo, Ohio, 1980
(000 Bushels)

Destination	Cargoes	Total	Corn	Soybeans	Wheat
Spain	20	11,931	7,021	4,919	--
United Kingdom	15	7,851	7,469	382	--
Japan	12	6,367	--	6,367	--
Italy	4	2,522	1,919	--	603
Norway	3	1,836	--	1,836	--
France	2	1,290	--	1,290	--
West Germany	2	1,272	652	620	--
Netherlands	1	176	--	176	--
USSR	1	637	637	--	--
Greece	1	383	--	383	--
Morocco	1	574	--	--	574
Canary Islands	0	315	315	--	--
Total:	62	35,154	18,004	15,973	1,177

A.6

Lake Shipments of Grain From Huron, Ohio, 1980
(000 Bushels)

Destination	Cargoes	Total	Wheat	Corn	Soybeans
Great Lakes Canada	35	10,152	--	6,847	3,305
St. Lawrence	3	1,802	608	1,194	--
Overseas	5	3,072	--	2,454	618
Domestic - U.S.	1	542	542	--	--
Total:	44	15,568	1,150	10,495	3,923

Direct Overseas Grain Destinations, Huron, Ohio, 1980
(000 Bushels)

Destination	Cargoes	Total	Corn	Soybeans
United Kingdom	2	1,207,072	1,207,072	--
Italy	1	654,024	654,024	--
West Germany	1	617,986	--	617,986
Scotland	1	593,373	593,373	--
Total:	5	3,072,455	2,454,469	617,986

Appendix B

Lake Shipments of Grain From Canadian Ports

Table

B.1

Lake Shipments of Canadian Grain From Thunder Bay, 1980
(Metric Tons)

Destination	Cargoes	Total	Wheat[a]	Oats	Barley	Rye	Flaxseed	Rapeseed
Great Lakes Canada		1,685,095	1,315,048	69,465	298,823	1,759	0	0
St. Lawrence		10,952,984	9,546,823	120,367	1,145,135	38,987	55,619	46,053
Overseas	21	1,202,127	380,118	109,223	84,245	315,159	187,322	126,000
Total of All Ports:		13,840,206	11,241,989	299,055	1,528,203	355,905	242,941	172,113

[a]Includes Durum.

Direct Overseas Grain Destinations, Thunder Bay, 1980
(Metric Tons)

Destination Foreign Port	Cargoes (Est.)	Wheat[a]	Oats	Barley	Rye	Flaxseed	Rapeseed	Sunflower	Total
Holland	28	1,575	23,253	--	7,140	67,741	74,992	52,224	226,945
Destination Unknown	23	57,998	7,040	22,253	17,513	37,220	25,804	3,384	171,212
USSR	21	4,423	--	--	289,716	--	--	--	294,139
Brazil	17	259,729	--	--	--	--	--	--	259,729
West Germany	11	--	--	--	790	80,361	5,897	--	87,048
Poland	6	19,978	72,262	--	--	--	--	--	92,240
United Kingdom	4	--	--	9,786	--	2,000	8,367	1,093	21,246
Northern Ireland	3	13,523	--	--	--	--	--	--	13,523
Colombia	3	--	--	47,206	--	--	--	--	47,206
Italy	2	10,078	6,668	--	--	--	--	--	16,746
Morocco	1	--	--	--	--	--	11,000	--	11,000
Peru	1	--	--	5,000	--	--	--	--	5,000
Algeria	1	12,814	--	--	--	--	--	--	12,814
Total:	121	380,118	109,223	84,245	315,159	187,322	126,060	56,721	1,258,848

[a]Includes Durum.

B.2

Lake Shipments of Grain From Goderich, Ontario, Canada, 1980
(000 Bushels)

Destination	Cargoes	Total		Wheat		Corn	
		Bushels	Metric Tons	Bushels	Metric Tons	Bushels	Metric Tons
Overseas	13	4,229	107,422	--	--	4,229	107,422
St. Lawrence - Canada	9	3,761	95,534	--	--	3,761	95,534
St. Lawrence - U.S.	1	346	8,789	--	--	346	8,789
Newfoundland, N.S.	2	101	2,566	--	--	101	2,566
Georgian Bay, Ont.	5	1,477	40,197	1,477	40,197	--	--
Total:	30	9,914	254,508	1,477	40,197	8,437	214,311

B.3

Lake Shipments of Grain From Sarnia, Ontario, Canada, 1980
(000 Bushels)

Destination	Cargoes	Total		Wheat		Corn		Soybeans	
		Bushels	Metric Tons	Bushels	Metric Tons	Bushels	Metric Tons	Bushels	Metric Tons
Great Lakes Canada	26	10,327	277,706	7,137	194,237	1,861	47,272	1,330	36,197
Overseas	16	5,057	128,455	--	--	5,057	128,455	--	--
Total:	42	15,384	406,161	7,137	194,237	6,918	175,727	1,330	36,197

B.4

Lake Shipments of Grain From Wallaceburg, Ontario, Canada, 1980

(000 Bushels)

Destination	Cargoes	Total		Wheat		Corn	
		Bushels	Metric Tons	Bushels	Metric Tons	Bushels	Metric Tons
St. Lawrence - Canada	9	1,301	33,748	392	10,658	909	23,090
Total:	9	1,301	33,748	392	10,658	909	23,090

B.5

Lake Shipments of Grain From Windsor, Ontario, Canada, 1980

(000 Bushels)

Destination	Cargoes	Total		Wheat		Corn		Soybeans		Soybean Meal	
		Bushels	Metric Tons	Bushels	Metric Tons	Bushels	Metric Tons	Bushels	Metric Tons	Bushels	Metric Tons
Great Lakes Canada	8	3,624	97,305	2,894	78,762	730	18,543	--	--	--	--
Overseas	20	4,628	107,329	--	--	3,794	96,373	127	3,456	347[a]	7,500
Total:	28	7,892	204,634	2,894	78,762	4,524	114,916	127	3,456	347[a]	7,500

[a]Soybean equivalent where one bushel of soybeans equals 47.5 lbs. of soybean meal.

Direct Overseas Grain Destinations, Windsor, Ontario, Canada, 1980

(000 Bushels)

Destination	Cargoes	Total	
		Bushels[b]	Metric Tons
Destination Unknown	7	2,791	70,900
Cuba	9	689	17,500
USSR	3	606	15,400
Japan	1	138	3,500
Total:	20	4,224	107,300

[b]Because the type of grain shipped to each country was unknown, the conversion of metric tons to bushels assumed all grain was corn.

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