Ocean Shipping In the Great Lakes: An Analysis of Issues

Phase II

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Executive Summary

In 2005, a report entitled "Ocean Shipping in the Great Lakes: Transportation Cost Increases That Would Result from a Cessation of Ocean Vessels Shipping"[1] was published. This research activity was funded by The Joyce Foundation and looked at transportation cost increases that would occur if, for whatever reason, ocean shipping ceased in the Great Lakes. The research concluded that shippers would incur additional costs of $55 million annually if this should occur. This is a relatively small amount compared to overall transportation costs associated with the movement of ocean vessel cargo into and out of the Great Lakes region. These cost advantages must be weighed against the costs associated with ocean vessel shipping, especially the cost of invasive species introduction and management. In fact, the research was originally prompted by a number of initiatives related to invasive species and their control through better methods of ballast management.

The original report does not call for any shift in cargo to other modes. It attempted to assess the economic benefits to industry of having ocean ships move directly into and out of the North America hinterland. These benefits were calculated as the transportation cost savings from direct ocean shipping as compared to the costs that would occur if the "most likely" combination of alternative modes were used. The report found that the costs of door-to-door transportation for the "most likely" combination of alternative inland modes would be $55 million higher than the costs currently incurred by using ocean shipping directly into and out of the Great Lakes region. It could be said that ocean shipping "saves" industry $55 million compared to what it would cost if these other modes had to be used for whatever reason.

The 2005 work resulted in a number of issues and questions that suggested further research as well as the need to communicate findings to a broader audience. This Phase II report was developed to update traffic and other information and to develop a more complete understanding of certain issues. The following summarizes findings for the key issues reviewed:

1. <u>Ocean Vessel Traffic Update.</u> Chapter 1 looks at traffic trends through the St. Lawrence Seaway since publication of the original ocean shipping report that utilized 2002 traffic. It determined that 2002 was a 'typical' traffic year and closely approximated the average traffic levels for the entire 2000-2006 time period. An analysis of traffic for this seven-year period indicated that there are, on average, about 565 inbound ocean vessels each season passing through the Montreal-Lake Ontario (MLO) section of the St. Lawrence Seaway and a similar number of outbound vessels. This is slightly more then two ships per day during the navigation season. These ocean vessels carry, on average, about 12,100,000 metric tons of cargo annually. Actual volumes have varied considerably from this average due primarily to steel import levels, which can be greatly affected by policy decisions such as the imposition in 2003 of tariffs by the US government on imported steel. Changes in steel imports also affect the availability of ocean vessels for outbound grain movements. Year 2006 was a very strong year for ocean vessel traffic driven by high levels of steel imports and high levels of grain exports. Conversely, high steel inventories and a slowing economy indicate that 2007 may be lower than average in terms of ocean vessel passages.

[1] Taylor, John C. and Roach, James L., "Ocean Shipping in the Great Lakes: Transportation Cost Increases That Would Result from a Cessation of Ocean Vessel Shipping," August 2005, pp 1-89.

2. Grain Traffic Trends and Prospects. Chapter 2 examines grain traffic trends. Grain traffic through the MLO has declined dramatically since its peak of 27.8 million tons in 1978—today it is only about one-third of its former level. Most of this decline has been in wheat traffic, especially Canadian wheat, which once accounted for over half of all grain shipments through the MLO. Corn traffic has also declined to about 1/4 of its former level. Conversely, there has been growth in soybeans, flaxseed, and canola.

The USDA forecasts a flat export market for both the US and Canada with respect to wheat. Since wheat makes up 61 percent of all grain shipments, it will be important for the Seaway to retain its current wheat market share to prevent further traffic losses. This could be a challenge given worldwide competition especially from countries comprising the former Soviet Union. These countries have low production costs and are closer to emerging markets such as the Middle East.

An unknown is the future amount of ocean vessel traffic into the lakes with products like steel and iron products. In fact, the fronthaul movement of steel and other products into the Great Lakes may be a key determinant of how much outbound grain moves by ocean vessels since these vessels present an opportunity for an attractively priced backhaul movement of grain. This review suggests that it is unlikely that there is much upside potential for grain movements through the Seaway. It may be possible to stabilize traffic around current levels if worldwide market share for exports can be maintained.

3. Steel Traffic Trends. Chapter 3 reviews steel traffic trends. Steel traffic is a major component of inbound cargo traffic through the MLO. It is particularly important because it also provides ships that can haul outbound export grain, which is another important component of MLO traffic. Steel traffic levels vary considerably from year to year due to regional and global economic circumstances. Steel traffic through the Seaway will be dependent on the health of the Great Lakes economy and its competitive position with respect to the rest of North America. It will also depend on the relative competitiveness of the North American steel industry. A less competitive industry could result in more imported steel on ocean vessels but lessened demand for iron ore and other raw materials (carried by laker vessels) used by US and Canadian steel producers. One forecaster sees modest growth of imported steel traffic through the year 2020.

4. Prospects for Container Traffic on the Great Lakes. Container traffic prospects on the Great Lakes is the subject of Chapter 4. The authors do not believe there is any potential for conventional container ship service into the Great Lakes. The smaller 1000-1500 TEU vessels that could fit through the Seaway could not compete in the trans-Atlantic trade with the much larger (4,400-10,000+ TEU) ships serving Montreal, Halifax, and New York. Further, the extra time involved in serving ports such as Detroit and Chicago and the infrequent service from these ports would not be attractive to shippers. They are accustomed to almost daily service between major eastern ports and Northern Europe as well as efficient rail and trucking services to and from these ports. The three month winter closure of the Seaway would be a major problem for shippers and the high rates they would pay the railroads or truckers during this period would further negate any economic advantage. The Harbor Maintenance Tax is a further economic obstacle for containers landing at US ports especially as compared to containers landing at Montreal and moving by rail or truck to the Great Lakes Region.

There are some containers moving on ocean vessels on the Great Lakes as incidental or project related cargo. However, these volumes are very small ranging from 1500-2000 TEU's annually—less than half the capacity of a single container ship using the Port of Montreal. There may be an opportunity to increase this business particularly in certain specialty or low volume areas where containerization makes sense. There may also be the potential for certain types of short sea feeder services for containers moving upbound from Halifax or Montreal into Lake Ontario or possibly Lake Erie. Containers could move on integrated tug barges or modified laker vessels. A Canadian port would have an advantage since it would be exempt from the HMT. These feeder services, if economically viable, would likely be low volume compared to existing volumes currently moving by rail and truck.

5. Capacity of Alternative Modes. Chapter 5 addresses the capacity of alternative modes and their ability to handle any traffic that might be diverted from ocean ships. The total amount of cargo carried by ocean vessels into the Great Lakes is quite small when compared to existing movements by rail, truck, laker, and barge modes of transportation. Only about two ocean vessels each day enter the Great Lakes and two per day leave the Great Lakes carrying about 12 million tons of cargo annually. This compares to about 200 million tons of cargo carried on the Great Lakes by the combined ocean/laker fleet of ships. The total volume of ocean vessel traffic is about the amount that could be carried by a medium density single-track rail line or a single daily tug/barge tow on the Lower Mississippi.

This review suggests that there is adequate capacity in the Great Lakes region transportation system to accommodate traffic currently carried by ocean vessels. Truck traffic would increase less than one percent and would only approach that on Highway 401 west of Montreal where there would be an additional 89 trucks per day. The number would be far less on other routes. Rail traffic would grow by the equivalent of 1.6 trains each day spread over the entire rail system in the Great Lakes region. This is insignificant compared to volumes approaching 150 daily trains on the rail lines north and south of Lake Erie. Rail executives from both CN and CP indicated that rail congestion is not a problem in the east and that the railroads could handle additional traffic. There could be an issue with the availability of laker vessels. This fleet has downsized over the years and is often close to being fully utilized. That said, interviews indicated that capacity could be found if there was assurance that traffic would be available. This could include the retention and modernization of vessels scheduled for retirement, the conversion of existing vessels to integrated tug barge designs, and the possible construction of new laker vessels.

It is important to understand that the diversion of ocean vessel traffic would result in changes to transportation modes and routes in the entire Great Lakes region. Diverted traffic would not simply shift to other modes in the ocean vessel corridor between the Great Lakes and Montreal. Major traffic shifts would occur with significant amounts of US grain moving from Duluth to the St. Lawrence River assumed to move by rail and barge to the Gulf of Mexico for export. A majority of the imported steel was assumed to move by rail and truck from Philadelphia to the Great Lakes region or by barge from New Orleans to Chicago. The point of this is that ocean vessel traffic would be widely dispersed throughout the eastern part of North America and there would not be a concentration of traffic on any existing transportation route or corridor.

6. Impacts of Alternative Modes on US and Canadian Transportation Employment. Chapter 6 studies the impact of any modal shift on employment levels. The cessation of ocean vessel shipping in the Great Lakes would cause cargo to shift to other modes of transportation including lakers, trains, barges, and trucks. These modes employ residents of the US or Canada almost exclusively. The change from ocean vessels with foreign employees to domestic transportation carriers with US and Canadian employees will mean an increase in the number of domestic[2] jobs. Our estimate is that 1,319 additional domestic jobs would be created if ocean vessels did not come into the Great Lakes. Many of these jobs will go to residents of the Great Lakes area who will work on laker vessels, barges, trains, and trucks. However, there would be some dislocation of jobs and a portion of jobs performed at Great Lakes ports would shift to ports on the St. Lawrence River, East Coast, or Gulf of Mexico.

7. Air Quality Impacts. Chapter 7 examines the air quality impacts of any modal shift. Emissions come from each mode and ocean vessels, like rail and other modes, are significant contributors to global air pollution. In fact, in some emissions categories such as PM-10 and SOX, ocean vessels are far larger contributors per million ton miles than is the case with rail. Even on the other categories of CO, NOX, and HC, marine does not have as big an advantage as might be expected and cleaner rail engines are leading to further improvements for rail. Rail is the main non-marine alternative to ocean direct shipping directly into/out of the Lakes. In the "most likely" alternative scenarios for these goods movements suggested in our earlier report, trucks are a very small factor. Our analysis and one done by the Great Lakes Commission indicates that the cessation of ocean shipping into the Great Lakes would have no significant impact on air quality and in fact, may result in air quality benefits.

8. Ocean Vessel Saving for Michigan and Wisconsin. Chapter 8 studies the level of benefits from ocean shipping for industry in Michigan and Wisconsin**.** Port level information is available from the US Army Corps of Engineers in their annual Waterborne Commerce Report. This information was obtained for Michigan and Wisconsin ports and an estimate of savings related to 'foreign commerce' at these ports was developed. In Michigan, only Detroit and Menominee receive regular ocean vessel service and most of the traffic is inbound iron and steel products. Estimated annual transportation savings attributable to direct ocean vessel service for Michigan shippers is estimated at $2.5-$4.3 million annually. In Wisconsin, Superior, Milwaukee, Marinette, and Green Bay receive regular service. Outbound grain from Superior and Milwaukee are major traffic categories. Wisconsin shippers save about $5 million annually because of ocean shipping.

9. Revenue Impacts on the St. Lawrence Seaway Associated with a Cessation of Ocean Shipping. Finally, Chapter 9 reviews the revenue impacts on the St. Lawrence that would result from any modal shift. The St. Lawrence Seaway encompasses a series of 15 locks—13 in Canada and two in the United States. The Canadian locks are the responsibility of the St. Lawrence Seaway Management Corporation while the US locks are the responsibility of the St. Lawrence Seaway Development Corporation. The two SLS entities had combined expenses of $111 million in FY 2006 and employed 737 persons to operate the various components of the Seaway System. Most of the Canadian costs ($95 million) are covered by toll revenues ($71 million) while US costs are largely covered by a federal appropriation from the Harbor Maintenance Trust Fund. The loss of ocean vessel toll revenues would greatly affect the operation of the Canadian SLSMC but would have less effect on its US counterpart due to its reliance on federal appropriations. Toll revenues from ocean vessels were estimated at $22 million for 2005 and $32 million in 2006. The higher values for 2006 were due to significantly higher ocean traffic levels. Lost revenues from ocean vessels due to a shift in traffic to other modes would be somewhat offset by increased laker traffic. After including new laker revenues, the average annual loss of ocean vessel toll revenues for the 2002-2006 period is about $18

[2] Domestic as used in this report refers to residents of the US or Canada.

million. Any actual financial loss would have to be made up by increased tolls on the remaining traffic or increased governmental contributions. It is also possible that Seaway operating costs could be reduced to account for reduced traffic levels.

Chapter 1
Ocean Vessel Traffic Update

The purpose of this chapter is to update traffic and other information since the publication of the "Ocean Shipping in the Great Lakes: Transportation Cost Increases That Would Result From A Cessation of Ocean Vessel Shipping." This report was published in August 2005 but utilized traffic information from 2002.

Year 2002 was a "Typical" Traffic Year

Year 2002 traffic was utilized in the original report since it appeared to represent a more typical traffic year than the much lower volumes experienced in 2003. It should be noted that year 2002 traffic, as a "typical" traffic year was coupled with 2004 cost information so financial values shown in the original report represent costs and benefits as of 2004. A review of Table 1-1 indicates that 2002 was indeed a typical year both in terms of ocean vessel transits[3] and cargo tonnage. This shows 2002 ocean vessel transits as 1,137 through the MLO compared to an average of 1,133 for the 2000-2006 period. Cargo tonnage was 12,285,000 tons in year 2002 compared to an average of 12,139,000 for the 2000-2006 period.

Table 1-1
Ocean and Laker Vessel Traffic Trends
2000-2006
MLO Section

	MLO Section					
Year	Cargo Vessel Transits*			Cargo Tonnage		
	Total Vessels	**Ocean Vessels**	Laker Vessels	Total Vessels	**Ocean Vessels**	Laker Vessels
2006	2581	**1350**	1231	35572	**14955**	20617
2005	2320	**1044**	1276	31273	**10464**	20809
2004	2236	**1021**	1215	30800	**11017**	19783
2003	2199	**929**	1270	28900	**9562**	19338
2002**	2253	**1137**	1116	30002	**12285**	17718
2001	2235	**1133**	1102	30278	**11702**	18576
2000	2548	**1316**	1232	35406	**14987**	20419
Avr 00-06	2339	**1133**	1206	31747	**12139**	19609

*Cargo vessels include cargo, barge, and tanker vessels. Non-cargo and passenger vessels are not included.
**Original Study Year.
Source: The St. Lawrence Seaway Traffic Reports

[3] In 2002, there were 569 ocean vessels that transited the MLO section upbound and 568 ocean vessels that transited the MLO in a downbound direction for a total of 1,137.

Vessel Transits

On average, about 565 ocean vessels come into the Great Lakes through the MLO each year and a similar number leave the Lakes. This means about two ocean vessels daily during a typical 275-day season. In 2006, a busy year for ocean vessels, this average approached 2-1/2 per day. It is significant that there is a large drop-off in ocean traffic west of Lake Ontario. About a quarter of tonnage and vessel movements do not go further west than Lake Ontario ports—there are on average about 1-1/2 ocean vessels each day that pass through the Welland Canal into Lake Erie and the other Great Lakes. A similar number leave each day through the Welland Canal.

Traffic Trends Since 2002

Ocean vessel traffic has a tendency to be much more uneven than laker vessel traffic through the St. Lawrence Seaway. This is evident from Table 1-1 that shows ocean vessel tonnage ranging from a low of 9,562,000 metric tons in 2003 to a high of 14,987,000 metric tons in 2000. Year 2006 was very close to the 2000 value with 14,955,000 metric tons.

Table 1-2
Grain and Steel Traffic Trends
2000-2006
MLO Section

Year	Total	**OV**	Laker	Total I/S	Iron &	Steel	Pig Iron
	Grain	**Grain**	Grain	Products*	Steel**	Slab	
2006	11339	**5635**	5704	**4602**	3466	898	238
2005	9525	**4029**	5496	**3272**	2416	627	229
2004	9011	**3764**	5247	**4270**	3608	494	168
2003	9189	**3693**	5496	**2673**	2067	427	179
2002***	9864	**4712**	5152	**4301**	2930	1138	233
2001	11162	**5168**	5994	**3116**	2512	384	220
2000	12504	**6470**	6034	**5091**	4512	366	213
Avr 00-06	10371	**4782**	5589	**3904**	3073	619	211

*Total of iron & steel, steel slab and pig iron categories. Most iron and steel products move in ocean vessels.
**Iron and steel is typically primary iron and steel products such as coils, bars, rods, and pipe.
***2002 was the original study year.
Source: St. Lawrence Seaway Management Corporation

Traffic fluctuations in recent years are primarily due to steel imports. In 2003, the impact of the Section 201 U.S. tariffs on steel imports dramatically reduced the importation of steel products into the U.S. and there was reduced ocean vessel traffic into the Great Lakes. This tariff was removed in December 2003, and 2004 steel volumes returned to more normal levels. There are many domestic and global economic issues that influence the levels of imported steel. These will be explored in a separate memorandum on steel cargo trends and prospects

The original study report discussed the fact that inbound steel and outbound grain products represented over 3/4 of ocean vessel traffic on the Great Lakes. The demand for steel is the principal driver that determines whether an ocean vessel will come into the Great Lakes. Once in the lakes, that vessel will unload the steel and offer an attractive rate to load grain for the outbound movement. Thus, a reduction in steel imports will also affect the amount of grain moving by ocean vessels outbound from the Lakes. Years with high levels of steel imports will also tend to be high years for export grain by ocean vessels. For example, Table 1-2 indicates that 2003 was the lowest year for steel imports and the lowest year for outbound wheat by ocean vessel. Conversely, years 2000 and 2006 were high years for steel imports and high years for grain exports by ocean vessels.

Obviously, good and bad crop years in the US and Canada will influence grain movements. Year 2006 was a good year for wheat production in Canada and movements from Thunder Bay reflect this. A review of grain movements does seem to suggest that more grain is moving from smaller ports such as Hamilton, Goderich, Windsor, Toledo, Milwaukee and Burns Harbor then was previously the case. Toledo has been especially strong and in 2006 surpassed Duluth as a grain port. These smaller ports seem to have increased their share at the expense of Duluth and Thunder Bay. Some of this may be due to their relative proximity to the ports where steel is unloaded. A shipload of steel unloaded in Detroit for example would find it more attractive to take on a load of grain in Windsor or Toledo then to spend time sailing to Lake Superior for an outbound load.

Conclusions

This chapter looked at traffic trends through the St. Lawrence Seaway since the publication of the original "Ocean Shipping" report that utilized 2002 traffic. It determined that 2002 was a 'typical' traffic year and closely approximated the average traffic levels for the entire 2000-2006 time period. An analysis of traffic for this seven year period indicated that there are, on average, about 565 inbound ocean vessels each season passing through the MLO and a similar number of outbound vessels. This is slightly more then two ships per day during the navigation season. These ocean vessels carry on average about 12,100,000 metric tons of cargo. Actual volumes have varied considerably from this average due primarily to steel importation levels, which can be greatly affected by policy decisions such as the imposition in 2003 of tariffs by the US government on imported steel. Changes in steel imports also affect the availability of ocean vessels for outbound grain movements. Year 2006 was a very strong year for ocean vessel traffic that was driven by high levels of steel imports and high levels of grain exports. Conversely, high steel inventories and a slowing economy indicate that 2007 may be lower than average in terms of ocean vessel passages.

Chapter 2
Grain Traffic Trends and Prospects for Ocean Vessels Through the MLO

Over three-fourths of ocean vessel traffic through the MLO consists of inbound steel traffic to Great Lakes ports and outbound grain traffic from Great Lakes ports. The importance of these two traffic categories suggests a review of past, present and possible future traffic trends. This chapter deals with grain traffic and Chapter 3 deals with steel traffic.

Grain Traffic Trends

Table 2-1 provides data on total grain traffic movements through the MLO from 1959 to 2006. This includes movement by both ocean vessels and laker vessels. The peak years for grain traffic occurred from about 1970 to 1984 when shipments of more than 20 million tons annually were the norm. The peak year was 1978 when 27.7 million tons passed through the MLO. Grain traffic has subsequently declined to 11.3 million tons in 2006. The peak years represented a period when large volumes of grain were shipped to Russia and Europe. These were natural markets for the Seaway given long-standing shipping and business relationships and the relative proximity of northern Europe to the northern part of the North American continent. This period saw the development of infrastructure and facilities such as large grain elevators on the Great Lakes and St. Lawrence River to handle these traffic volumes. Many of these facilities are now underutilized.

In the mid-1980's the markets began to change. Europe and Russia began to significantly increase their own production and become more self-sufficient. Concurrently, Asian countries began to import more grain as their economies improved. This resulted in a major shift of grain traffic from an eastward move via the Seaway to a westward move to the west coast. For Canada, especially, the grain producing regions are located much closer to the west coast, and rail movement to Vancouver or Prince Rupert tidewater is much less expensive than an eastward movement by rail to Thunder Bay and water movement over the Great Lakes and the St. Lawrence River to the Atlantic Ocean.[4] The result of this was a gradual downward trend for grain shipments through the Seaway. There were occasional traffic spikes caused by good crop years in North America and poor crop years elsewhere but the trend was slowly downward.

Commodities

The top five categories of grain traffic through the MLO in 1985 and 2005 are shown in Table 2-2 and additional detail is provided in Table 2-A at the end of this report.

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[4] The Canadian Wheat Board estimates that the cost of moving wheat from a mid-prairie point to an export point on the St. Lawrence River is $88.97 Cdn. /ton and the Pacific seaboard is $64.54 Cdn./ton for 2004/2005. This differential of $20+ per ton has existed for at least the last ten years.

Table 2-1
Grain Commodities Through the MLO

Year	Grain Traffic
1959	6972
1960	7773
1961	10223
1962	10676
1963	13188
1964	16112
1965	16795
1966	19111
1967	12675
1968	12852
1969	11870
1970	18983
1971	21228
1972	22278
1973	23207
1974	15553
1975	20815
1976	20041
1977	23243
1978	27736
1979	24716
1980	26747
1981	24453
1982	24247
1983	24263
1984	23501
1985	16375
1986	16354
1987	18324
1988	15469
1989	11448
1990	12229
1991	15445
1992	12245
1993	10842
1994	13245
1995	14587
1996	12303
1997	13482
1998	12964
1999	13553
2000	12504
2001	11162
2002	9864
2003	9189
2004	9049
2005	9525
2006	11339

Source: St. Lawrence Seaway Management Corporation Annual Traffic Reports

Table 2-2
Grain Commodities Through the MLO
(1985 & 2005)
(000's of Metric Tons)

Commodities	1985		2005	
	Tons	%	Tons	%
Wheat	11502	70.2%	5855	61.5%
Soybeans	736	15.3%	1257	13.2%
Corn	2509	4.5%	577	6.1%
Flaxseed	340	2.1%	418	4.4%
Canola	0	0	414	4.3%
Other (rye, oats, barley, peas etc.)	1287	7.9%	1003	10.5%

Wheat declined significantly during this period from 11.5 million metric tons to 5.9 million metric tons. It also declined as a percentage and currently represents about 61 percent of all grain traffic. Corn traffic declined even more from 2.5 mmt to .6 mmt. Conversely, flaxseed increased and canola increased from nothing to .4 mmt. Although it does not show on this table, there was also a period during the 1980's when sunflower seeds comprised over 1.4 mmt. This cargo has largely disappeared.

<u>Commodities by Country of Origin</u>

Table 2-3
US and Canadian Grain Commodities Shipped Through the MLO
(1985 & 2005)

Commodity	1985	2005
Wheat (000's of metric tons)	11502	5855
US	17.0%	35.7%
Canada	83.0%	64.3%
Corn (000's of metric tons)	2509	577
US	77.3%	96.2%
Canada	22.7%	3.8%
Soybeans (000's of metric tons)	736	1257
US	89.7%	62.2%
Canada	10.3%	37.8%
Flaxseed (000's of metric tons)	340	418
US	0	22.2%
Canada	100%	77.8%
Canola (000's of metric tons)	0	414
US	0	0
Canada	0	100%
Other Grain (000's of metric tons)	1287	1003

US	40.6%	35.6%
Canada	59.4%	64.4%
Total (000's of metric tons)	16374	9524
US	31.0%	40.7%
Canada	69.0%	59.3%

Source: St. Lawrence Seaway Management Corporation Annual Traffic Reports

- Most of the wheat comes from Canada (about 2/3).
- Almost all of the corn comes from the US (about 96%).
- Most of the soybeans come from the US (about 2/3)
- Most of the flaxseed comes from Canada (about ¾)
- All of the canola comes from Canada.

<u>Ocean Vessel Destinations</u>

Data is available from Statistics Canada by Canadian port of origin and port of destination. A review of 2002 foreign port data indicates that the majority of Canadian grain moving on ocean vessels through the MLO is destined for European or United Kingdom ports. These two areas account for about 54 percent of total ocean vessel traffic from Canadian Great Lakes ports.[5] The port of Ghent, Belgium handles almost 500,000 tons of grain traffic originating at Canadian ports—this is almost one-fourth of all grain traffic moving through the MLO in ocean vessels. Most of this traffic is flaxseed. Antwerp, Belgium also handles about 100,000 tons annually primarily of flaxseed. A major wheat port is Liverpool, England, which handled about 115,000 tons in 2002. The large majority of Canadian grain originates at Thunder Bay with lesser amounts at Goderich and Hamilton loaded onto ocean vessels.

Table 2-4
Destination Ports for Canadian Grain Leaving the Great Lakes on Ocean Vessels

Destination Port Country	% of Total	Comment
Europe (not incl UK/Ire)	42%	Flaxseed thru Belgium is over half
UK/Ireland	12%	Mostly wheat
South America/P. Rico	13%	Mostly wheat
Middle East	12%	Mostly wheat with some peas, flaxseed
Mexico	9%	2/3 wheat/ remainder mostly canola seeds
Japan	7%	Mainly canola seeds
South Africa/Australia	5%	Mainly barley

Source: Statistics Canada

Slightly more than half of all grain traffic moves through the MLO in laker vessels with the remainder moving in ocean vessels. The lakers transport the grain to elevators on the St. Lawrence for transshipment to ocean vessels and onward movement to the ultimate destination in Europe and elsewhere. Ocean vessels may top off their cargoes at these elevators because

[5] Grain traffic on ocean vessels from Canadian Great Lakes ports is estimated to be about 2.3 mmt. About 2.1 mmt of this originates in Thunder Bay.

draft restrictions prevent a fully loaded ship from traversing the Seaway. Most of the US grain moves out of Duluth/Superior while most of the Canadian grain moves out of Thunder Bay.

Wheat is the dominant commodity for the lakers and 2.7 million tons of wheat alone was moved by lakers from Thunder Bay to Port Cartier, Quebec City, Montreal, Baie-Comeau, Trois-Rivieres, and Sorel. Additional wheat moved from Hamilton, Prescott, Sarnia, and Windsor. The authors do not have access to the ultimate destination of grain traffic transshipped through the St. Lawrence ports. However, one may speculate that they would be similar to those described earlier since many of the ocean vessels coming out of the Great Lakes will top off at the St. Lawrence ports before proceeding to their overseas destination.

The ocean vessels outbound from the Great Lakes tend to carry a more diverse mix of grains whereas the lakers tend to carry primarily wheat.

Import/Export Forecasts

The US Department of Agriculture, in February 2006, published a report entitled "USDA Agricultural Baseline Projections to 2015."[6] This report examines trends in commodity imports and exports and develops projections by country by year to 2015. The report includes projections of imports and exports of agricultural commodities for both Canada and the US. This report was based on complex macroeconomic models that considered worldwide trends in population and income growth as well as the productive and consuming characteristics of each country.

Table 2-5
Selected USDA Export Projections for the US and Canada to 2015
(millions of metric tons)

Commodity	2004/2005	2015/2016
Wheat		
US	28.9	30.6
Canada	15.0	15.2
Soybeans		
US	30.0	26.5
Canada	*	*
Corn		
US	46.1	60.3
Canada	*	*

*Canada is not a major exporter by worldwide standards of this commodity and was not included in USDA projections for this commodity.
Source: US Department of Agriculture.

- Wheat. The top five wheat exporting nations are the US, Australia, European Union, Canada and Argentina. These five countries account for about 75 percent of worldwide

[6] U.S. Department of Agriculture, *USDA Agricultural Baseline Projections to 2015*, February 2006.

exports during the USDA forecast period. These exports were 110.5 mmt in 2004/5 and are expected to grow to 130.6 mmt in 2015/16. The US, Canada, and the EU are expected to decline in terms of market share as Australia, Argentina, Ukraine and Kazakhstan increase their share. The USDA forecast shows that wheat exports from the US and Canada will remain basically flat during the forecast period with small up or down changes from year to year. The Seaway will need to retain its current share of US and Canadian wheat exports in order to preserve it wheat traffic base. Significant import growth areas are assumed by USDA to be the Middle East and N. Africa (+6.5 mmt), Mexico and South America (+4.6mmt), European Union and the former Soviet Union (+3.1mmt) and Sub-Saharan Africa (+2.1). Asia will see very little growth in wheat imports. The ability for Seaway export wheat to compete in these growing markets is not clear. There will be increased worldwide competition especially for the European and Middle Eastern markets from Russia and other former Soviet Union countries such as the Ukraine.

- Soybeans. The US has been the dominant producer of soybeans accounting for 30 million tons of exports or about 46 percent of world trade in soybeans. This is expected to change as Brazil rapidly increases soybean production—almost tripling production from 20 million tons in 2005 to 58 million tons in 2015. They will become, by far, the dominant player in the world and US exports are projected to decrease to 27 million tons in 2015.
- Corn. The US dominates the world in corn production and in corn exports. The US share of world exports is currently about 60 percent and this is expected to grow to about 63 percent by 2015/16. Most of the growth in corn exports will be to Mexico and China. The location of corn growing areas in North America and the emerging worldwide markets for corn do not seem very favorable for the Seaway. Canada produces relatively little corn for export although there are small amounts of Canadian corn moving through the Seaway. The major US corn growing regions tend to be somewhat south of the catchment area of the Great Lakes.

Emergence of Competitive Trade Routes

The SLS must compete in a changing global environment where trade routes, markets, and modal options are changing. The shift toward Asian markets and away from Europe in the 1980’s redirected a lot of grain traffic from an east coast routing via the Seaway to an all rail move to the west coast. The elimination of rail rate structures that favored an easterly move also changed and there is now a significant cost penalty for grain moving to the St. Lawrence. The rail mode has also experienced major efficiency gains with dedicated unit trains, heavier railcar loadings, reduced crew sizes, and more efficient locomotives. Grain from the northern plains and prairies have options to move east via the Seaway, south via the Mississippi River to the Gulf, south to the Gulf by rail, and all rail to the west coast and the St. Lawrence. Our prior report indicated that the loss of ocean shipping for grain traffic would result in only modest cost penalties to shippers who would adapt by using lakers, rail, and barge modes that appear to have adequate capacity to handle current ocean vessel grain volumes.

Conclusions

Grain traffic through the MLO has declined dramatically since its peak of 27.8 million tons in 1978—today it is only about one-third of its former level. Most of this decline has been in wheat traffic especially Canadian wheat that once accounted for over half of all grain shipments through the MLO. Corn traffic has also declined to about 1/4 of its former level. Conversely, there has been growth in soybeans, flaxseed, and canola. Unfortunately, the volumes associated with these commodities do not begin to make up for the loss of wheat and corn traffic. Further, in recent years, these growth areas appear to have leveled off and stabilized in terms of their volume. There does appear to be some opportunity for growth in barley and oilseeds, which will utilize land formerly devoted to wheat production in Canada.[7]

The USDA forecasts a flat export market for both the US and Canada with respect to wheat. Since wheat makes up 61 percent of all grain shipments, it will be important for the Seaway to retain its current wheat market share to prevent further traffic losses. This could be a challenge given the location of wheat importing growth markets and increased worldwide competition especially from countries comprising the former Soviet Union. These countries have low production costs and are closer to emerging markets such as the Middle East. That said, there might be some opportunities to serve these emerging markets with lower volume niche products such as barley, rye, canola, flaxseed, oats, peas, and the like.

The significance of these trends for ocean vessel shipping is unclear given an apparent flat US and Canadian export market climate for the major Seaway grain commodities. An unknown is the future amount of ocean vessel traffic into the lakes with products like steel and iron products. In fact, the fronthaul movement of steel and other products into the Great Lakes may be a key determinant of how much outbound grain moves by ocean vessels since these vessels present an opportunity for an attractively priced backhaul movement of grain. A review of this data suggests that it is unlikely that there is much upside potential for grain movements through the Seaway. It may be possible to stabilize traffic around current levels if worldwide market share for exports can be maintained.

[7] USDA Baseline Projections, February 2006, pg 74.

Chapter 3
Steel Traffic Trends

Iron and steel products represent about 37 percent of ocean vessel traffic through the MLO. This is only slightly less then agricultural products that represent 40 percent of traffic. Together these two categories represent over ¾ of total ocean vessel traffic through the MLO. There is considerable synergy between steel and agricultural products since inbound ocean vessels carry imported steel products and these same vessels often leave the Great Lakes with grain or other agricultural products. Steel tends to be the head haul movement providing the business impetus for the ships to come into the Great Lakes and grain provides a backhaul movement. As such, a slow year for steel also tends to be a slow year for agricultural products moving in ocean vessels.

Steel Traffic Trends

There is considerable volatility in the level of steel movements into the Great Lakes due to a variety of national and international circumstances. Table 3-1 indicates that steel traffic fluctuated from a high of 5,091,000 tons in 2000 to a low of 2,673,000 tons in 2003. The low levels for 2003 may be attributed to the Section 201 tariffs that were enacted to protect the US steel industry from foreign competition. During this period, the US steel industry made a number of structural changes to become more competitive, the tariffs ended in December 2003, and US steel imports resumed more normal levels. In 2004 and 2005, China's demand for steel drove up international prices for steel and a more competitive North American steel industry supplied more of the product resulting in lower import levels and depletion of inventory levels. In 2006, with world prices lower, steel users built up high inventory levels.[8] Partial year data for 2007 indicates that high inventory levels and a flat economy will result in much lower levels of imported steel for 2007.[9]

Table 3-1
Steel Traffic Trends
(000's of Metric Tons)
2000-2006
MLO Section

Year	Total I/S Products*	Iron & Steel**	Steel Slab	Pig Iron
2006	**4602**	3466	898	238
2005	**3272**	2416	627	229
2004	**4270**	3608	494	168
2003	**2673**	2067	427	179
2002***	**4301**	2930	1138	233
2001	**3116**	2512	384	220

[8] Portions of this discussion were taken from a speech by David Phelps, President, American Institute for International Steel, at the Break Bulk Conference in New Orleans, October 31, 2006.
[9] St. Lawrence Seaway Monthly Traffic Reports indicate that the "General Cargo" category through August 31, 2006, is about ½ of 2006 levels. General Cargo is primarily imported steel. Grain movements as expected are also down significantly reflecting fewer ocean ships to move outbound grain products.

2000	**5091**	4512	366	213
Avr 00-06	**3904**	3073	619	211

*Total of iron and steel, steel slab and pig iron categories. Most iron and steel products move in ocean vessels.
**Iron and steel is typically primary iron and steel products such as coils, bars, rods, and pipe.
***2002 was the original study year.
Source: St. Lawrence Seaway Management Corporation

Future Trends in MLO Steel Cargo

Steel cargoes into the Great Lakes may be expected to vary considerably from year to year due to worldwide and regional economic trends. Longer term traffic levels are difficult to project but the gradual loss of manufacturing employment and slower population and economic growth in the Great Lakes region compared to the south and west are not favorable trends. Increases in auto production in the Great Lakes region and the removal of certain protective tariffs[10] could result in more imported steel. Conversely, developments such as a new $3.7 billion ThyssenKrupp steel plant in Alabama that will process Brazilian steel slabs into finished steel products for the auto industry and other users may adversely affect the competitive position of the Great Lakes region.[11]

One forecaster indicates that by 2020, steel traffic through the MLO will range from 5-8 million metric tons with a "most likely" estimate of about 6 million metric tons[12]. This compares to an average of about 4 million metric tons during the 2000-2006 period. This same forecast shows considerable variation in year-to-year volumes.

Conclusions

Steel traffic is a major component of inbound cargo traffic through the MLO. It is particularly important because it also provides ships that can haul outbound export grain, which is another important component of MLO traffic. Steel traffic levels vary considerably from year to year due to regional and global economic circumstances. Steel traffic through the Seaway will be dependent on the health of the Great Lakes economy and its competitive position with respect to the rest of North America. It will also depend on the relative competitiveness of the North American steel industry. A less competitive industry could result in more imported steel on ocean vessels but lessened demand for iron ore and other raw materials (carried by laker vessels) used by US and Canadian steel producers. One forecaster sees modest growth of imported steel traffic through the year 2020.

[10] For example, the automotive industry is pushing for the removal of protective tariffs on certain types of imported steel from Germany and Korea.
[11] Traffic World Magazine, May 28, 2007. Page 14.
[12] Presentation to the National Academy of Sciences Committee on the St. Lawrence Seaway, Hazen Ghonima, President , TAF Consultants, May 23-24, 2006, Washington, D.C.

Chapter 4
Prospects for Container Traffic on the Great Lakes

The movement of shipping containers on the world's oceans is growing and the economies of many parts of the world are tied to the efficiencies associated with a single box moving from a producer in one country to a consumer in another country. The rapid growth of global trade has placed unprecedented demands on container ports and the surface systems that serve these ports.

The potential for increased waterborne movement of containers into the Great Lakes region has long been of interest to port agencies and the communities that they serve. There is a perception that the direct movement of containers by ship into a Great Lakes community will be beneficial to the local economy and allow it to more effectively participate in global trade.

This chapter provides a short review of transportation related issues and/or problems related to the likelihood of container ships coming into the Great Lakes.

Major Container Ports

Containerization and container ports are growing throughout the world. Table 4-1 shows the volume of traffic moving through the fifteen largest ports in North America. Also shown is Halifax, which is #21 on the list. The largest container port in the world is Singapore with over 23 million TEU's[13] in 2005. In addition, Hong Kong and Shanghai each handle about 20 million TEU's annually.

Container Shipping into the Great Lakes is Limited at Present

The Annual Traffic Report for the St. Lawrence Seaway indicates that container shipping in the Great Lakes ranged from 15-20,000 metric tons annually for the 2000-2006 period. Assuming 10 tons per TEU this represents about 1500-2000 TEU's annually. Virtually all of these containers originate or terminate in Lake Ontario—likely in Toronto.[14] Only a relative handful (a hundred or so) goes beyond Lake Ontario into the other Great Lakes. This is likely incidental deck cargo. It appears that there was somewhat of an up tick in 2006 for containers moving beyond Lake Ontario and the number increased to perhaps 300 containers. Some of this may be parts for wind generating plants destined for western states and provinces.

Viable Trading Routes into the Great Lakes are Limited

Any container movement into the Great Lakes would have to capture traffic from the ports of Halifax, Montreal, and New York/New Jersey. A container route into the lakes could be most effective in capturing traffic between these ports and European or Mediterranean ports since it could provide a direct movement into the North American heartland. In fact, Halifax often

[13] TEU means a "Twenty foot Equivalent Unit" and is the common way of measuring cargo activity at a given port even though some containers may be longer then twenty feet.
[14] For example, in 2002, 14,721 metric tons of containers passed through the MLO while only 848 tons passed through the Welland Canal Section.

markets its port as being at least a day closer sailing distance to Europe then the Port of New York/New Jersey. The adverse distance associated with traffic from other parts of the world (i.e., ships from southern points have to travel far north around New Brunswick and the Gaspe Peninsula to gain access to the St. Lawrence River) appears to make this an unlikely move.

Table 4-1
North American Container Traffic

2005	Port	2005 TEU's
1	Los Angeles	7,484,624
2	Long Beach	6,709,818
3	New York/New Jersey	4,792,922
4	Oakland	2,272,525
5	Seattle	2,087,929
6	Tacoma	2,066,447
7	Charleston	1,986,586
8	Hampton Roads	1,981,955
9	Savannah	1,901,520
10	Vancouver	1,767,379
11	San Juan	1,727,389
12	Houston	1,582,081
13	Montreal	1,254,560
14	Honolulu	1,077,468
15	Miami	1,054,462
21	Halifax	550,462

Source: American Association of Port Authorities.

Small Seaway Size Ships Could Not Compete in the Trans-Atlantic Market

Container ships continue to increase in size and efficiency. Maersk Lines just completed the Emma Maersk, which can carry from 11,000-14,500 TEU's. This ship is over 1300 feet long, has a beam of 184 feet and draft of 50 feet.[15] It will have a crew of only 13 people. There are many other ships being built, or recently built, in the 8,000-10,000 TEU range. By comparison, the larger ships coming into the Port of Montreal are in the 4,400 TEU range. A container ship moving west of Montreal would need to be much smaller because of the dimensional constraints of the Seaway. A container ship passing through the Seaway into the Great Lakes would likely be in the 1000-1500 TEU range. The international shipping community would classify this size ship as a feeder ship.

It would be difficult or impossible for these small vessels to effectively compete in the Trans-Atlantic trade against the large ships that will serve the Port of Halifax or the Port of New York/New Jersey or the medium size ships serving the Port of Montreal. A small vessel requires

[15] The Seaway can accommodate ships with a maximum dimension of 225.5 meters long (740 feet), 23.8 meters in breadth (78feet) and 9.1 meters draft (30 feet).

a crew similar to a larger vessel yet the larger vessel can carry 3-10 times the number of TEU's. There has been discussion over the years regarding expansion and deepening of the St. Lawrence Seaway locks and channels. However, that does not currently appear to be on the horizon and current efforts are being directed towards funding to maintain Seaway infrastructure in its present configuration.

<u>More Ships are Required to Service Great Lakes Ports</u>

Ship owners prefer an operating plan that gets as many trips as possible from a given vessel in a given service. A service from Northern Europe (e.g., Hamburg, Antwerp etc.) to Montreal takes about 7-8 days—depending on the number of stops. Cycle time including port time is about 21-days—that is, a given ship will be able to depart Montreal for Northern Europe every 3-weeks. Weekly service would thus require three ships. If a ship went beyond Montreal to Detroit or Chicago additional time would be required—about one additional week to Detroit and two additional weeks for Chicago service.

- Three ships can provide a weekly service between Montreal and N. Europe
- Four ships would be required to provide a weekly service to/from Detroit
- Five ships would be required to provide a weekly service to/from Chicago

These ships would have to be much smaller then the ships serving only Montreal and all five ships would have less capacity then just two larger ships leaving Montreal. Twice weekly service would require respectively 8 and 10 ships.

<u>Service Levels Would be Less then Currently at Montreal</u>

Montreal currently is able to generate sufficient traffic to offer very high levels of service to Northern Europe with ships departing at least 3-5 times each week. Close to daily departure opportunities make this very attractive for companies involved in closely timed supply chain operations. Weekly or bi-weekly service would be much less desirable and would increase inventory and other carrying costs. Further, it is difficult to see how such a service could be competitive with Montreal, Halifax, or the Port of New York/New Jersey given the well-developed rail and truck networks designed to service these ports.

<u>Alternative Modes of Transportation Provide Good Levels of Service</u>

Railroads and trucking companies have developed extensive intermodal service networks serving Montreal, Halifax, and New York. Both CN and CP provide multiple daily train services from Detroit and Chicago to dockside in Montreal. A container loaded in these cities can be in transported and loaded on a ship in Montreal in 2-3 days and on the way to Europe. This level of service and the frequent sailings from Montreal offer shippers from the Midwest the ability to regularly ship and receive containers. There are similar intermodal rail services from Chicago to the East Coast where again sailings are very frequent. The most time sensitive freight could be trucked from Chicago to one of these ports in less then a day if necessary and be on its way to Europe. Weekly or twice weekly sailings from Great Lakes ports would incur both longer transit times and longer wait times for a ship.

Nine Month Season Makes Competition Difficult

A very difficult problem is the three months in the winter when the Seaway is closed. Shippers will have to make alternative arrangements for this time period and the other modes will be reluctant to offer attractive rates for this type of seasonal service. The railroads and truckers will not maintain an inventory of locomotives, railcars, and trucks that cannot be utilized fully throughout the year. As such, they will try to convince the shippers that they would be better off by contracting year round with them to take the traffic to Montreal or another port. Any new service proposed for the Great Lakes will likely find significant resistance from the railroads and truckers to prevent them from switching a portion of their traffic to ocean vessels coming to a Great Lakes port. This could include initiatives to raise rates on traffic on other routes.

The Harbor Maintenance Tax Would Add Costs for US Bound Containers

The US imposes a .125% Harbor Maintenance Tax (HMT) on the value of goods imported into the US by water. This Harbor Maintenance Tax is used to provide dredging and other maintenance activities at US ports, channels, and harbors. This tax is also used to pay for the operation of the St. Lawrence Seaway Development Corporation --the entity responsible for the operation of the two US locks on the Seaway. This tax would apply to the value of any containerized goods imported into a US Great Lakes port. For example, the owner of a container containing $100,000 of merchandise would have to pay US Customs $125 for that container. This tax only applies to goods entering the US by water—it does not apply to goods landed in Montreal and trucked or railed into the US. It would also apply to any goods landed at an east coast US port. The HMT gives the ports of Montreal or Halifax and the surface modes that serve them a cost advantage over east coast US ports or container ships coming into the lakes to service US ports. Containers tend to have higher value products compared to the other traffic and the HMT would affect them more than other types of cargo.

Feeder Services May Be Viable

Conventional container services do not appear to be viable in the Great Lakes because of size constraints and the difficulty in competing in the trans-Atlantic market with much larger ships. However, it may be possible to transload containers from a larger vessel to a smaller Seaway size vessel at Halifax or Montreal. This type of "short sea shipping" is common in Europe and may have some application in North America. However, rail and truck services are much more efficient in North America and whether feeder type services could compete is not clear. Another issue relates to whether transloading costs at the transfer port could be kept low enough to make the concept viable.

Conclusions

The authors do not believe there is any potential for conventional container ship service into the Great Lakes. The smaller vessels that could fit through the Seaway could not compete in the trans-Atlantic trade with the much larger ships serving Montreal, Halifax, and New York. Further, the extra time involved in serving ports such as Detroit and Chicago and the infrequent service from these ports would not be attractive to shippers. They are accustomed to almost daily service between major eastern ports and Northern Europe as well as efficient rail and trucking services to and from these ports. The three month winter closure of the Seaway would be a major problem for shippers and the high rates they would pay the railroads or truckers during this period would further negate any economic advantage. The Harbor Maintenance Tax is a further economic obstacle for containers landing at US ports especially as compared to containers landing at Montreal and moving by rail or truck to the Great Lakes Region.

There will always be containers moving on the Great Lakes as incidental or project related cargo. There may in fact be an opportunity to increase this business particularly in certain specialty or low volume areas where containerization makes sense. There may also be the potential for certain types of short sea feeder services for containers moving upbound from Halifax or Montreal into Lake Ontario or possibly Lake Erie. A Canadian port would have an advantage since it would be exempt from the HMT. These feeder services, if economically viable, would likely be low volume compared to existing volumes currently moving by rail and truck.

Chapter 5
Capacity of Alternative Modes

The cessation of ocean shipping in the Great Lakes, should it occur, would result in cargo shifts to rail, truck, barge, and laker modes of transportation. The ability of these alternative modes to handle this additional traffic is examined in this memorandum.

The 2005 Ocean Shipping Report[16] contains information on the diversion of ocean vessel traffic to alternative modes. This is shown in Table 5-1 and indicates that the 12.3 million tons of ocean vessel cargo would shift to:

- Laker vessel-- 24.2%
- Rail—48.7%
- Barge—9.6%
- Truck—17.5%

Table 5-1
Modal Shift Diversion and Capacity Requirements
(000's of Tons Annually)

Traffic Diverted To →	Laker	Rail	Barge	Truck	Total
Thunder Bay Grain	1049	1049	0	0	2098
Duluth Grain	1021	511	511	0	2042
Total Grain Above	2070	1560	511	0	4140
Imported Steel	0	2340	671	1545	4556
"All Other"	897	2082	0	610	3589
Total Tonnage (000's)	2967	5982	1182	2155	**12285**
% of Total	24.2%	48.7%	9.6%	17.5%	
Units Required	119 trips/yr =7.4 lakers	598 trains/yr or 1.6/day	788 barges or 20 tows/yr	71,833 trucks/yr or 197/day	
Assumptions	25,000 tons/trip @16 trips/laker	100 cars @100 tons/car	1500 tons/barge @ 40/barges/tow on Lower Miss. River	30 tons per truck	

Source: Taylor –Roach Report, page 67.

Laker Fleet Capacity

[16] Taylor –Roach Report entitled" Ocean Shipping in the Great Lakes: Transportation Cost Increases That Would Result From A Cessation of Ocean Vessel Shipping." .August 2005. Pages 66-71.

Approximately 3 million tons of cargo would be diverted from ocean vessels to laker vessels. Most of this is grain from Duluth and Thunder Bay. It is assumed that 7.4 vessel equivalents of laker capacity would be required (assuming 16 trips annually for each vessel and 25,000 tons of capacity) to handle cargo diverted from ocean vessels...

The current laker fleet is comprised of about 131 bulkers, self-unloaders, and tankers. This represents US or Canadian flag vessels that are members of the US Lake Carriers Association or the Canadian Shipowners Association.[17] The laker fleet has declined in size over the years due to general decreases in the movement of certain bulk cargoes such as iron ore and grain.[18]

Additional traffic from ocean vessels would result in the need for an increase in the laker fleet and/or increased utilization of existing vessels. Although it varies from year to year, there are often vessels that are laid up and potentially could be utilized given a need. Further, vessels that may be scheduled for retirement could be retained in service. As noted earlier, the fleet has gradually declined in size in part because of the decrease in traffic. New traffic opportunities could retain ships in service and possibly result in justification for new vessels or conversions of older vessels to more efficient tug-barge combinations. There have been no new vessels constructed for lakes service since the 1980's and significant obstacles exist both in the US and Canada. This includes the lack of shipbuilding capability in Canada and the requirement that any foreign built ship built for Canadian service would be subject to a 25 percent tariff. Any ship built for US Great Lakes service must be built in the US and the associated cost may make the overall cost structure uncompetitive. Great Lakes shipping is under significant cost pressures and shipping officials indicate that the laker fleet covers its operating costs but not its replacement cost.[19]

Rail Capacity

About 600 additional trains annually (assuming 100 car trains at 100 metric tons/railcar) would be required to handle 6 million tons of cargo diverted from ocean vessels. Traffic is comprised of Duluth and Thunder Bay grain (26%), steel (39%), and other traffic (35%).

Additional train traffic due to diversion from ocean vessels would be widely dispersed throughout the Great Lakes region and beyond. It would include unit grain trains from Thunder Bay to the St. Lawrence; South Dakota grain trains to St. Louis for transloading to barge or all rail to the Gulf of Mexico; steel from Philadelphia to Cleveland; and, numerous other moves. Traffic would not be concentrated in a single corridor. The additional rail traffic amounts to the equivalent of 1.6 new trains each day. However, this traffic could involve single car moves in existing rail services or unit trains. Additional rail traffic on any given rail route would be quite

[17] Source: Canadian Shipowners Association and Lake Carriers Association internet sites.
[18] The Canadian Shipowners Association indicates that there were 88 ships in 1997 and 68 ships in 2006. A 2007 Transportation Journal article indicates that the Great lakes Domestic Cargo –Carrying Fleet decreased from 426 vessels in 1977 to 156 vessels in 2004. Page 43.
[19] Interviews with Lake Carriers Association and Canadian Maritime Chamber of Commerce officials.

small in comparison to existing traffic levels. For example, there are about 150 trains each day just in the four major rail corridors north and south of Lake Erie[20]

Rail officials that were interviewed indicated that, in general, routes east of Chicago had adequate capacity. This includes routes to east coast US cities as well as to Canadian cities such as Toronto and Montreal. Multiple heavy-duty rail routes had been developed over the decades to serve the manufacturing and population centers of the East and Midwest. These routes have not grown as fast as others due to slower population and job growth especially as compared to the south and west. .

There is considerable discussion of rail "congestion" and rail capacity problems. Some perceive this as universally applying to all parts of North America. In fact, rail capacity problems are limited to a few high volume corridors or bottleneck points in the rail system. This includes Chicago and rail routes serving the fast growing ports and cities of the south and west. Discussions with CN and CP executives indicated that their railroads had the capacity to handle significant additional grain volumes from the Great Lakes region to ports on the St. Lawrence River. A representative of the rail industry that testified before the NAS Committee on the St. Lawrence Seaway indicated that the ocean vessel volumes were so small that they could be easily handled by the railroads.[21]

Railroads have enormous potential to carry heavy volumes of freight. Some routes such as the BNSF Transcon from Los Angeles to Chicago carry over 100 daily trains on some segments—most of them high priority intermodal trains. The Union Pacific Railroad in Nebraska carries about 140 trains per day on their three track mainline—a mix of coal, intermodal and general merchandise. This route segment carries the heaviest tonnage in the world with over 400 million gross ton-miles per year—twice the volume carried on the Great Lakes by lakers and ocean vessels combined. Many rail segments carry in excess of 100 million gross ton-miles. These are typically double track mainlines with bi-directional signaling and frequent crossovers. However, there are a number of single-track rail lines that carry traffic in the 40-50 million tons per year range, which translates into 30-50 daily trains.[22]

The 12.3 million tons of cargo carried by ocean vessels on the Great Lakes could easily be carried by a single-track rail line. At a modest 6,000/tons per train, this line would have to accommodate the equivalent of about six loaded and six empty trains each day. This is just an illustrative statement and not a suggestion that additional rail capacity is needed given the adequacy of the existing rail system to handle the diverted rail traffic.

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[20] CSX and NS both have double track routes south of Lake Erie; CN has a double track route between London and Montreal and CP has a single-track route from Windsor to Montreal.

[21] James McClelland, Executive Vice-President (Ret.) of Planning for Norfolk Southern Railway. May 24, 2006 meeting of the National Academy of Sciences Committee on the St. Lawrence Seaway.

[22] Railroad tonnage data from "U.S. Railroad Traffic Atlas," December 2003, page 76. "Trains Magazine," January 2006, pages 54-55 was also utilized.

Barge Capacity

Approximately 1.2 million tons of cargo was assumed to be diverted to barges on the inland waterway system. This is comprised of 511,000 metric tons of southbound grain and 671,000 metric tons of northbound steel to and from destinations on the Gulf of Mexico. This is a complementary move in the sense that barges can be utilized in both directions (i.e., grain down and steel up). This tonnage represents about 800 barge loads of cargo or about 20 tows annually, (a tow is comprised of a towboat and 30-50 barges on the Lower Mississippi). [23]

The domestic barge industry carries in excess of 800 million tons of cargo annually—most of it on the Mississippi River and its tributaries. The industry operates over 27,000 barges.[24] The addition of slightly more than one million tons of cargo diverted from ocean vessels on the Great Lakes would not be significant.

Truck Traffic

Approximately 72,000 truckloads of cargo annually were assumed to be diverted from ocean vessels. This is about 200 truckloads per day. Most of the new truck traffic is steel or "other" traffic moving relatively short distances such as Montreal to Hamilton (360 miles) or Philadelphia to Cleveland (490 miles). Longer moves were assumed to shift more to the railroad or the barge mode in the case of steel from New Orleans.

- About 40 percent of the steel traffic formerly moving by ocean vessel was assumed to be transloaded at Montreal to truck or rail. The biggest truck traffic increases would occur on the Highway 401 route between Montreal-Toronto-Hamilton where about 89 additional daily truckloads of mostly steel would travel. About 24 of these trucks continue westward toward Detroit and only about seven would continue past the Detroit area to Chicago.
- About 46 percent of the steel traffic was assumed to be transloaded at Philadelphia to truck or rail. Somewhat more of this was assumed to move by rail than was the case at Montreal owing to the greater distances involved. Truck traffic would increase by about 35 trucks per day between Philadelphia and Hamilton via I-81/90. Traffic would increase by about 42 trucks per day on I-76 to Cleveland, 21 trucks per day on I-76 between Cleveland and Detroit and seven trucks per day between Detroit/Toledo and Chicago.
- About 15 percent of traffic was assumed to move by barge from the Gulf of Mexico to the Chicago area. Some of this traffic would be delivered to the end user direct by barge with no onward movement. Some would move by truck to local Chicago area destinations or nearby communities such as Milwaukee. In general, no significant additional truck traffic would be expected compared to cargo moving by ocean vessel.

Truck traffic resulting from a diversion is so dispersed that no corridor would handle over 89 additional trucks each day. Most would handle for fewer. All of the highway corridors are heavily used by truck traffic at the present time and many of the routes exceed 10,000 trucks per day. As an example, I-94 between Detroit and Chicago carried 12,000 trucks per day in

[23] Derived from interviews and field trip on Ingram Barge Company tow on the Lower Mississippi River.
[24] American Waterways Operators internet site.

2006. Truck traffic increases in all cases would be less than one percent of existing levels and typically, the increases would be much less.

Conclusion

The total amount of cargo carried by ocean vessels into the Great Lakes is quite small when compared to existing movements by rail, truck, laker, and barge modes of transportation. Only about two ocean vessels each day enter the Great Lakes and two per day leave the Great Lakes carrying about 12.3 million tons of cargo annually. This compares to about 200 million tons of cargo carried on the Great Lakes by the combined ocean/laker fleet of ships. The total volume of ocean vessel traffic is about the amount that could be carried by a medium density single-track rail line or a single daily tug/barge tow on the Lower Mississippi.

This review suggests that there is adequate capacity in the Great Lakes region transportation system to accommodate traffic currently carried by ocean vessels. Truck traffic would increase less than one percent and would only approach that on Highway 401 west of Montreal. Rail traffic would grow by the equivalent of 1.6 trains each day spread over the entire rail system in the Great Lakes region. This is insignificant compared to volumes approaching 150 daily trains on the rail lines north and south of Lake Erie. Rail executives from both CN and CP indicated that rail congestion is not a problem in the east and that the railroads could handle additional traffic. There could be an issue with the availability of laker vessels. This fleet has downsized over the years and is often close to being fully utilized. That said, interviews indicated that capacity could be found if there was assurance that traffic would be available. This could include the retention and modernization of vessels scheduled for retirement, the conversion of existing vessels to integrated tug barge designs, and the possible construction of new laker vessels.

It is important to understand that the diversion of ocean vessel traffic would result in changes to transportation modes and routes in the entire Great Lakes Region. Diverted traffic would not simply shift to other modes in the ocean vessel corridors between the Great Lakes and Montreal. Major traffic shifts would occur with significant amounts of US grain moving from Duluth to the St. Lawrence River assumed to move by rail and barge to the Gulf of Mexico for export. A majority of the imported steel was assumed to move by rail and truck from Philadelphia to the Great Lakes Region or by barge from New Orleans to Chicago. The point of this is that ocean vessel traffic would be widely dispersed throughout the eastern part of North America and there would not be a concentration of traffic on any existing transportation route or corridor.

Chapter 6
Impacts of Alternative Modes on US and Canadian Transportation Employment

This report provides an estimate of job impacts that would occur if, for whatever reason, ocean vessels cease to come into the Great Lakes.

The estimates contained in this report were based on traffic and other data in the 2005 report entitled "Ocean Shipping in the Great Lakes: Transportation Cost Increases that would Result from a Cessation of Ocean Shipping." Traffic and other data are from 2002 but these levels are representative of the 2000-2006 period. Jobs are expressed as full time equivalents (FTE's) which is an 8-hour day and a 220-day year. We recognize that many jobs in the transportation industry often involve irregular work hours, long workdays and work away from home for extended periods. Each mode of transportation has specific standards and requirements for operating employees that differ significantly.

Table 6-1
Summary of Job Gains or Losses with a Cessation of Ocean Vessel Shipping into the Great Lakes

Job Impact	FTE's
Ocean vessel employment on the GL would disappear	-891 Foreign
GL ports would lose jobs related to ocean vessel cargo handling	-801 Domestic
SLS and Lakes pilots & support personnel would lose jobs	-100 Domestic
SLSMC & SLSDC would lose jobs	-100 Domestic
GL port cargo handling loss would be offset by shift of some OV traffic to lakers	+ 97 Domestic
St. Lawrence ports would gain with increased transshipping to/from rail, lakers & truck	+374 Domestic
East Coast, Gulf and River ports would gain	+357 Domestic
Railroads would gain jobs	+157 Domestic
Trucking companies would gain jobs	+980 Domestic
Lake carriers would gain jobs	+240 Domestic
Barge companies would gain jobs	+115 Domestic
Net Change (including foreign OV employees)	+428
Net Change—US and Canada Employees	**+1319 Domestic**

Ocean Vessel Employment

We developed estimates of ocean vessel employment by making certain assumptions regarding crew size, average time in the Lakes and the number of upbound vessels entering through the MLO in 2002. This results in an estimate of 891 FTE jobs associated with ocean vessels on the Great Lakes. The large majority of these jobs are filled by residents of foreign countries, often from Asia or Eastern Europe. Ocean ships that cease to operate in the Great Lakes would likely be deployed elsewhere in the world.

Table-6-2
Ocean Vessel Employment in the Great Lakes

Number upbound ocean vessels	568
Average number days RT from Montreal to GL to Montreal	15
Typical # employees per ship	23
Total employee days	195,960
Full time equivalent jobs	891

Great Lakes Port Related Jobs

Ports on the Great Lakes employ significant numbers of people to load and unload ships, switch rail cars, provide local truck service, provide ship repair and fuel services, provide security and administrative support and many other functions. These employees commonly perform these services for both ocean vessel operators and US or Canadian laker vessel operators. A significant number of persons are required to load or unload ocean vessels especially if it involves non-bulk cargo such as steel. Our approach was to estimate the number of jobs involved in loading and unloading ships and we then added a factor to account for the various ancillary jobs associated with the ship being in port.

Table 6-3 at the end of this memorandum indicates the procedure that was used to develop port cargo handling estimates. Basically, traffic tonnage was converted into ship equivalents based on 20,000 tons of cargo per ship. We then assumed that a grain vessel could be loaded or unloaded in 24-hours by two crews of 12 employees each. In addition, we assumed that the port would have support personnel related to security, administration, port rail switching, maintenance etc. A total of 30 employee days including support personnel was assumed to load or unload a grain vessel. A much higher number was used for steel where 270 employee days was assumed. This is based on 2-shifts/day of 36 cargo handlers and 9 support personnel over a three-day period for 270 employee days. We recognize that ships may offload steel at several ports but the total number of jobs should be about the same to unload a given ship. We also added jobs required to load and unload rail cars, trucks, or barges at a given port. These jobs will disappear if ocean ships no longer serve the port. For example, rail cars arriving at a port must be switched, unloaded, and elevated prior to the cargo being loaded onto an ocean vessel. Conversely, steel arriving at a port on an ocean vessel must be offloaded, stored, and loaded onto trucks or railcars for onward movement. We estimate that there are 801 port related FTE's associated with ocean vessels in the Great Lakes.

SLSMC &SLSDC

Ocean vessels represent about 25-30 percent of traffic through the St. Lawrence Seaway. The loss of this traffic, even with the recapture of some traffic to laker vessels, could potentially result in some loss of employment at the St. Lawrence Seaway Management Corporation and the St. Lawrence Seaway Development Commission—the two entities that operate the Seaway. In FY 2006, these entities employed 737 persons.[25] Since the operation of the locks is a 24-hour a day operation it may be impossible to reduce employment commensurate with cargo losses. For purposes of this analysis, it was assumed that 100 jobs would be lost.

Pilotage

There is a requirement that all ocean vessels have a pilot to navigate through the Seaway and the Great Lakes. The cessation of ocean shipping would virtually eliminate this profession since lakers typically do not require a pilot. We estimate that the loss of Great Lakes pilots[26] and support personnel (dispatchers, administrative support, pilot boats, etc) would be approximately 100 jobs.

Ocean Vessel Traffic Diverted to Lakers

Laker vessels are assumed to pick up about half of grain cargo formerly carried by ocean vessels as well as other cargo. This results in the retention of 97 cargo handling jobs at Great Lakes ports. It also results in new jobs to operate the additional laker vessels required to move this traffic. Approximately 240 additional laker jobs will be created.

St. Lawrence Ports

Ports on the St. Lawrence River would gain jobs due to transshipping from rail, truck, and laker vessel. For example, lakers and trains would bring grain currently carried by ocean vessels to St. Lawrence ports for elevation and later loading into ocean vessels. Steel and other cargo would also be offloaded from ocean vessels at Montreal or other St. Lawrence ports and reloaded onto truck or rail for destinations in the Great Lakes area. We estimate that ports on the St. Lawrence River would gain 374 jobs.

East Coast, Gulf, and Mississippi River Ports

Cessation of ocean vessel shipping in the Great Lakes would likely change trading and routing patterns. Some cargo such as steel would likely move through east coast ports such as Philadelphia or Gulf ports such as New Orleans. It would move by rail, truck or barge into the Great Lakes area. Some export grain, especially from the US, is expected to utilize rail and barge to the Gulf for loading to ocean vessels. We estimate that East Coast, Gulf and Mississippi River ports would gain 357 jobs.

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[25] FY 2006 Annual Reports of the SLSMC & SLSDC. The SLSMS employed 589 persons & the SLSDC employed 148 persons.

[26] We were unable to conclusively determine the number of pilots. The Western Great Lakes pilots Association is responsible for lakes, Superior, Huron, and Michigan. They have 23 pilots—19 US and 4 Canadian. Other sources indicate that there are 41 pilots total for all of the lakes.

Railroads

Railroads are assumed to pick up half of the grain traffic currently carried by ocean vessels. Canadian grain would move from the prairies to the St. Lawrence while US grain would move to St. Louis for transloading to barge or all rail to the Gulf. Steel and other traffic would move from Montreal, Philadelphia and other locations to final destination in the Great Lakes area. Jobs include road crews (2-person crew with 200-mile crew district), switch crews, and support personnel (MOW, administration, equipment maintenance etc.). We estimate that there would be 157 new railroad jobs.

Trucks

Trucks are assumed to carry steel from Montreal, Philadelphia, and Chicago to the Great Lakes area. Trucks will also handle other types of cargo from these and other ports. Assumptions include an average 500-mile one-way trip with a 30-ton average load. Approximately 980 FTE's are required to handle the 72,000 truckloads.

Barges

Barge companies would handle grain traffic that would be transloaded from rail at St. Louis for onward move to New Orleans or other Gulf points where it would be loaded onto ocean vessels. Barges would also handle steel traffic from New Orleans to the Chicago area. We estimate the need for an additional 115 barge related employees.

Conclusions

The cessation of ocean vessel shipping in the Great Lakes would cause cargo to shift to other modes of transportation including lakers, trains, barges, and trucks. These modes employ residents of the US or Canada almost exclusively. The change from ocean vessels with foreign employees to domestic transportation carriers with US and Canadian employees will mean an increase in the number of domestic[27] jobs. Our estimate is that 1,319 additional domestic jobs would be created if ocean vessels did not come into the Great Lakes. Many of these jobs will go to residents of the Great Lakes area who will work on laker vessels, barges, trains, and trucks. However, there would be some dislocation of jobs and a portion of jobs performed at Great Lakes ports would shift to ports on the St. Lawrence River, East Coast, or Gulf of Mexico.

[27] Domestic as used in this report refers to residents of the US or Canada.

Table 6-3
Port Employment Impacts Worksheet

Total Time to Load/Unload Grain and Non-Grain Products

	Total Emp Days/Ship @20K/Ship	Port Days/Ship	
Grain--Load or unload ocean or laker vessel	30	1	Assumes 2 shifts/day @12 employees=24emp+6 support=30 2/
Grain--Load or unload grain from rail/barge to/from port elevator	30		Assumes same as ship/unload time
Steel and other--Load or unload ocean vessel or laker	270	3	Assumes 2 shifts/day@36=72+18support=90x3d=270 2/
Steel and other--Load or unload to/from rail/truck/barge at port	135		Assumes half of ship load/unload time 2/

2002 Ocean Vessel Traffic

	Total	**Loaded**	Ballast	Tonnage	Number of Ship Equivalents @20K/ship 1/	Employee Days to L/UL One Ship 3/	Total Emp Days	Total FTE's to L/UL All Ships	FTE's to L/UL to/fr R/T/Barge 3/	Total FTE's	.
Upbound	569	**531**	38	6814	341	270	91989	418	209	**627**	
Downbound	568	**391**	177	5470	274	110	30085	137	37	**174**	
				12284	614			555	246	**801**	4/

Alternative Mode

	Tonnage	Number of Ship Equivalents	Employee Days to L/UL	Total Emp Days	Total FTE's to L/UL
Thunder Bay Grain					
Rail to St. Lawrence					
Unload grain to elevator at StL port	1049	52	30	1574	7.2
Load OV	1049	52	30	1574	7.2
Laker to St Lawrence					
Load laker at GL port	1049	52	30	1574	7.2
Unload grain to elevator at StL port	1049	52	30	1574	7.2
Load OV	1049	52	30	1574	7.2
Duluth Grain					

	Laker to Stl						
	Load laker at GL port	1021	51	30	1532	7.0	
	Unload grain to elevator at StL port	1021	51	30	1532	7.0	
	Load OV	1021	51	30	1532	7.0	
	Rail to Gulf						
	Unload rail to elevator at Gulf port	511	26	30	767	3.5	
	Load OV at Gulf port	511	26	30	767	3.5	
	Rail to St. Louis				0		
	Unload rail at St. Louis	511	26	30	767	3.5	
	Load barge at St. Louis	511	26	30	767	3.5	
	Unload barge at Gulf	511	26	30	767	3.5	
	Load OV at Gulf port	511	26	30	767	3.5	
Steel					0		
	Unload steel from OV at Philadelphia port	2082	104	270	28107	127.8	
	Load rail/truck at Philadelphia port	2082	104	135	14054	63.9	
					0		
	Unload steel from OV at Montreal port	1803	90	270	24341	110.6	
	Load rail/truck at Montreal port	1803	90	135	12170	55.3	
	Unload steel from OV at Gulf port	671	34	270	9058.5	41.2	
	Load rail/truck at Gulf port	671	34	135	4529.25	20.6	
All Other Cargo							
	Unload ship at StL port	900	45	270	12150	55.2	
	Load to alt. mode	900	45	135	6075	27.6	
	Unload ship at other port	900	45	270	12150	55.2	Assume 1/2 at GL Port
	Load to alt mode	900	45	135	6075	27.6	Assume 1/2 at GL Port
	Unload from alt mode	900	45	135	6075	27.6	
	Load to OV at St.L port	900	45	270	12150	55.2	
	Unload from alt mode	900	45	135	6075	27.6	Assume 1/2 at GL Port
	Load to OV at other port	900	45	270	12150	55.2	Assume 1/2 at GL Port
						828.3	4/

Note: Most upbound traffic is steel or other products requiring more time to unload. Most downbound traffic is grain requiring less time to load and unload.

Note: FTE's are calculated based on 220 working days per year.

Notes: Support employees assumed at .25 and include administration, maintenance, port rail switching, general overhead, security etc.
Ship may load or unload at several ports (especially steel)
An employee day represents one person working one 8-hour day. An employee working a 12-hour shift is 1.5 employee days.

1/Various sources indicated that ocean vessels moved about 20,000 tons through the Seaway whereas laker vessels move about 25,000 tons. This is attributed to hull design with ocean vessels having V shaped hulls and lakers more U shaped hulls. A review of SLSMC traffic data (Table M-1 for 2002) indicates that the average loaded ocean vessel through the MLO carried 13,300 tons average loaded laker vessel carried 21,450 tons. For simplicity we assume all ships are 20,000 tons in this analysis.

2/Some terminals may operate one long shift (e.g. 12 hours) while others may operate two shorter shifts. Others may operate 24-hours a day.

3/Assume that all upbound is non-grain @ 270 days & downbound is 1/3 non-grain & 2/3 grain=270+30+30=330/3=110 days; l/ul=30+30+135=195/3=65

4/Employee counts are higher without ocean ships because more handling is involved (e.g. grain loaded on OV at TB is not handled again; movement by laker to Montreal involves additional handling at Montreal).

5/3/2007

Chapter 7
Air Quality Impacts

One of the responses to the release of our original report dealt with the negative air quality impacts that would result if current ocean tonnages were ever shifted to alternative modes such as rail, truck, barge, and laker. Persons commenting on the report suggested that these modal shifts would result in large increases in air pollution. However, the air pollution impacts of these modal changes are not as clear cut as some might suggest, and in fact, some pollutant categories would be reduced if a modal shift away from ocean shipping direct to/from Great Lakes ports were to occur. It is also important to point out that most of the modal shift that would occur if ocean shipping were not used in the future would be toward laker vessels, barge and rail, with only very slight increases in truck (less than 200 trucks per day across all of North America).

The original report does not call for any shift in tonnage to other modes. It attempted to assess the economic benefits to industry of having ocean ships move directly into and out of the North America hinterland. These benefits were calculated as the transportation cost savings from direct ocean shipping as compared to the costs that would occur if the "most likely" combination of alternative modes were used. The report found that the costs of door-to-door transportation/handling for the "most likely" combination of alternative inland modes would be US$54.9 million higher than the costs currently incurred by using ocean shipping directly into and out of the Great Lakes region. It could be said that ocean shipping "saves" industry US$54.9 million compared to what it would cost if these other modes had to be used for whatever reason.

The following sections first include the results of our analysis of air pollution impacts of using the "most likely" set of alternative modes. Additional sections review research on modal air pollution comparisons performed by the Great Lakes Commission, modal air pollution rate comparisons reported on for the Clean Ships Conference in San Diego, CA in 2006, other research on air pollution levels by mode, and some information on enforcement of bilge water regulations by the Coast Guard.

Total Ton-Miles by Mode and Tons of Pollutants for Current Ocean Direct vs. "Most Likely" Alternative Approaches

As part of the costing work performed by the authors, it was necessary to determine the "most likely" set of alternative modes that would be used for various commodities and origin-destinations. As a result, it was possible to estimate the total ton-miles of travel, by mode, involved in the door to door movement of the key commodity origin-destination groups using ocean ships directly into/out of the Great Lakes. So, for instance, for grain exports from Duluth to the Mediterranean, we were able to determine the annual tonnage involved, and the total annual miles on rail from the Plains to Duluth and on the ocean vessel from Duluth to Europe. We were also able to split out the ocean miles between open ocean offshore miles and miles within the North American continent. By totaling the ton miles by mode for each of the major commodity origin-destination pairs we were able to arrive at total ton miles by mode for the door-to-door movements of all goods moving into/out of the Lakes on ocean ships. It was also possible to determine the ton miles that would be involved if ocean ships simply brought the goods to/from the North American coast with rail, laker, barge, or truck used for the inland move within North America. So total ton miles for each of the modes that would be used in the "most likely" alternative were able to be determined.

Given the above ton miles by mode data, it was then possible to estimate the total tons of pollutants that would be emitted by mode using the current ocean direct to the Lakes system, vs. the use of ocean ships in the open ocean with alternative modes used to/from the coasts. This was done by determining the estimated tons of pollution emitted per million ton miles for each of five key pollutant categories for each mode and then totaling the tons of each pollutant that would result from the total number of ton-miles that would apply to each mode for the current system vs. the "most likely" alternative set of modes.

The only comprehensive source we were able to find was one in a 2004 article by Perakis and Yang in *Marine Economics and Logistics*, an academic marine oriented journal.[28] The authors of the article used a number of EPA sources to develop air emission rates for each mode on five key pollutants. Their data is as follows:

Table 7-1
Air Emission Rates of the Three Transportation Modes
Short Tons per Million Ton Miles

Mode/Category	Carbon Monoxide	Nitrogen Oxide	Volatile Organic Compounds	Sulfur Dioxide	Particulate Matter (PM-10)
Truck	1.430	1.840	.220	.082	.160
Marine	.170	.570	.110	.940	.069
Rail	.110	.930	.049	.110	.026

This data suggests that marine emits more pollutants per million ton miles than rail on four of the five pollutant categories. Marine emits 55% more carbon monoxide, 100% more volatile organic compounds, 754% more sulfur dioxide, and 165% more PM-10 than rail according to this data. Marine also emits 1046% more sulfur dioxide than truck. Marine does show up as 64% better than rail on nitrogen oxide, a key pollutant category.

While we cannot vouch for the accuracy of the Perakis and Yang data, they do seem reasonable given advances in rail efficiency in recent years. We also informally reviewed the data with several environmental experts who indicated the data seemed reasonable, especially as it related to sulfur dioxide and PM-10. In using this data, one shortcoming is that we had to assume marine pollution rates for ocean vessels, lakers, and barge were the same. This is a broad generalization. Another limitation is that we did not have a source on greenhouse gas emissions for the modes, however, it is generally believed that

[28] Perakis, An and Zhiyong Yang, "Evaluation of the Economic Impact of Proposed Non-Indigenous Species Control Measures for the St. Lawrence Seaway Using Multi-Attribute Decision Theory," *Maritime Economics & Logistics*, Vol. 6, Iss. 1, March, 2004, pp. 16-33.

these rates parallel fuel efficiency levels, and we would expect marine to be 40-50% more fuel efficient than rail on a ton-mile basis. At the same time, it should be noted that much of the grain and "all other" product ocean tonnage switches to the laker mode so there would be little greenhouse gas impact on that portion of the volume.

Table 7-2 summarizes the ton miles by mode and the pollution impacts for each pollution category for the current system moving 12.3 million tons by ocean vessel into/out of the Lakes with inland moves to or from the actual origin/destinations vs. the "most likely" alternative set of modes using ocean just from the coasts. Overall, we found that on a door-to-door basis, taking into account all ton miles between foreign ports and the North American end use origin/destination, that there were an additional 6.5% of ton miles required with the "most likely" alternative as compared to the current ocean direct mode/routings. This approach includes all mid-ocean ton miles away from the North American continent. Given the pollution rates above, we found that the total short tons of all five pollutants for the current direct ocean option resulted in 111,052 short tons of emissions, while the "most likely" alternative resulted in 116,952 short tons, with the alternative 5.3% worse than the current system. By looking just at NOX/VOX, two more critical pollutants, we found that the current direct ocean system developed 42,602 short tons of these two emissions, vs. 47,964 short tons for the "most likely" alternative, a total which is 12.6% worse than the current system. However, it is important to note that the "most likely" combination of alternative modes would result in fewer tons of sulfur dioxide being emitted.

Table 7-3 shows comparisons of the pollution levels when just mileage within the North American continent is considered – as compared to the previous approach that included open ocean emissions where few people are in close proximity to the discharges. This analysis results in the inclusion of significant miles of ocean vessel tonnage being included for the current system – from/to inland points and an "assumed entry to North America point" of Quebec City. However, for the "most likely" alternative set of modes the only ocean miles that are considered are those from the assumed North American entry point of Quebec City to Montreal – where goods using this particular alternative routing would transfer to/from other modes like laker or rail. Comparing these two alternatives, there were 4.5% fewer miles across all modes using the "most likely" combination of alternatives. Totaling all five pollutant categories, pollution emissions inland from Quebec City or other coastal ports to from inland origin/destinations are estimated at 28,642. Using the "most likely" combination of alternative modes the total pollutants are estimated at 25,595 tons, an actual 10.6% reduction in the total tons of pollutants for the "most likely" alternative. Looking just at nitrogen oxides and volatile organic compounds the "most likely" alternative would emit 17.6% more pollutants than the current system. However, it is important to note that for sulfur dioxide and particulates (PM-10), the "most likely" alternative set of modes is far better than using ocean vessels directly into the Lakes. The alternative approach would lower sulfur dioxide emission tons by 46.5%, while PM-10 tons would drop by 18.1%.

In studying these results, it is important to note that the primary comparison is between marine and rail. Very little of the freight in the "most likely" alternative moves by truck.

The principal truck move is for some 40% of the steel moving to destinations from coastal ports. As such, the higher pollutant rates for truck are not a significant factor in the total results. Given the difficulty in making these calculations and the uncertainty on rates of pollution for different specific engines, it may be more important to simply put into perspective the total pollutant tonnage generated by this 12.3 million metric tons of freight, as compared to the total short tons of these pollutants in the U.S. as a whole. For the U.S. in total, in 2004 there were 106.5 million tons of the five pollutants generated from transportation sources.[29] This compares to the total 116,952 short tons that would be generated in the "most likely" scenario including all open ocean and North American continent miles. For NOX and VOX alone, there would be 47,964 short tons generated in the "most likely" all miles alternative, compared to 18.7 million tons of these two pollutants in the U.S. in 2004.

Great Lakes Commission Analysis of Air Pollution
Levels for Ocean Direct vs. "Alternative Modes

An analysis by David Knight of the Great Lakes Commission and presented at the International Association for Great Lakes Research in 2007 examines the implications of modal shifts for freight transportation in the Great Lakes/St. Lawrence region.[30] The study examined two scenarios that are relevant to current ocean shipping into/out of the Great Lakes and the implications of any shift to a likely alternative mode. One scenario involved steel moving from Antwerp to Burns Harbor, Indiana while the other scenario involved grain moving from Thunder Bay, Ontario to Port Cartier, Quebec.

For the steel move, an estimated 341,000 tons was assumed to be the annual volume. Class VI ocean vessels hauling 12,630 tons per trip were assumed with a total distance of 263,142 vessel miles per year. Twenty seven annual trips were assumed with each trip having a one-way distance of 4,873 miles. The alternative routing/mode was assumed to be an ocean trip to Philadelphia with a rail move to Burns Harbor. The ocean move is 3,533 miles with 27 round trips and an annual tonnage of the same 12,630 tons. Total marine distance would be 190,782 miles. The rail move is assumed to require 54 trains at 6,315 tons per train with 64 one hundred ton cars. The distance per trip is 756 miles or 81, 648 miles. Given the above assumptions, total ton miles of freight by mode were calculated and a pollution rate per ton mile was applied for the three pollutant categories of Carbon Monoxide, Hydrocarbons, and Nitrogen Oxide. The results are that the direct ocean route to Burns Harbor would generate 33 tons of Carbon Monoxide as compared to the alternative which would also generate 33 tons for no net difference. For Hydrocarbons the direct marine route would generate 11 tons vs. 14.6 tons for the alternative, or a 32.7 % increase. Finally, for Nitrogen Oxide, the direct ocean routing would generate 244 net tons of emissions while the alternative would generate just 203 tons for a 16.8% reduction with the alternative.

[29] Environmental Protection Agency, *Air Pollution Emission Trends Web Page, Average Annual Emissions*, 2005, www.epa.gov/ttn/chief/trends/index.html.
[30] Knight, David, *Implications of Modal Shifts for Freight Transportation in the Great Lakes/St. Lawrence Region,* at the International Association for Great Lakes Research, 2007.

For grain, the analysis looked at moves from Thunder Bay to Port Cartier, Quebec by ocean vessel as compared to a rail move from Thunder Bay to Quebec City and a truck move onward to Port Cartier since there is no rail from Quebec City to Port Cartier. In reviewing this comparison, it is our belief that the move to Port Cartier is not realistic because the truck move would be too expensive. We believe the more realistic move is that the grain would move just to Quebec City where it would transfer to ocean vessel. As such, we will compare the data on emissions for these moves from Thunder Bay to Quebec City. The ocean direct move to Quebec City is an estimated 1328 miles. We assumed this was 360 less miles or 21.3% less miles than the trip from Thunder Bay to Quebec City. A total of 27 trips were assumed by Knight at 25,815 tons per trip. The total emissions for this trip, adjusting the totals down by 21.3% to reflect the shorter distance to Quebec City, were 36.3 tons of Carbon Monoxide, 11.7 tons of Hydrocarbons, and 265.2 tons for Nitrogen Oxide. By comparison, the rail move would be 1,055 miles and would require 62 trains at 11,242 tons per train using 105 hopper cars carrying 108 tons per car. Emissions for this approach would total 17 tons for Carbon Monoxide, 12 tons for Hydrocarbons, and 49 tons for Nitrogen Oxide. So comparing the ocean direct route to the rail route, the rail route would result in approximately half the Carbon Monoxide, .3 tons more hydrocarbons, and about 20% of the Nitrogen Oxides seen with ocean ships.

Overall, the alternative routings add considerably less air pollution than might have been expected. In fact, based on the Knight data, the alternative mode/routings generate less total tons of air pollutants and less tons of each of the three pollutants individually in all cases except for one where there is a .3 tons increase for the alternative modes. In addition, the Knight analysis did not consider sulfur dioxide and PM-10, both of which favor rail as compared to ocean in terms of emission tons per million ton-miles carried.

There is also one additional point to consider, and that is what the final routing to users of imported goods entails. Take the steel example discussed above. The majority of steel coming into the Midwest is finished or semi finished steel coils, rods, wire, etc. It is not mostly raw steel going directly into steel mills where the ship pulls directly into a slip at the mill waterfront. So steel coming to the ports of Detroit or Chicago, for instance, must actually be loaded onto trucks and driven to steel processors facilities that are almost always further inland. This adds another air pollution impact. However, consider movements to the coasts that then come inland by rail. These rail movements can come directly to the processors yards in many cases because they often have rail service. This eliminates a truck move completely. In making modal comparisons, it is critical to consider the entire routing all the way from origin to final destination.

<u>California Data on Marine Source
Air Pollution</u>

Another indicator of the nature and extent of ocean ship air pollution impact can be found in data reported for California. For PM-10, this data indicates that ships account for 43%

of all PM-10 emissions in California related to international goods movement.[31] All international import – export movements involving potentially ships, rail, and trucks, ships coming into/out of the harbor and idling account for 43% of the PM-10 emissions in California territory. This ship contribution is expected to increase to 75% by 2020 due to improvements in rail and truck emissions. For Nitrogen Oxides ships account for 23% of the total. By 2020, this share is expected to increase to 55% of the total California territory emissions related to international goods movement. This contribution from ships goes up by 2020 because new engine standards for locomotives will reduce NOX by 58%, but the new ship standards will reduce NOX just 6%.

Another indicator from the same presentation notes that one ship at berth can generate one ton of Nitrogen Oxide and 100 pounds of PM-10 each day. As a result the report goes on to note that air pollution from ships visiting the ports of LA and Long Beach, in a single day, equals roughly the same amount as is released from 1 million vehicles.[32]

The Sulfur Dioxide contribution from ships can be illustrated by comments concerning new California Air Resources Board (CARB) regulations. A new CARB regulation will require vessel operators to switch to auxiliary engines when within 24 miles of the California coast. The fuel used in those engines will be required to be no more than .5% sulfur, compared with 2.7% for conventional bunker fuel.[33]

Other sources have also indicated that there is still a very significant air pollutant load from marine vessels. For instance, a recent article in the Seattle Times indicates that "worldwide, ships also are a leading source of smog forming nitrogen oxides."[34] It goes on to say "the vessels are powered by low quality diesel fuel, so dirty that each particle of exhaust legally can be 3,000 times higher in sulfur than the fuel soon to be used by new diesel trucks." Some new controls on ocean vessels are planned; however, the Bush Administration substantially amended proposed EPA regulations in favor of International Maritime Organization (IMO) and other maritime organization regulations, which will require improvements. However, this article also indicates the Administration has followed through with regulations that will require tractors, trains, and small ships to use the same clean fuel as diesel cars by 2012.

Marine Pollution Penalty Precedents

While there are few penalties for ballast water discharges, since there still are no standards for such discharges other than salt water exchange requirements, it is interesting to note what the penalty environment is for shipping in some other pollution categories.

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[31] Plenys, Tom, Coalition for Clean Air, "Marine Emissions: Addressing Local and Global Challenges," *Clean Ships Conference*, San Diego, CA, February 8, 2006 (based on California ARB reports).
[32] Plenys, Tom, Coalition for Clean Air, "Marine Emissions: Addressing Local and Global Challenges," *Clean Ships Conference*, San Diego, CA, February 8, 2006 (as sourced from the January 2003 State and Federal Strategy for the California State Implementation Plan, August 25, 2003).
[33] Mongelluzzo, Bill, "21 Miles Too Far," *Traffic World*, January 22, 2007, p. 32.
[34] Welch, Craig, "Bush Cuts Some Diesel Pollution, But Lets Big Ships Keep Spewing," *Seattle Times*, September 28, 2004, pp. A1.

For air pollution for instance, The CARB regulations referred to above include extensive recordkeeping requirements and fines of $25,000 to $75,000 per day that a vessel is in port for violations.

For bilge water pollution, fines for violating rules are even more extensive. A 2005 account in *American Shipper* notes that a number of steamship companies have been hauled into court by the Justice Department for bypassing oily water separation equipment.[35] They note that potential fines can be in the range of upwards of $20 million for violations of those rules. For instance, one carrier was fined a record $25 million for violations of marine pollution rules.

Conclusions

The above information points out that air emissions come from each mode and that ocean vessels, like rail and other modes, are significant contributors to global air pollution. In fact, in some emissions categories such as PM-10 and SOX, ocean vessels are far larger contributors per million ton miles than is the case with rail. Even on the other categories of CO, NOX, and HC, marine does not have as big an advantage as might be expected and cleaner rail engines are leading to further improvements for rail. Rail is the main non-marine alternative to ocean direct shipping directly into/out of the Lakes. In the "most likely" alternative scenarios for these goods movements suggested in our earlier report, trucks are a very small factor. Our analysis and one done by the Great Lakes Commission indicates that the cessation of ocean shipping into the Great Lakes would have no significant impact on air quality and in fact, may result in air quality benefits.

[35] Mottley, Robert, "Dirty Deeds at Sea," *American Shipper*, September, 2005, p. 46.

Table 7-2
Air Pollution Impact
Foreign Ports To/From North American Continent Interior Origin/Destination
Actual Short Tons

Option-Mode/ Pollutant	Million Ton-Miles 1	CO	NO	VOX	SO2	PM10	Total Pollution	NO/VO Only
Current Ocean to Lakes								
Ocean	56893	9672	32429	6258	53479	3926	105764	38687
Rail	3290	362	3060	161	362	85	4030	3221
Truck	337	482	620	74	28	54	1258	694
Total	60520	10516	36109	6493	53869	4065	111052	42602
Alternative Route								
Ocean	49989	8498	28493	5499	46990	3449	92929	33992
Laker	3660	622	2086	403	3440	253	6804	2489
Barge	1440	245	821	158	1354	99	2677	979
Marine	55089	9365	31400	6060	51784	3801	102410	37460
Rail	8182	900	7609	401	900	213	10023	8010
Truck	1211	1732	2228	266	99	194	4519	2494
Total	64482	11997	41237	6727	52783	4208	116952	47964
Difference	3962	1481	5128	234	(1086)	143	5900	5362
Alternative Is:	Worse 6.5%	Worse 14.1%	Worse 14.2%	Worse 3.6%	Better (2.0%)	Worse 3.5%	Worse 5.3%	Worse 12.6%

1 Based on calculations of distances and tons for each commodity and routing.

Table 7-3
Air Pollution Impact
North America Only1
Short Tons

Option-Mode/ Pollutant	Million Ton-Miles 1	CO	NO	VOX	SO2	PM10	Total Pollution	NO/VO Only
Current Ocean to Lakes								
Ocean	12429	2113	7085	1367	11683	858	23106	8452
Rail	3290	362	3059	161	362	86	4030	3220
Truck	337	482	620	74	276	54	1506	694
Total	16056	2957	10764	1602	12321	998	28642	12366
Alternative Route								
Ocean	764	130	435	84	718	53	1420	519
Laker	3742	636	2133	412	3517	258	6956	2545
Barge	1440	245	821	158	1354	99	2677	979
Marine	5946	1011	3389	654	5589	410	11053	4043
Rail	8182	900	7609	401	900	213	10023	8010
Truck	1211	1732	2228	266	99	194	4519	2494
Total	15339	3643	13226	1321	6588	817	25595	14547
Difference	(717)	686	2462	(281)	(5733)	(181)	(3047)	2181
Alternative Is:	Better (4.5%)	Worse 23.2%	Worse 22.9%	Better (17.5%)	Better (46.5%)	Better (18.1%)	Better (10.6%)	Worse 17.6%

1 From/to Quebec City or other coastal ports to/from inland North American origin/destinations

Chapter 8
Ocean Vessel Savings for Michigan and Wisconsin

The 2005 report indicated that there was about $55 million in transportation user savings attributed to ocean vessels. There have been requests for a breakdown of these savings at the state level. This effort, in its entirety, goes beyond the scope of this research project, but as an example, information was developed for two states—Michigan and Wisconsin. This involved a review of US Army Corps of Engineers traffic data for each port over the 2002-2005 time period.[36] Conversions were then made from short tons to metric tons and an estimation of savings per ton was applied to the traffic.

Ocean Vessel Traffic at Michigan Ports

Table 8-1 provides information about ocean vessel traffic at Michigan ports during the 2002-2005 period. This assumes that ocean vessel traffic is synonymous with "foreign" traffic as reported by the US Army Corps of Engineers.[37] To summarize:

- Only two Michigan ports consistently receive ocean vessel service—Detroit and Menominee.[38] These two ports typically account for over 95 percent of Michigan ocean vessel traffic.

Table 8-1
Ocean Vessel Commerce at Michigan Ports
(Thousands of short tons)

Port	2002	2003	2004	2005
Detroit (includes Ecorse etc.)	679	387	653	419
Menominee-Marinette	142	111	87	73
Ludington	41	38	0	0
Grand Haven	0	17	0	0
Muskegon	0	0	7	0
Manistee	0	6	0	0
Monroe	0	0	2	3
Total Short Tons	862	559	749	495
Total Metric Tons	782	507	679	449
Michigan % of OV Traffic	6.4%	5.3%	6.2%	4.3%

[36] The Corps data provides information for at the port level only. When a given port is located in two states (e.g., Menominee/Marinette or Duluth/Superior) estimates had to made for each state.
[37] Foreign traffic, as defined by the US Army Corps of Engineers, has an origin or destination outside of the US or Canada. It is possible that some domestic or Canadian traffic moves in ocean vessels into or out of Michigan ports. In 2002, this type of traffic appeared to represent about 8 % of total ocean vessel traffic in the Great Lakes. The net result of this is that there may be some underreporting of ocean vessel traffic.
[38] Menominee, Michigan, and Marinette, Wisconsin are separated by the Menominee River. Port facilities are located in both states but data is reported only for the Port of Menominee-Marinette. Half of the traffic was allocated to Michigan and half to Wisconsin.

Total Savings in 2004 $'s (000's)	$4,300	$2,789	$3,736	$2,469

- Infrequent ocean vessel service occurred in Monroe, Muskegon, Gran Haven, Manistee and Ludington. In 2005, Monroe was the only port besides Detroit and Menominee receiving service.
- Approximately 2/3 of Michigan traffic represents primary iron and steel products (plates & sheets, bars, tubes etc.) and pig iron—mostly inbound to the Port of Detroit. Other traffic includes pulp & waste paper; sulfur, clay & salt; coke; and, lumber. There are very small amounts of machinery and other higher value goods.
- About 90% of all traffic is inbound to Michigan ports.
- Michigan ports handle about 5-7% of all ocean vessel traffic passing through the Montreal-Lake Ontario (MLO) section of the St. Lawrence Seaway.
- Businesses in Michigan save from $2.5 to $4.3 million annually in transportation costs because of the availability of ocean shipping.

Ocean Vessel Traffic at Wisconsin Ports

Table 8-2 provides information about ocean vessel traffic at Wisconsin ports during the 2002-2005 period. Data provided herein is based on assumptions made to separate Wisconsin traffic from combined port traffic data provided by the US Army Corps of Engineers.[39]

To summarize:

- Four Wisconsin communities receive regular ocean vessel service—Milwaukee, Green Bay, Marinette, and Superior. The latter two are associated with the Port of Menominee/Marinette and the Port of Duluth/Superior.

Table 8-2
Ocean Vessel Commerce at Wisconsin Ports
(Thousands of tons)

Port	2002	2003	2004	2005
Milwaukee	278	95	193	284
Green Bay	2	45	60	37
Menominee/Marinette	142	111	87	73
Duluth/Superior	807	623	577	654
Total Short Tons	1229	874	917	1048
Total Metric Tons	1115	793	832	951
Wisconsin % of OV Traffic	9.1%	8.3%	7.6%	9.1%
Total Savings in 2004 $'s (000's)	**$5,574**	**$4,360**	**$4,574**	**$5,228**

- About a million metric tons of foreign commerce is handled annually at Wisconsin ports. This represents about 9 percent of ocean vessel traffic through the MLO portion of the Seaway.

[39] The Corps database provides port level data only and does not separate by state. As such, assumptions were made to separate Wisconsin traffic from overall port traffic for the ports of Menominee/Marinette and Duluth/Superior. This results in a rough approximation only for those two ports.

- Approximately ¾ of the traffic is outbound—primarily agricultural products from Superior and Milwaukee. There are also significant inbound movements of primary iron and steel products including pig iron and steel plates and slabs.
- Businesses in Wisconsin save about $5 million annually in transportation costs because of the availability of ocean vessel shipping.

Conclusions

Port level information is available from the US Army Corps of Engineers in their annual Waterborne Commerce Report. This information was obtained for Michigan and Wisconsin ports and an estimate of savings related to 'foreign commerce' at these ports was developed. In Michigan, only Detroit and Menominee receive regular ocean vessel service and most of the traffic is inbound iron and steel products. Estimated annual transportation savings to Michigan shippers is estimated at $2.5-$4.3 million annually. In Wisconsin, Superior, Milwaukee, Marinette, and Green Bay receive regular service. Outbound grain from Superior and Milwaukee are major traffic categories. Wisconsin shippers save about $5 million annually because of ocean shipping.

Chapter 9
Revenue Impacts on the St. Lawrence Seaway Associated with a Cessation of Ocean Shipping

Principal operations of the bi-national St. Lawrence Seaway involve the waterway between Montreal and Lake Erie. This waterway encompasses a series of 15 locks—13 in Canada and 2 in the U.S. The Canadian locks are the responsibility of the St. Lawrence Seaway Management Corporation while the U.S. locks are the responsibility of the St. Lawrence Seaway Development Corporation. Table 9-1 provides information on these two entities.

Table 9-1
Summary of Seaway Operational Entities
FY 2006
(Thousands of US or Canadian dollars)[40]

	SLS Management Corp. (Canada)[41]	SLS Development Corp. (USA)[42]	Combined Total
Locks Operated	13	2	15
Employees	589	148	737
Toll Revenue	$70,962	$0	$70,962
Other Revenue[43]	$5,082	$674	$5,756
Federal Contribution	$22,757 (Capital Trust Fund)	$14,424 (Harbor Mtn. Trust Fund)	$37,181
Total Revenue	$98,801	$15,098	$113,899
Total Expenses	$95,455	$15,945	$111,400
Net	$3346	$(847)	$2,499

The two SLS entities employ 737 persons and expend about $111 million annually to operate the various components of the Seaway System. Approximately 2/3 of combined operating expenses are covered by user tolls and other fees. This is higher on the Canadian side and much less so on the US side since no tolls are charged for use of the US locks.

St. Lawrence Seaway Development Corporation

The American SLSDC receives an annual appropriation from the US federal government to support its operation. Since no tolls are collected on the US locks, this appropriation represents virtually all of the revenue to the SLSDC. Funds for this appropriation come from the Harbor Maintenance Trust Fund (HMTF) that is supported by taxes on imports into the US. The HMTF was established

[40] US & Canadian dollars are assumed to be at parity, which is the case as of October 2007. The 2005 Roach-Taylor Report assumed a ratio of $1Cdn=.80US which reflected the exchange rate at that time.
[41] 2006 Annual Report, SLS Management Corporation. Fiscal year is April 1, 2005- March 31, 2006 (i.e., the 2005 traffic season).
[42] 2006 Annual Report, SLS Development Corporation. Fiscal year is October 1, 2005-September 30, 2006.
[43] Other navigation revenue, power generation revenue, license fees, sale of assets etc.

as part of the Water Resources Development Act of 1986 and is used to pay the cost of maintaining and operating federally approved navigation projects as well as the St. Lawrence Seaway Development Corporation. The fund receives over $1 billion annually from a .125 percent tax on the value of imported goods into the US[44] as well as other waterborne commerce taxes. These taxes are the responsibility of the cargo owner as opposed to the ship operator and are collected by U.S. Customs.

Ships destined for US Great Lakes ports indirectly pay a share of the US lock operations through payment of the HMT. This tax is also paid by lake vessels moving cargo into US ports. Vessels passing through the American locks destined for Canadian ports do not pay the Harbor Maintenance Tax.

St. Lawrence Seaway Management Corporation

The SLSMC is a far larger operation than its US counterpart since it operates 13 of the 15 locks on the Seaway. It has 589 employees and generates over $70 million in toll and other revenues from users. Over ¾ of the expenses associated with the Canadian SLSMC are paid by tolls and other navigation fees. In addition, monetary assistance is provided through a Capital Trust Fund intended to cover operating deficits and assure that the locks are maintained in good condition. This arrangement was established in 1998 when the former St. Lawrence Seaway Authority was dissolved and its funds as well as other Canadian funds were placed in a Capital Trust Fund for use by the SLSMC.

Loss of Ocean Vessel Tolls Would Affect the SLSMC

It is important to understand that the loss of ocean vessel traffic and associated tolls would greatly impact the operation of the Canadian SLSMC. Most of their funding comes from tolls and other revenues. The American SLSDC by contrast is funded by a federal appropriation from the HMTF and would not be directly affected financially by a loss in ocean vessel revenue. That said, it is likely that the erosion of traffic would result in some reduction in personnel and other activities.

[44] A very crude approximation of revenues generated from ocean vessels follows: 12 million tons of cargo in 2002 of which half is related to Canadian ports. Thus, 6 million tons to/from US ports of which 3 million are imports and subject to the tax. Assuming most of the imports are high value cargos such as steel @ $650/ton the value of the cargo would be about $2 billion. The tax of .125% would result in HMT revenues of $2.5 million.

Table 9-2
Estimate of Loss of Toll Revenues to SLSMC if No Ocean Vessels
2005
(000's Canadian $'s)

Cargo Category	2002 Revenue	2003 Revenue	2004 Revenue	2005 Revenue	2006 Revenue	2002-06 Rev Total	2002-06 Rev/Yr
Bulk	22422	25003	26253	28291	30390	132359	26472
Coal	2656	2678	2981	2755	2786	13856	2771
Grain	11607	10869	10831	11492	13728	58527	11705
Gov't Aid	0	0	0	0	0	0	0
Containers	9	9	9	11	15	53	11
General Cargo	8682	6367	11357	7959	11484	45849	9170
Steel Slab	2659	868	1081	1378	2185	8171	1634
Gross Reg. Tonnage	7761	7666	8061	8281	9248	41017	8203
Passengers	49	36	57	27	40	209	42
Lockage Fees	8806	8761	9431	9838	10675	47511	9502
Grand Total Rev	64651	62257	70061	70032	80551	347552	69510
Total Tonnage	41388	40847	43482	43301	47164	216182	43236
Ocean Vessel Tonnage	12292	9585	11056	10471	15005	58409	11682
% Ocean Vessel	0.30	0.23	0.25	0.24	0.32	0.27	0.27
% Ocean Vessel Rev + 8%1/	0.38	0.31	0.33	0.32	0.40	1.75	0.35
Ocean Vessel Lost Rev	24373	19590	23419	22538	32071	121990	24398
Laker Add'l Revenue	6093	4897	5855	5634	8018	30498	6100
Net Loss Cdn$'s	18280	14692	17564	16903	24053	91493	18299
Net Loss US $'s	16452	13223	15808	15213	21648	82343	16469

Note: This is a simple model calibrated on the 2005 & 2006 experience. It represents a rough way to calculate the net losses associated with the loss of ocean shipping. It will not precisely match other approaches.
1/Ocean vessels generate higher revenues on a tonnage basis then laker vessels due to higher value cargoes such as steel and other general cargo ($2.41/ton at the MLO & $1.06 at the Welland) for GC compared to grain or coal (each about $.60 per ton at the MLO and $.66 at the Welland).
5/21/2007

<u>2005 and 2006 SLSMC Estimated Ocean Vessel Revenues</u>

Table 9-2 provides an estimate of 2005 and 2006[45] revenues generated by ocean vessels. This shows $22.1 million in ocean vessel revenues for 2005 and $32.2 million in 2006. The increase in revenues between 2005 and 2006 may be attributed to much higher levels of ocean vessel traffic in 2006—15 million tons compared to 10.5 million tons in 2005. Memorandum No. 1 provides additional detail on traffic trends.

[45] It is important to note that the Table 9-1 contains FY 2006 information that more closely matches 2005 traffic levels given that the SLSMC fiscal year is April 1, 2005 to March 31, 2006.

Table 9-3
Revenue Losses Associated with the Loss of Ocean Vessel Traffic

	2005	2006
Loss of revenue from ocean vessels	$22,118	$32,227
New revenue from traffic shift to laker vessels	$5,425	$7,695
Net change after laker revenue included	$16,693	$24,532

Revenues lost from ocean vessel traffic would be somewhat offset by increased laker traffic[46] but the net loss in 2005 would amount to $16.7 million. For 2006, the loss would be significantly higher since ocean vessels were estimated to pay about $32.2 million in tolls and other fees. The net loss for 2006 after additional laker revenue would be about $24.5 million.

It is obvious that ocean vessel revenues are directly tied to ocean vessel traffic levels that have fluctuated much more than laker vessel traffic. For example, ocean vessel traffic on the St. Lawrence Seaway was 12.3 mmt in 2002, 9.6 mmt in 2003, 11.1 mmt in 2004, 10.5mmt in 2005, and 15 mmt in 2006. A review of the 2002-2006 period indicates that the SLSMC would have a net loss of about $18 million annually in toll revenues if ocean vessel traffic had ended.

Any actual financial loss would have to be made up by increased tolls on the remaining traffic or increased governmental contributions. This loss could also be offset somewhat by reducing personnel and other expenses associated with the SLSDC and SLSMC. It is again important to state that virtually all of the impact would fall on the Canadian SLSMC since tolls are their primary funding source. The US entity relies almost exclusively on a federal appropriation from the HMTF[47].

Conclusions

The St. Lawrence Seaway encompasses a series of 15 locks—13 in Canada and two in the United States. The Canadian locks are the responsibility of the St. Lawrence Seaway Management Corporation while the US locks are the responsibility of the St. Lawrence Seaway Development Corporation. The two SLS entities had combined expenses of $111 million in FY 2006 and employed 737 persons to operate the various components of the Seaway System. Most of the Canadian costs ($95 million) are covered by toll revenues ($71 million) while US costs are largely covered by a federal appropriation from the Harbor Maintenance Trust Fund. The loss of ocean vessel toll revenues would greatly affect the operation of the Canadian SLSMC but would have less effect on the US counterpart due to its reliance on federal appropriations. Toll revenues from ocean vessels were estimated at $22 million for 2005 and $32 million in 2006. The higher values for 2006 were due to significantly higher ocean traffic levels. Lost revenues from ocean vessels would be

[46] It was assumed that half of all grain currently moving on ocean vessels would move on laker vessels and thus continue to pay tolls to the SLSMC. Other traffic as well would shift from ocean vessels to lakers.
[47] It is likely that the HMTF would lose a small portion of its annual $1 billion + revenue base. This loss would occur if former US port bound ships docked in Montreal or another Canadian port. Ships that docked in east coast or Gulf ports in lieu of Great Lakes US ports would pay the HMT. We estimate the loss to the HMTF to be in the $1 million range (e.g., see footnote #4 and assume 40% of inbound traffic docks in Montreal or other Canada port instead of GL US port).

somewhat offset by increased laker traffic. After including new laker revenues, the average annual loss of ocean vessel toll revenues for the 2002-2006 period is about $18 million. Any actual financial loss would have to be made up by increased tolls on the remaining traffic or increased governmental contributions. It is also possible that Seaway operating costs could be reduced to account for reduced traffic levels.