Weighing the Costs and Benefits of Expanding the St. Lawrence Seaway:

An Economic, Environmental, and Policy Analysis

by

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Abstract

In 2002, the U.S. Army Corps of Engineers published a report that suggested that the St. Lawrence Seaway is outdated for current waterway commerce conditions. Containerships have become an increasingly important fleet in transporting international commodities, and the Army Corps of Engineers suggests that the Seaway must be expanded to accommodate these 35 foot draft, 110 foot width, and 1000 foot length vessels. In this paper, I argue that the Seaway should not be expanded for both economic and environmental reasons. My economic arguments against the expansion proposal is that the Seaway may not attract a large number of containerships and world fleet traffic; the foundation of the argument rests on such data as current Seaway trading patterns, international commerce trends, and containership use. Another argument against expansion is the potential ecological impacts that containership and potentially greater vessel traffic would inflict upon the Great Lakes region. Based on these arguments, I conclude that in current and future studies of the Seaway, the U.S. and Canadian governments should focus on improvements to the current Seaway infrastructure rather than on expansion.

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Intro/Problem Statement

In May 2003, the United States and Canadian governments initiated the Great Lakes/ St. Lawrence Seaway Study in order to assess the Seaway's infrastructure and the economic, environmental, and engineering factors that are relevant to its current and future needs. (Great Lakes/St. Lawrence Seaway Study) The study is a follow-up to the 2002 Army Corps of Engineers Reconnaissance Report that reviewed the Great Lakes Navigation System. In its report, the U.S. Army Corps of Engineers recommended that the Seaway be expanded.

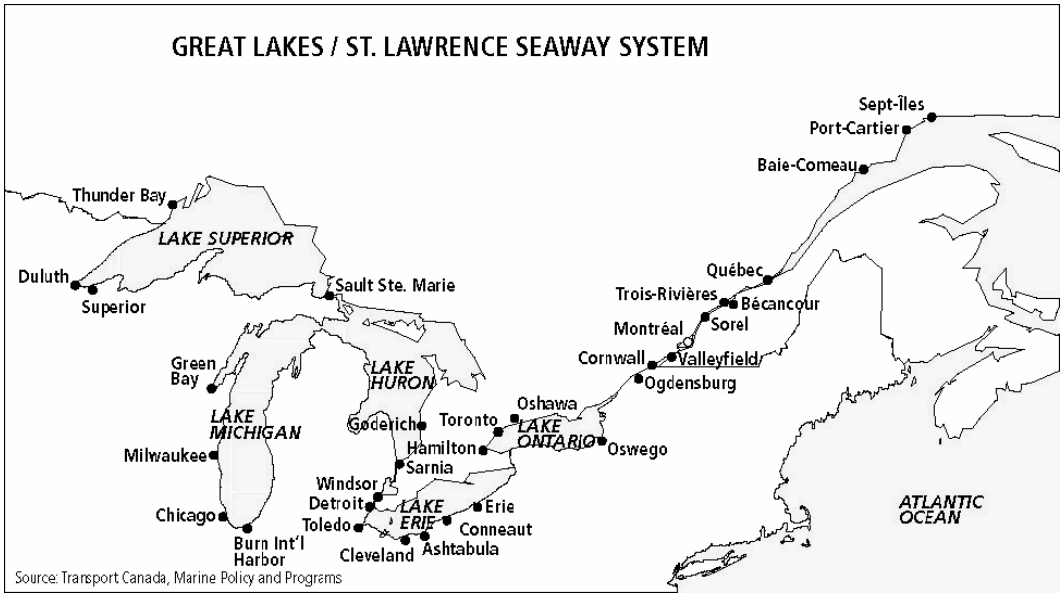
To aid in its study of the Seaway infrastructure, both the U.S. and Canadian governments have held public meetings in the Great Lakes region and have received input from individuals and organizations that have an environmental and economic stake in the Seaway. Through the course of the public meetings, some interest groups and concerned citizens have made it clear that expansion should not be considered a viable option. These opponents have included environmental organizations, such as Great Lakes United and Save the River, and citizen groups such as the Mohawk Council of Akwesasne.

In this paper, my assessment of the U.S. Army Corps of Engineers' arguments for expansion will demonstrate why the U.S. and Canadian governments should not consider expansion as part of the current and future studies of Seaway infrastructure. I will also pit the U.S. Army Corps of Engineers arguments for expansion against the arguments made by opponents of expansion. In the following section, I will provide a brief history of the Seaway, the details and criticisms of the original Army Corps of Engineers report, and introduce the actors involved in the expansion debate.

Background/Theory

The Great Lakes/St. Lawrence Seaway System (GL/SLS; see Figure 1) extends a distance of more than 3,700 km, or 2,340 miles (SchoonerVoyage). It has two components: the Great Lakes Navigation System and the St. Lawrence Seaway. The Great Lakes Navigation System consists of the upper four Great Lakes and their navigable channels: the St. Mary's River, the Straits of Mackinac, and the St. Clair/Detroit River System (U.S. Army Corps of Engineers). The St. Lawrence Seaway connects the upper four Great Lakes with the deepwater channel of the lower St. Lawrence River and from there on to the Atlantic Ocean (U.S. Army Corps of Engineers 2002). Because the two components are geographically, ecologically, and economically related, and the impacts on the Seaway affect the Great Lakes region, I will henceforth refer to the two components as one entity (i.e., the Great Lakes/St. Lawrence Seaway). I will use the term "Seaway" when discussing specific expansion plans.

Figure 1. Map of Great Lakes/St Lawrence Seaway System



(Transport Canada)

The Saint Lawrence River and Seaway is of vital geographic and economic importance to the Great Lakes system, and the Seaway provides navigation to deep-draft ocean vessels. (Great Lakes Information Network) As early as 1680, the Saint Lawrence River was recognized for its economic value. The Saint Lawrence River, which forms a natural waterway connecting the Great Lakes and other channels, served as a critical route for the movement of goods into and out of America (Claudi and Willey 1999, 207). Starting in 1825, canals were built on the St. Lawrence River to bypass natural obstacles that hindered navigation and restricted trade. At the end of the nineteenth century, rapid industrial growth in North America's interior combined with the desire to harness the turbulent waters of the river for electric power prompted interest in the construction of a deeper waterway on the Saint Lawrence River. (Mills, Chrisman, and Holeck 1999, 351) The waterway's name became the Saint Lawrence Seaway and the Seaway officially opened in 1959. Currently, vessels with the maximum dimensions of 740 foot length, 78-foot beam, and 26 foot 3 inch draft can enter the Seaway. (Bureau of Transportation Statistics)

Due to the rising costs of maintaining the transportation infrastructure on which commercial navigation depends, in 2003 the United States and Canadian governments initiated a study of the current Seaway structure. According to the study's website, the Canadian and American governments believe that assessing the existing engineering infrastructure and current economic and environmental conditions would prove invaluable in determining what actions would be required to ensure no operational degradation in the System for the next 50 years. (Great Lakes/St. Lawrence Seaway Study) The website makes clear that the study is not considering expansion; the website states:

> "The scope of the study is limited to the evaluation of the existing marine transportation infrastructure. It is important to note that the focus of the study is on the optimization of the existing infrastructure based on the system's current configuration and that the evaluation of major infrastructure modifications, such as an expansion of the Seaway locks or an increase in channel dimensions, is not part of the study."
> (Great Lakes/St. Lawrence Seaway Study)

However, though Seaway expansion is supposedly not a part of the current study, Seaway expansion has been suggested in the past, and may become a part of the future studies conducted by the U.S. and Canadian governments. Because Seaway still might be expanded, and the U.S. Army Corps of Engineers' report on expansion is the most predominant and the most recent suggestion for expansion, I will assess the arguments made in the U.S. Army Corps of Engineers report to predict whether Seaway expansion is an economically and environmentally viable option.

Proposals to Expand the Seaway

The U.S. Army Corps of Engineers made the most recent suggestion for expansion in a 2002 report on the Great Lakes/St. Lawrence Seaway, and the criticisms the report received led to the present Seaway study. In the U.S. Army Corps of Engineers 2002 Reconnaissance Report "Great Lakes Navigation System Review," the purpose of the report was stated as determining the best course of action for the aging Seaway infrastructure. Two options were presented: continue with routine maintenance of the Seaway infrastructure or expand the locks and canals as the maintenance is done (Pennsylvania Transportation Institute 2003). Another objective of the Reconnaissance Report was to assess the level of U.S. federal interest in expansion of the Great Lakes/St. Lawrence Seaway (Pennsylvania Transportation Institute 2003). The Army Corps concluded that the United States and Canadian governments should consider expanding the St.

Lawrence Seaway system. The report outlined five options for physically widening and deepening the navigation system's connecting channels, locks and ports, cumulating in a 35-foot deep navigation system from Montreal to Duluth (Schoonover and Muller 2002). The justification of the Army Corps for expansion to 35 feet is that the expanded Seaway would enable the newer, ultra-large containerships to enter the Seaway system, and because other nations use these containerships to transport commodities to the United States and Canada, the expansion would subsequently allow greater world containership fleet and other international vessel traffic to enter the Seaway (U.S Army Corps of Engineers 2002).

The Army Corps was not the first to suggest Seaway expansion or construction of new Seaway infrastructure. In 1987, the Connecting Channels and Harbors Study examined deepening the Upper Great Lakes channels and selected harbors to 32 feet, but it was determined that such deepening lacked economic justification (Schoonover and Muller 2002, 4). Instead, the report recommended deepening the Upper St. Mary's River and two ship channels in the Duluth/Superior Harbor by only one foot. Even with this modest proposal, the states of Michigan, Wisconsin, and Minnesota withheld support due to concerns with sediment disposal, water quality, and habitat (Schoonover and Muller 2002, 4). That same year, the St. Lawrence Seaway Additional Locks Study concluded that building either new locks at the existing size, or larger locks designed to accommodate 1000-foot ships, were unjustified because the projections indicated that the Welland Canal (located on the Seaway) would not reach capacity until 2030 (Schoonover and Muller 2002, 4). The study also noted that replacement of locks at the same size would be the best alternative when considering the totality of factors: economics, environment, engineering needs, and social acceptability (Schoonover and Muller 2002, 4).

Furthermore, communities along the U.S. side of the St. Lawrence River would receive little benefit from this project (Schoonover and Muller 2002, 4).

Nonetheless, despite the past problems with expansion proposals, the Army Corps of Engineers again suggested a Seaway expansion. In its report, the Army Corps of Engineers proposed the following improvements to the Great Lakes/St. Lawrence Seaway System:

1) deepening of the Great Lakes connecting channels to improve vessel traffic

2) improvements to the St. Lawrence Seaway: replacing the existing locks with larger and deeper chambers and providing channels compatible with the larger lock dimensions

3) deepening individual ports and improvements to ports and harbors within the Great Lakes System. These improvements would include modifications to existing infrastructure and channels to accommodate deeper draft vessel traffic

(U.S. Army Corps of Engineers 2002, viii)

The Army Corps of Engineers rationalized the above improvements by stating that the current maintenance methods are not adequate to support the aging Seaway infrastructure. The Army Corps of Engineers writes:

> "The aging Seaway locks are first maintained through normal operation and maintenance, then limited rehabilitation, and ultimately major rehabilitations… Each successively more aggressive approach to maintenance is phased in as the condition of the Seaway locks deteriorates requiring longer closures… maintaining the locks will likely result in repairs that address immediate concerns … however, these repairs may not be sufficient in scope to deal with underlying structural problems."
>
> (U.S. Army Corps of Engineers 2002, viii)

To justify Seaway expansion, the U.S. Army Corps of Engineers argued that expansion would allow bigger containerships to enter the Seaway; these, and other large ships that the Corps wants to introduce to the Great Lakes region, would be part of the international fleet, handling international trade (Lake Ontario Keeper 2002). Hence, accommodating containerships

would theoretically increase international commerce in the region. In the report, the Army Corps writes:

> "While 70% of the world's fleet can transit the 80' X 766' locks and the 26'-3" Seaway, these vessels represent only 13% of world vessel capacity and 5% of the world container vessel capacity.. Ever larger ships are being built, indicating that the percentage of the world fleet that is Seaway capable will continue to decline in the foreseeable future. However, a deeper wider Seaway could accommodate 34% (in terms of capacity) of the world fleet and most importantly, 27% of the world container fleet in terms of gross ton capacity."
>
> (U.S. Army Corps of Engineers 2002, iii)

Thus, according to the ACE, in order for the St. Lawrence Seaway to remain internationally competitive, the Seaway must be expanded to accommodate bigger containerships.

An analysis of the Army Corps assertions for expansion leads to the following questions: the Seaway expansion may physically allow bigger containerships to enter, but with what amount of certainty can the Army Corps claim that the expansion alone will be enough incentive for the containerships to go to the Great Lake ports? In another words, will the Seaway expansion be sufficient cause for containerships to prefer the Great Lakes ports over the Eastern and Western Coast ports? These questions will be explored in detail later in the paper. For now, the point that these questions raise is that expansion does not necessarily mean containership traffic and international commerce will change their patterns to favor the Great Lakes region.

The Army Corps of Engineers answers the above questions by claiming that a transportation cost analysis for an improved Seaway identified potential bulk Seaway traffic (U.S. Army Corps of Engineers 2002). Furthermore, according to the Army Corps's savings analysis showed some potential for container traffic on the Great Lakes/St. Lawrence System. The Army Corps's container analysis also demonstrated some possibility for existing overland East Coast/ Great Lakes container traffic to divert to the Seaway (U.S. Army Corps of Engineers 2002). These arguments will be evaluated more closely in the results section. However, per

Army Corps analysis, an expanded Seaway would attract more containerships in the Great Lakes region and thus increase international commerce in the Great Lakes region.

Criticisms of the U.S. Army Corps's Economic Analysis Objectivity

As mentioned earlier, the U.S. Army Corps of Engineers' report came under heavy scrutiny. One criticism of the report was its lack of objective analysis. The Corps's alleged lack of objectivity in the Reconnaissance Report is of no surprise because they have been similarly biased in past projects. For example, the Army Corps of Engineers conducted a study of the Upper Mississippi River and Illinois Waterway (UMRIV). The focus of the study was the entire lock and dam system of the Upper Mississippi River and Illinois Waterway Navigation System and the river ecology (Water Science and Technology Board 2004). The Army Corps was to develop an integrated plan to be approved as a framework for modifications and operational changes to the Upper Mississippi River and Illinois water system (Water Science and Technology Board 2004). However, in an analysis of the U.S. ACE's study, the U.S. National Academy of Sciences made the following criticism:

> "The near lack of any analysis of the viability of non-structural elements for managing waterway traffic represents a considerable analytical gap with the feasibility study because it is not clear how the benefits of the lock extensions can be reliably estimated without first managing waterway traffic more effectively within the existing system."
> (Water Science and Technology Board 2004, 6)

As project managers, the U.S. Army Corps of Engineers would be responsible for structural improvements to the UMRIV; therefore, it would be beneficial for the U.S. Army Corps of Engineers to exclusively focus on structural components in their feasibility study. This example puts into question the objectivity of the data and analysis used to justify expansion in the 2002 Reconnaissance Report. Because there may be questionable data/analysis in its

Reconnaissance Report, then the U.S. Army Corps of Engineers may have provided uncertain and insufficient arguments to favor a Seaway expansion in the near future.

Another criticism of the Army Corps of Engineers report is its faulty economic analysis. The Army Corps has also been criticized for faulty analysis in past project proposals. The following example of the U.S. Army Corps of Engineers' past faulty analysis is especially significant to the St. Lawrence Seaway expansion report because of the similarities between the two project proposals. In a February 1992 report, the U.S. Army Corps of Engineers proposed deepening the Delaware River Channel from 40 to 45 feet. As in the current Seaway expansion proposal, the ACE suggested deepening as a means to accommodate larger vessels (U.S. Government Accountability Office 2002). Much like the analysis for the St. Lawrence Seaway expansion, the Army Corps projected (in an updated 1998 report) transportation cost savings related to importing and exporting cargo in containerships; these savings were projected to be $40.1 million. However, the Government Accountability Office (GAO) evaluated the updated 1998 report and concluded that the U.S. Army Corps of Engineers' economic analysis of the Delaware River main ship channel contained a number of material errors (U.S. Government Accountability Office 2002). The problems with the economic analysis included: miscalculations, invalid assumptions, and use of significantly outdated information (U.S. Government Accountability Office 2002). The GAO provided an example of the latter problem:

> "The Corps misapplied commodity growth rate projections, miscalculated trade route distances, and continued to include benefits from some import and export traffic that has declined dramatically over the last decade"
>
> (U.S. Government Accountability Office 2002, 2)

Another U.S. Government Accountability Office criticism of the Army Corps Report was that it neglected to consider a number of unresolved issues and uncertainties, all of which would affect

the outcome of the project (i.e. decrease or increase benefits and costs). (General Accountability Office 2002, 2) These problems with its economic analysis led the U.S. Army Corps of Engineers to overstate the benefits of Delaware River deepening project by about $4.7 million. (U.S. Government Accountability Office 2002, 5)

Another criticism of the Delaware River Report is especially significant to the current St. Lawrence Seaway expansion debate because it calls into question the benefits that would arise from the channel deepening. In its critique, the U.S. Government Accountability Office writes:

> "…it is uncertain whether all of the potential benefits of a 45 foot channel would contribute to national economic development because most of the ships coming into the Delaware River ports are foreign owned. The Corps' analysis did not take into account the distribution of the project benefits between U.S. and foreign interests; in essence, the Corps assumed that all transportation savings attributable to the project would accrue to U.S. interests."
>
> (U.S. Government Accountability Office 2002, 7)

Due to the similarities between the St. Lawrence Seaway expansion proposal and the Delaware River proposal, the above criticisms of the latter project raise doubt about the economic analysis that the U.S. ACE used to justify expansion. Although some of the particular circumstances between the Delaware River Channel project proposal may differ from the St. Lawrence Seaway project proposal, the above U.S. Government Accountability Office criticism questions the Army Corps of Engineers objectivity and economic analysis when projecting the benefits of deepening navigation systems. This and the UMRIV examples thus show the unreliability of the U.S. ACE claims, and as I will mention further in the results portion, questionable analysis is indeed present in the Reconnaissance Report.

Criticisms of Army Corps's 2002 Seaway expansion proposal

The past project criticisms detailed in above paragraphs served to support later arguments that expansion benefits may be overstated. I will now turn my focus to criticisms of the 2002 Reconnaissance Report. First, the Army Corps of Engineers report projects an increase in international traffic/commerce in the St. Lawrence Seaway, but this is inconsistent with recent data on Seaway traffic. The vast majority of trade on the Great Lakes is domestic, and if the growth is forecasted in domestic shipping, then the focus of the report should be on the domestic fleet and not ocean-going vessels (Lake Ontario Keeper 2002). The current data on the Seaway's international commerce are important because they serve as an indicator of the potential to attract future international commerce in the region. This problem will be discussed in more detail in the Results section.

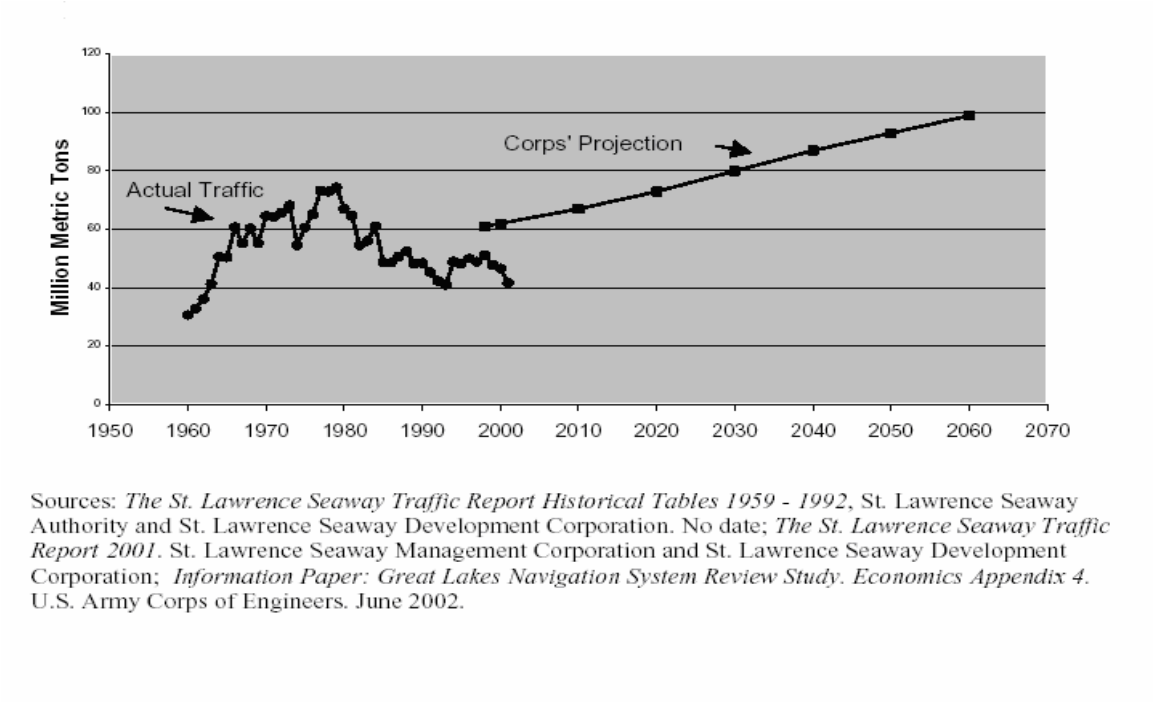
Second, the U.S. Army Corps of Engineers has had a history of over-projecting traffic in the Seaway and this leads to the conclusion that its projections for the expanded Seaway may not be accurate. The Lake Ontario Keeper and Transport Canada evaluated the Corps's history and found the following example**:**

> "Between 1998 and 2000 the Corps forecasted an increase in tonnage for all commodities modeled [for the Great Lakes/St. Lawrence Seaway]…an overall increase of 2.49% for shipping on the Great Lakes, and a tonnage increase of 6.36 % on the St. Lawrence. However, according to the St. Lawrence Seaway Development Corporation's 2000 annual report between 1999 and 2000, overall cargo by tonnage on the Montréal-Lake Ontario Section (the only section for which data is provided) declined by 2.7%. There were also declines in the three largest commodities by tonnage, with grain declining 7.5%, iron ore declining by 4.4%."
>
> (Lake Ontario Keeper 2002, 8)

This quote thus shows that the Army Corps's forecasting is not always accurate. Great Lakes United (GLU) pointed to errors in the Corps's projection methodology that leads to its flawed forecasts. In their report entitled "Rethinking the Economics of Navigation," GLU states

that the Army Corps's forecasts are extremely unreliable because small errors in certain variables-such as grain yield, elasticity and export demand result in wildly different levels of traffic. Figure 2 (taken from the GLU report) shows how these errors impact the U.S. Army Corps of Engineers' forecasts.

Figure 2. Actual and Corps's Projected St. Lawrence Seaway Navigation Traffic



Sources: *The St. Lawrence Seaway Traffic Report Historical Tables 1959 - 1992*, St. Lawrence Seaway Authority and St. Lawrence Seaway Development Corporation. No date; *The St. Lawrence Seaway Traffic Report 2001*. St. Lawrence Seaway Management Corporation and St. Lawrence Seaway Development Corporation; *Information Paper: Great Lakes Navigation System Review Study. Economics Appendix 4*. U.S. Army Corps of Engineers. June 2002.

(Schoonover and Muller 2002, 17)

This graph demonstrates the discrepancies between Army Corps's predictions and the actual traffic on the Seaway. Thus, Great Lakes United's graph and Lake Ontario Keeper's analysis illustrate that the Corps's short term forecasting is not reliable; therefore, its long-term predictions for the Seaway may not be either.

As mentioned earlier, these criticisms of the report led the U.S and Canadian governments to initiate the present Great Lakes St. Lawrence Seaway Study. The ongoing study is conducted by both Canadian and United States government agencies including Transport Canada, U.S. Army

Corps of Engineers, U.S. Department of Transportation, St. Lawrence Seaway Management Corporation, St. Lawrence Seaway Development Corporation, Environment Canada, and the U.S. Fish and Wildlife Service.

To complete its analysis of the St. Lawrence Seaway infrastructure and to acquire feedback about the study, the United States and Canadian governments held stakeholder meetings in the Great Lakes region. These meetings comprised of various interest groups and individuals who held differing views about Seaway expansion. As stated earlier, the U.S. and Canadian governments emphasized at these meetings that expansion would not be considered as an option in their current study, but, as the interest groups stated, the possibility of expansion may be raised in future studies.

Among those who oppose Seaway expansion are Great Lakes United, Save the River, and the Mohawk Council of Akwesasne. Both Great Lakes United (GLU) and Save the River (STR) are environmental organizations. Great Lakes United is an international coalition that consists of member organizations representing environmentalists, conservationists, community groups, and citizens of the United States, Canada, and First Nations and Tribes (Great Lakes United). Save The River is a non-profit, member-based environmental organization whose mission is to preserve and protect the ecological integrity of the Thousand Islands Region of the St. Lawrence River through advocacy, education and research (Save the River). Both these organizations argue against opposition mainly on environmental grounds, while the Mohawk Council of Akwesasne (MCA) has both environmental and economic arguments against an expanded Seaway. The Mohawk Council of Akwesasne represents First Nations citizen opposition against expansion.

Some of the above groups' environmental concerns are presented below, but more general environmental effects of expansion (not necessarily specified by these groups) are

presented below. A more extensive review of GLU, STR, and MCA arguments will be presented in the results section.

Expanding the navigation system poses numerous threats to water quality, aquatic life, and the economy**.** The channel construction will require the dredging of hundreds of millions of cubic yards of soil (as stated by the Corps) and this dredging will destroy valuable fish habitat and also bring contaminated sediments back into the water (Lake Ontario Keeper 2002, 22). Dredging also has monetary impacts, which the Akwesasne have faced in the past. In their testimony at the stakeholder meetings, the Akwesasne said, "Dredging spoils were placed on prime river-valley farmland which severely affected the residents of Akwesasne for whom agriculture was an important component of the economy. The lands uncovered by dredging spoils have proved to be unproductive for farming purposes. Toxins from dredge spoils have their affects on the health of community members generation after generation." (Mohawk Council of Akwesasne). The Akwesasne's past experience with dredging is an indicator of the effects dredging for the expanded Seaway may have on their community.

There are a number of other environmental arguments against expansion. One is that the large containerships that will use the navigation system will produce large surge waves that will increase shoreline erosion, water turbidity, and degrade wetlands (U.S. Environmental Protection Agency). In addition to these effects, Great Lakes United has stated that if boat activity does rise**,** more invasive species will likely be introduced to the Great Lakes and St. Lawrence River ecosystems. Invasive species are non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human health (U.S. Environmental Protection Agency). Invasive species have both negative economic and environmental impacts. Invasive species have been responsible for approximately $137 billion dollars in yearly costs nationwide,

according to 2000 figures from the U.S. Fish and Wildlife Service (U.S. Environmental Protection Agency). These costs include property loss, management and control costs, and alteration of ecosystems supporting commercial and recreational activities (U.S. Environmental Protection Agency). For example, zebra mussels are an invasive species of European origin. They were introduced to the Great Lakes region in 1986 and have now firmly established themselves in the ecosystem (U.S. Environmental Protection Agency). The zebra mussel has caused economic damages in the Great Lakes Region by clogging up water filtration systems. The zebra mussels will be discussed in more depth in the Results portion of this paper.

In terms of environmental impacts, invasive species represent the second leading cause of species extinction and loss of biodiversity in aquatic environments worldwide (U.S. Environmental Protection Agency). Invasive species cause a loss of biodiversity because they compete with native species for food and habitat, and when the native species with which the invasive species is competing dies off, this disrupts the complex web of ecological relationships that were dependent on these native species.

The connection between boats and invasive species is that invasive species often arrive in aquatic systems through the ballast water of boats. Ballast water is material that is used to maintain a boat's stability and assists in allowing the vessel to be steered when the ship has little or no cargo on board (Claudi and Wiley 1999, 205). Ships carry the ballast water in internal water tanks located in various regions of the ship (Claudi and Wiley 1999, 205). The tanks are filled or emptied according to the amount of cargo the ship carries and this process provides balance and buoyancy when required. The water that is taken from underwater intake ports (usually located underneath the stern of the ship) is likely to be teaming with living organisms (Claudi and Wiley 1999, 206). When this water is discharged at the final destination, all of the

organisms taken up are released into the receiving waters (Claudi and Wiley 1999). In this way, invasive species are transported from one region to another and, as mentioned above, disrupt the economy and environment of the area to which they are introduced.

While it is important to consider the environmental damages caused by the expansion, it is just as crucial that we analyze the potential environmental benefits of the proposed expanded Seaway. In the 2002 Reconnaissance Report, the Army Corps argues that a wider Seaway would enable the existing overland East Coast, Great Lakes container traffic to divert to the Seaway, i.e., there would be a shift from land transportation modes to water transportation for the shipment of goods. With greater carrying capacities, cargo boats and containerships are more energy efficient than land transportation systems and reduce the number of railway cars and trucks on the highway and rail systems. A reduction in both railway cars and truck use would be environmentally beneficial. A truck typically uses 1 gallon of diesel fuel to move a ton of freight 59 miles (59 ton miles/gallon), while rail efficiencies have been estimated at 202 to 316 ton miles/gallon (Center for Neighborhood Technology, 5). This energy consumption is damaging because trucks and trains frequently travel greater than 100 or 200 miles and therefore would be using a great deal of diesel fuel, which contains several pollutants that are harmful to public health alone or in combination with other substances (State of Massachusetts). If transportation were shifted from land modes to water modes, then a decrease in rail and truck traffic would likely result in a reduction in the number of diesel emissions per mile due to the fact that ships, such as barges, typically use a gallon of diesel fuel for every 500 ton miles (Center for Neighborhood Technology). Thus, lesser number of railway cars and trucks would potentially result in lower environmental impacts from diesel fuel.

Furthermore, lesser number of railway cars and trucks would decrease the strain on railway and highway systems, and thus diminish the need for maintenance or expansion of their respective infrastructures to accommodate the railway/truck traffic. Railway construction and maintenance activities can cause temporary environmental impacts such as air pollutant emissions and erosion, or can have long term impacts such as habitat disruption and hydrologic alterations (U.S. Environmental Protection Agency).

A reduction of truck activity would also be environmentally beneficial. Road construction and trucks are a major source of runoff. Runoff from the road includes sediment, bacteria, organic nutrients, hydrocarbons, construction chemicals, etc. The polluted runoff from roads typically contaminates streams first, which then drain into larger streams, rivers, ponds, lakes, wetlands, and estuaries. Additionally, paved roads increase impervious surface in the watershed; impervious surfaces prevent water from seeping through into the water table, and large amounts of runoff are redirected to streams, which eventually lead to downstream flooding (U.S. Environmental Protection Agency). Thus, due to the negative environmental impacts of rail and trucks, a shift to marine transportation might be environmentally advantageous. This will be discussed further in the Results section.

The above paragraphs lead one to ask the following question: how probable is a shift in domestic transportation from land modes to water modes? Although rail and truck shipping modes are less energy efficient in carrying goods than cargo boats, they are more time efficient and get goods to regions more quickly (Department of Geography). To justify the environmental costs of boats and navigation system, further research will need to show whether significant amount of domestic transportation will shift; only a significant shift will result in environmental

benefits. I will examine this issue more closely in the environmental portion of the results section.

The remaining portion of this paper will asses the arguments that the Army Corps of Engineers has made in favor of expansion and also detail the counter arguments made by the Great Lakes United, Save the River, and Mohawk Council of Akwesasne.

Results

As mentioned earlier in the paper, the U.S. Army Corps of Engineers' current proposal to expand the St. Lawrence Seaway is not new; the United States government has explored deepening possibilities in the past, but did not implement these proposals due to a few states' objections or to economic unfeasibility. Similar to past studies, the current expansion proposal is not economically sound.

The Army Corps claims that if the Seaway were expanded to accommodate vessels with a 35 foot draft, 110 foot width, and 1000 foot length, then, as a result, the Seaway would attract transport traffic currently moving overland and would attract more world fleet, containerships, and boat traffic at large. In turn, the greater traffic in the Great Lakes/St. Lawrence Seaway region would generate employment and income benefits for the region. However, in the following sections, I will use national waterway commerce statistics, St. Lawrence Seaway statistics, and global trading pattern statistics to demonstrate the uncertainty of the economic benefits that the Army Corps predicts the St. Lawrence Seaway expansion will bring to the Great Lakes region. Furthermore, I will look at those groups of people who will be economically disadvantaged if an expansion were to occur. In addition to the economic components of the Seaway expansion, I will also assess the environmental effects of Seaway expansion. Before a

final decision is made to expand the Seaway, government officials must first consider whether the expanded Seaway will draw enough containership and world fleet traffic to justify the economic and environmental costs of the expansion.

Basics about national waterway commerce

According to the U.S. Bureau of Transportation Statistics, in 2002, water's share of all commercial freight (domestic and international) was the following: value: 8.3%, weight: 14.8 %, and ton-miles: 16.3 % (U.S. Bureau of Transportation Statistics). Domestic waterborne ton-miles and tonnage have declined in the last two decades, but the opposite has been true of U.S international trade, which has increased during the same period. The U.S. Bureau of Transportation Statistics state:

1) maritime transportation carries nearly 80% of the tonnage of U.S. import and export freight

2) from 1993 to 2002 the value per ton of waterborne freight increased from $290 to $370, reflecting rising reliance on imports for manufactured goods.

3) the total tonnage of domestic and international trade traveling U.S. waters increased more than 10 percent, from 2 billion tons in 1993 to 2.3 billion tons in 2002.

These statistics highlight the importance of waterway commerce to the U.S. economy. Furthermore, given the fact that the Army Corps of Engineers would like to attract a greater percentage of the world fleets, these statistics also suggest potentials for the St. Lawrence Seaway to attract and increase waterway traffic in the Great Lakes Region.

The main argument for St. Lawrence Seaway expansion is that a wider Seaway would increase vessel traffic by allowing more world fleet, such as containerships, to enter the Seaway system. Containerships have a cargo carrying capacity of 2,812,000 tons, and with this large

carrying capacity, more diverse goods would potentially be able to come to the ports located on the Seaway. Currently, the Seaway facilitates the trade of only bulk cargo such as grain, iron ore, coal, and petroleum products (Great Lakes St. Lawrence Seaway System). From 2003-2004, the total amount of cargo in the Seaway increased from 28,952 to 30,822 tons, or 6 % (Great Lakes St. Lawrence Seaway System). The addition of containerships would theoretically allow for an even greater increase in the amount of cargo passing through the system on a yearly basis.

However, it is not clear the *exact* degree to which waterborne traffic would increase if an expansion were to occur. It was mentioned earlier that domestic and foreign waterborne trade has increased since 1993; yet, in the past few years, both foreign waterborne trade and total waterborne trade have fluctuated between decline and slow growth. Although the cargo passing through U.S. seaports in 2003 accounted for the largest modal share (41 %) of the value of overall U.S. merchandise trade, this share declined from 49 % in 1990 as land and air trade's share increased (U.S. Bureau of Transportation Statistics).

Because the Army Corps of Engineers wants to attract a larger percentage of world fleet into the Great Lakes region, it is crucial to look at the total foreign waterborne freight in isolation from the total waterborne trade. The U.S. Bureau of Transportation Statistics table below illustrates the pattern of minimal change in foreign waterborne trade during the last three years; while the foreign waterborne freight had a 4.4% increase from 1999 to 2002, 2002's foreign waterborne trade reflected a decline from 2000 and 2001.

Table 1. Total Foreign Waterborne Trade

Year	Tons
1999	1,136,970.53
2000	1,221,738.32
2001	1,218,131.18
2002	1,189,724.95

(U.S. Bureau of Transportation Statistics)

A look at the total waterborne trade would help to determine whether the expanded Seaway would be able to attract waterborne traffic at large (i.e., both domestic and foreign). An examination of total waterborne trade shows a similar pattern to that of total foreign waterborne trade. According to U.S. Bureau of Transportation Statistics, the total waterborne trade in 2002 was 2,123,085 tons. The data for previous years are listed below:

Table 2. Total Waterborne Trade

Year	**Tons**
1999	2,094,485.84
2000	2,186,467.91
2001	2,171,165.86

(U.S Bureau of Transportation Statistics)

The table shows that from 1999 to 2002 there was only a 3.5 percent growth. These minimal changes in national foreign waterborne trade and total waterborne trade point to the uncertainty of whether an expanded St. Lawrence Seaway would increase world and domestic fleet traffic in the Great Lakes region. A closer examination of trade on the St. Lawrence Seaway also supports these doubts on the economic effects of expansion. For instance, a study done by Lake Ontario Keeper and Transport Canada shows that traffic by tonnage has been relatively flat in the St. Lawrence Seaway for the last 20 years. According to this report, the traffic on the St. Lawrence Seaway peaked in 1979 at 82 million tons and has not been above 60 million tons in the last 15 years (Lake Ontario Keeper 2002). Thus, with a current slow growth in traffic and trade in waterway commerce generally, as well as in the St. Lawrence Seaway in particular, actual world fleet traffic from Seaway expansion will likely fall short of the Army Corps's predictions.

As one of the Army Corps Engineers' primary goals for the St. Lawrence Seaway expansion is to accommodate containerships, in the next and following sections, I will take a

closer look at the types of commodities they transport and use this information, along with the Great Lakes/St. Lawrence Seaway regional trading patterns, to determine whether the expanded St. Lawrence Seaway would attract containership traffic. Though the Seaway expansion would be able to physically allow containerships to come to the region, it is unclear whether a significant number of containerships will, in actuality, pass through the St. Lawrence Seaway.

Containerships and St. Lawrence Seaway trading patterns

In its report, the Army Corps of Engineers stated that the Seaway can only handle 13% of the world fleet by vessel capacity and 5% of the world container traffic by tonnage, and that these numbers are declining as ever larger ships are being built (U.S Army Corps of Engineers 2002). The Corps used these numbers to justify an expansion so that a greater percentage of the world's fleet and world container traffic would come to the Seaway. However, particular features of containerships and the St. Lawrence Seaway commerce may impede an expanded Seaway's ability to attract significant amount of containership traffic.

The U.S. Army Corps of Engineers would like to draw containerships into the Great Lakes/ St. Lawrence Seaway region because of their increasing importance in maritime trade worldwide. According to the U.S. Bureau of Transportation Statistics, U.S. foreign waterborne container traffic more than doubled between 1990 and 2001 and is expected to continue similar growth over the next 20 years (U.S. Bureau of Transportation Statistics). On the other hand, containerships are used to transport only certain goods and this characteristic of containerships may hinder the ability of the Seaway to attract significant amounts of containership traffic due to the nature of commerce in the Great Lakes/ St. Lawrence Seaway region**.** As per the U.S Bureau of Transportation Statistics, the type of goods transported in maritime imports/ exports varies,

and this affects the type of vessels and the seaports used (U.S. Bureau of Transportation Statistics). Commodity characteristics such as value and weight are factors that determine the use of the containerships (U.S. Bureau of Transportation Statistics). The table below shows the major commodities that were transported by containerized trade in 2001:

Table 3. U.S. Waterborne Containerized Trade by Major Commodities: 2001 [in twenty-foot equivalent units (TEUs)]

Ranked by TEUs (twenty-foot equivalent units)	**Exports**		**Imports**	
	Commodity	***Percent Share***	***Commodity***	***Percent Share***
1	Paper and paperboard	12.4	Furniture	8.3
2	General cargo	7.3	General cargo	4.9
3	Fabrics, incl. raw cotton	4.2	Toys	3.9
4	Pet and animal feeds	3.6	Footwear	3.3
5	Grocery products	3.0	Apparel and misc.	3.2
6	Synthesis resins	2.8	Auto parts	3.2
7	Logs and lumber	2.6	EDP machinery	2.5
8	Wood pulp	2.0	Plastic products	2.3
9	Auto parts	2.0	Bananas	2.2
10	Vegetables	1.9	Electrical and electronics	1.9
	Others **Total**	58.4 **100.00**	Others **Total**	64.2 **100.00**

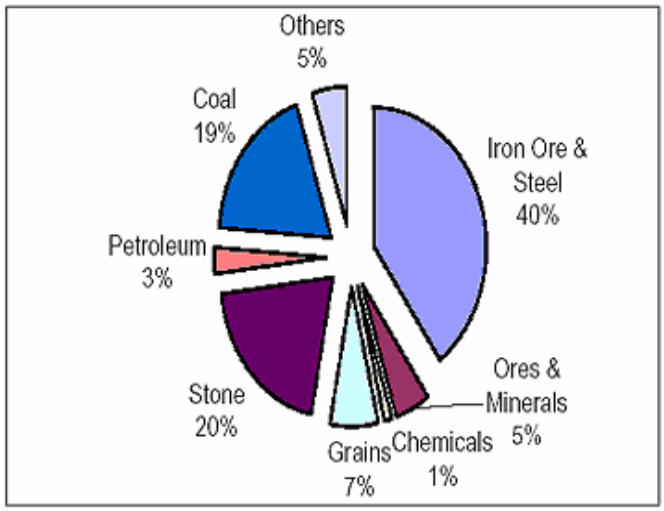
(U.S. Bureau of Transportation Statistics)

Now that we better understand the cargo that containerships transport and the link between the type of cargo and the type of vessel used, we must consider the dominant goods that are transported on the Seaway and the ships that are ideally suited to transport these goods. This

analysis will be help to determine whether containerships will indeed be attracted into the expanded Seaway.

The pie chart below illustrates the main commodities currently transported on the Great Lakes/St. Lawrence Seaway region:

Figure 3. Commodities Transported on the Great Lakes/St. Lawrence Seaway, by volume



Source: U.S. Army Corps of Engineers. *Information Paper: Great Lakes Navigation System Review, Economics Appendix 4*. June 2002.

(Lake Ontario Keeper 2002)

According to the pie chart, mined goods, such as iron ore, coal, and stone, are the predominant goods transported on the Seaway system. These four commodities support the steel industry in part or in whole, though shipments of coal are primarily to electric utilities (U.S. Army Corps of Engineers). The agricultural industry is also an important waterway user, shipping grains from Lake Superior ports through the St. Lawrence Seaway to ports along the lower St. Lawrence River (mostly for eventual shipment overseas) or directly to overseas

destinations(U.S. Army Corps of Engineers). The U.S. Army Corps of Engineers themselves point to the fact that each fleet is compatible with the traffic and market that the fleet is designed to serve; the three distinct fleets used in the Seaway system are the intra-laker fleet, a laker/Seaway fleet, and a laker/Seaway oceangoing fleet of salties (U.S. Army Corps of Engineers).These dominant fleet correspond with the main commodities transported on the system. In the Reconnaissance Report, the Army Corps of Engineers described each fleet's operation:

1) intra-laker fleet shuttle ore and local docks on Lake Superior and power plants and steel mills on the upper lakes;
2) laker/Seaway fleet, primarily a Canadian fleet, moves grain from Lake Superior to grain elevators on the lower St. Lawrence and iron ore from the lower St. Lawrence and iron ore from the lower St. Lawrence to grain elevators on the lower St. Lawrence and iron ore from the lower St. Lawrence to steel mills on Lake Ontario and the upper lakes.
3) The oceangoing fleet of salties is dominated by tramp operators bringing commodities such as steel slab from overseas origins into the lakes, taking on-light loads of grain in Lake Superior before moving back to the lower St. Lawrence where they are topped off with grain before continuing on to overseas destinations.

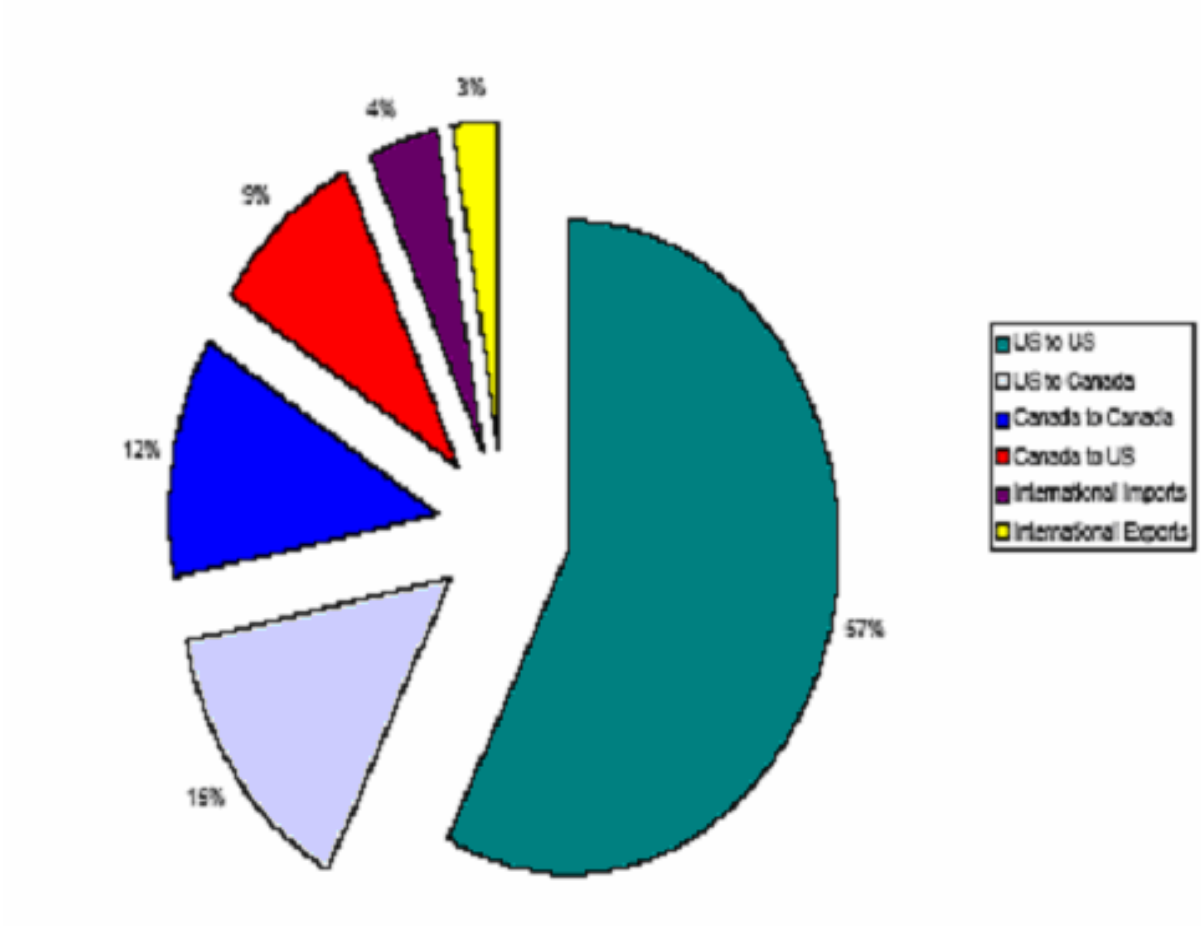
(U.S. Army Corps of Engineers 2002, Appendix: 5-1).

The above descriptions thus point to the distinctly established pattern for using certain fleets to transport certain goods to certain regions; because these commodities are primarily goods transported within the Great Lakes/ St. Lawrence Seaway region, and specific fleet are used for specific goods, then there is doubt to whether large number of containerships would come into the Great Lakes region given the fact that the types of goods it carries are not part of the dominant waterway commerce in the Great Lakes region. Furthermore, it is doubtful whether containerships would enter the Seaway to transport goods that are not part of the dominant waterway commerce in the Great Lakes/St. Lawrence Seaway region; these goods are not dominant commodities transported on the Great Lakes/St. Lawrence Seaway region because

it may be more economical for them to be transported into and out of the Great Lakes region via other means, i.e., air or land. The addition of a greater percentage of containership and world fleet may not easily change this trend in shipment. Thus, because the type of goods affects the types of vessels being used, the currently used fleet on the Seaway may be most ideal for the transport of abovementioned commodities. For this reason, it would not be economical for foreign containerships to enter the Seaway; given the fact that monetary incentives primarily drive international commerce trends, nations would probably have little incentive to send their containerships to the expanded Seaway**.**

The amount of international commerce in the Great Lakes region is another reason to doubt the extent of containership traffic that will pass through the expanded Seaway**.** The U.S. ACE believes that an expanded seaway will enable a greater percentage of containership and other world fleet to enter through the Seaway and increase international commerce in the region. However, currently, the primary commerce in the Great Lakes is *domestic* and *bi-national* (i.e. between U.S. and Canada), not international**.** In a 1998 analysis, the Corps stated that North American trade accounted for 93% of commercial shipping on the GL/SLS (Lake Ontario Keeper)**.** The pie chart (taken from the Lake Ontario report) below also illustrates the fact that *domestic* and *bi-national* trade currently predominates in the Great Lakes/ St. Lawrence Seaway.

Figure 4. Great Lakes/St Lawrence Seaway Traffic by Origin and Destination, 1998



(Lake Ontario Keeper 2002)

These statistics calls into question whether the expanded Seaway would attract a greater percentage of world fleet given the fact that the market for the primary commodities transported via the Great Lakes/St. Lawrence Seaway goods is domestic/bi-national and not international. As mentioned above, containerships are part of the world fleet the U.S. ACE wants to attract but containerships predominantly carry goods that are not part of the dominant commodities transported in the Great Lakes region.

The argument could be made that expansion would potentially increase general waterway traffic in the Seaway region and the increased traffic could increase profitability of transporting

via water mode the primary commodities that containerships carry. This change in commodity profitability would, in turn, induce more containerships to enter the Seaway. However, two things must be kept in mind. First, current market forces have not made water mode an economical method of transporting these goods (that are carried by containerships) to and from the Great Lakes/St. Lawrence region; given the fact that other factors have so far been unfavorable, how likely will it be that increased waterway traffic will increase the possibility of water transport for these goods? This question leads to the second point: a wide variety of factors affect the transport of certain goods by water mode**,** and greater waterway traffic in the St. Lawrence region may not change the impact that these factors have in making some goods cheaper to transport via land or air modes. Thus, given the uncertainty of whether the primary containerships' commodities will shift from land/air transport to water transport, the potential for containerships is limited in the Great Lakes and nations will be less inclined to send their containerships to the Great Lakes/St. Lawrence Seaway region.

Furthermore, we need to take a closer look at why mining and agricultural products are the primary commodities being transported in the Great Lakes/St. Lawrence Seaway region. Mined products and grains may have high transporting volumes on the Seaway for the following reasons:

1) water mode is the cheapest means of transport for these goods
2) the Great Lakes region probably has an abundance of these resources
3) these resources, as shown in the U.S. ACE analysis, also serve primary industries in the region

For the above reasons, these industries have become the most profitable to waterway commerce in the Great Lakes/St. Lawrence Seaway region**.** Therefore, as these commodities dominate waterway commerce, the waterway commerce in the Great Lakes region will probably

not shift its specialization to other goods which thus far have not been as profitable or economical to transport via water mode**.** The possible economic losses that the Great Lakes/St. Lawrence Seaway water commerce faces in shifting to transport of other commodities (e.g., primary containership commodities) makes it doubtful whether the region's waterway commerce will transition to a containership commodity based economy**.**

Hence, as this section has shown, the dominant commodities that are transported on the Great Lakes/St. Lawrence Seaway region, the types of vessels used to transport these goods, the types of goods that containerships transport, and the dominant domestic and bi-national commerce are all reasons to doubt whether the expanded Seaway will induce an increase in containership and other world fleet traffic. In the next section, I will further demonstrate the uncertainty of the expanded Seaway attracting greater number of world fleet and containerships and increasing international commerce in the region.

Expansion and international commerce

Because nearly all of the large ships that the Corps wants to introduce to the Great Lakes/St. Lawrence Seaway system are part of the international fleet, the Army Corps of Engineers believes that expansion will significantly increase international waterway commerce in the Great Lakes region. However, the arguments below will show that the Seaway's size limitation is not the limiting factor for the region's ability to attract international waterway traffic; rather, world fleets, including containerships, prefer coastal ports. Other factors, such as globalization, geography and time, also affect the decision of nations to send their fleets to coastal and not Great Lakes ports.

For this section only, I will assume the fact the previous section's arguments do not apply, i.e., the fact that commodities did not determine the type of boats being used for transport and that containerships would in fact ship the primary commodities that are transported on the Great Lakes/ St. Lawrence Seaway System. This temporary suspension of the previous section's argument will help to facilitate a deeper understanding of the other factors, aside from boat specialization and regional economy, which also contribute to limiting the international traffic in the St. Lawrence Seaway. These factors, which will be discussed below, include geography, globalization, and time.

Currently, world fleets share a preference for coastal ports over Great Lakes ports. The following table (using 2001 data from the U.S. Bureau of Transportation Statistics) compares the foreign waterway commerce that the Great Lakes/St. Lawrence Seaway region attracts with the amount that coastal ports attract. All figures are in tons.

Table 4. Great Lakes versus Coastal Ports Commerce

	Great Lakes	**Coastal**
Overseas	**5,687,722**	**1,162,598,344**
Canada	**51,048,216**	**-**
Total	**56,735,938**	**1,162,598,344**

(U.S. Bureau of Transportation Statistics)

An argument can be made that the Great Lakes Region is not attracting the same foreign commerce as that of the coastal ports because the latter ports can accommodate container ships and other bigger boats used in international commerce. Evidence supporting this claim can be found in the U.S. Bureau of Transportation Statistics report, "America's Freight Transportation

Gateways" In this report, the U.S. of Bureau of Transportation Statistics states that one of the reasons that the Port of Los Angeles is the top transportation gateway is that it "…reflects the specialization among U.S. seaports. The Pacific and Atlantic coast ports are heavily involved in container trade…." (U.S. Bureau of Transportation Statistics 2004) Because of the rising importance of containerships in international waterway commerce, if the Seaway were expanded to accommodate containerships, then the Seaway ports could potentially attract the same proportion of international commerce as the Port of Los Angeles and other coastal ports.

Table 5 shows the Top 10 Maritime Container Ports. The table reveals two trends that make it doubtful whether an expanded Seaway could attract significant containership traffic. First, the top 10 maritime containership ports handled 83.4% of container traffic in 2001, and the remaining 16.6 % container traffic was distributed among other U.S. ports. Second, with the exception of Seattle, all the top ten ports continue to have a positive average annual growth rate, and this piece of data demonstrates the difficulty that the expanded Seaway would have in attracting the containership traffic from the top ten ports. Therefore, any container traffic that the Great Lakes/St. Lawrence Seaway System could attract would have to be a small portion given that it will have to compete with other ports for 16.6% of container traffic.

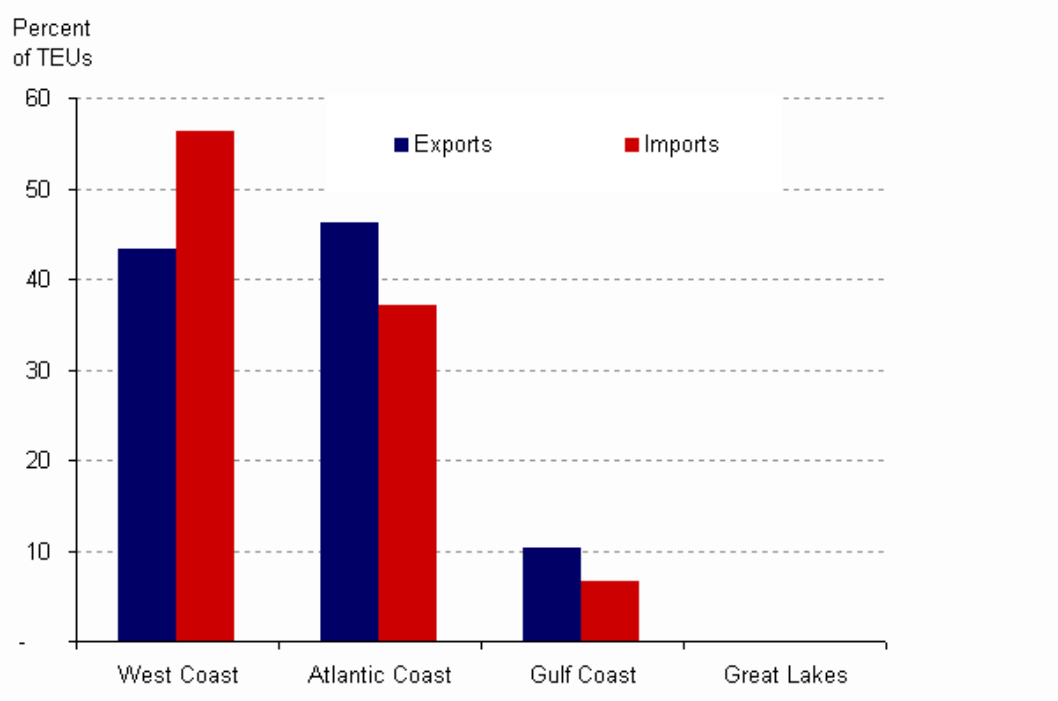
Table 5. Top 10 U.S. Maritime Container Ports: 1995, 2000, 2001 [thousands of twenty equivalent unites (TEUs)]

Ports	1995	2000	2001	Average number of TEUs per day (2001)	Percent change (1995-2000)	Average annual growth rate (percent)
Los Angeles, CA	1,849	3,228	3,425	9,384	85.2	10.8
Long Beach, CA	2,137	3,204	3,199	8,765	49.7	7.0
New York and New Jersey	1,537	2,200	2,332	6,388	51.7	7.2
Charleston, SC	758	1,246	1,156	3,166	52.5	7.3
Oakland, CA	919	989	960	2,630	4.5	.7
Norfolk, VA	647	850	885	2,424	36.7	5.4
Seattle, WA	993	960	824	2,257	-17.0	-3.1
Savannah, GA	445	720	813	2,226	82.6	10.6
Houston, TX	489	733	778	2,132	59.1	8.0
Miami, FL	497	684	717	1,964	44.2	6.3
Top 10, percent of total	77.1	82.6	83.4			

(U.S. Bureau of Transportation Statistics)

Furthermore, the trend for containership arrival is not merely towards these top 10 ports but, specifically, West Coast ports. According to the Bureau of Transportation Statistics, during the 1970s, when U.S. Asia-Pacific Rim trade was modest, East Coast ports handled the majority of maritime international trade; however, with the rise in trade with Asia, the East Coast ports' share of the value of trade declined while the West Coast ports' share has increased (U.S. Bureau of Transportation Statistics). Also, the Bureau of Transportation Statistics states that today, West Coast ports serve more as the import gateways into the United States, while the East Coast ports handle more exports than imports (U.S. Bureau of Transportation Statistics). This pattern is reflected in the following Bureau of Transportation graph:

Figure 5. U.S. Waterborne Containerized Exports and Imports by Coastal Port Region: 2001



(U.S. Bureau of Transportation Statistics)

Thus, the Bureau of Transportation Statistics' analysis and graph reveal that the West Coast continues to dominate in attracting importing containership traffic. Also, given the fact that coastal ports are favored over Great Lakes for international commerce, and that the East Coast has the infrastructure for containership yet attracts less containership traffic (i.e., importing containership traffic), then it remains uncertain whether the St. Lawrence Seaway can attract significant amounts of container traffic to justify expansion. The Seaway expansion may not induce containership traffic to divert from coastal ports because of other factors (aside from Seaway size) such as time and geography.

The Bureau of Transportation Statistics' analysis and graph also show that the West Coast has been attracting greater containership traffic because of the rise in trade with Asian

countries and this demonstrates the significant contributions that Asian countries make to the U.S. containership traffic. In fact, per Bureau of Transportation Statistics data, in 2001, the top five overall U.S. containerized cargo trading partners were all Asian countries: China, Japan, Hong Kong, Taiwan, and South Korea (U.S. Bureau of Transportation Statistics). Consequently, the Seaway expansion debate concerning containerships must focus on attracting containership trade from the above countries.

As mentioned above, the current importing container traffic preference is for the West Coast, and below I will show how geography has played a role in influencing containership imports to enter at this coast. I will analyze China's trading pattern as an example and use this information to show how geography, and not Seaway size, limits its trade via the St. Lawrence Seaway.

China is a suitable example for two reasons. Of the top five overall U.S. containerized cargo trading partners, China is the leading country, and therefore, if an expansion were to occur to accommodate containerships, then the Seaway would have to focus on attracting China trade into the region. Second, as discussed earlier, the grain industry dominates waterway commerce in the Great Lakes/ St. Lawrence Seaway region. The grain industry in the Great Lakes region has potential to attract Asian markets. The Great Lakes United commissioned the Institute for Agriculture and Trade Policy to analyze the arguments the Army Corp used to justify expansion. In this document, the Great Lakes United analyzed the market patterns for the grain industry.[1]

The Institute for Agriculture and Trade Policy states:

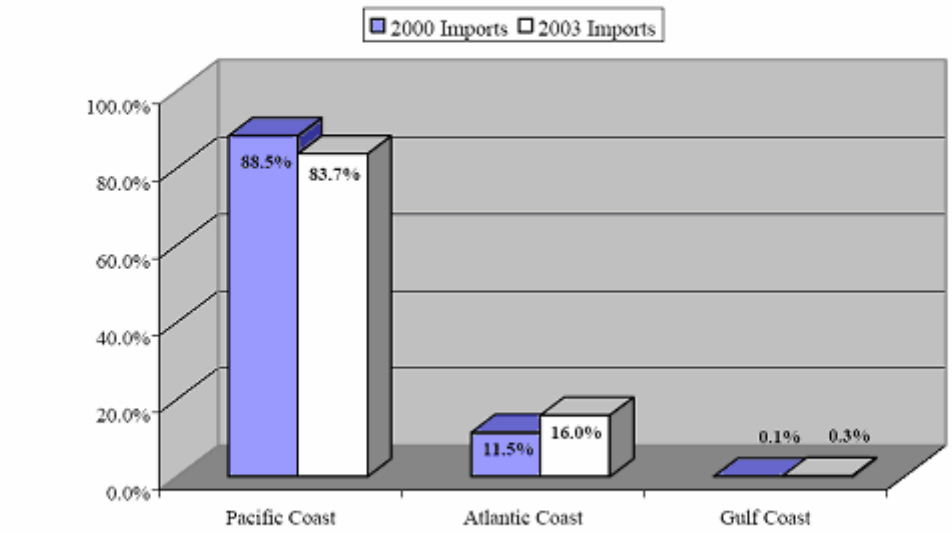
[1] It must be noted here that the Great Lakes United report will be cited throughout the results section, and the organization's analysis, like the Army Corps of Engineers, may appear biased as the Great Lakes United opposes expansion. However, their analysis will nonetheless serve the purpose of demonstrating that the potential for an expanded Seaway to increase international commerce and world fleet traffic is contingent upon various economic forces at play in the Seaway region, international commerce, and containership/world fleet traffic.

> "Europe has reduced its consumption of U.S. and Canadian grains dramatically since 1980. The increasingly global nature of the world market makes it essential to examine where future demand for agricultural and mined products will occur. Demand for U.S. grain has increasingly shifted toward Asian markets."
> (Schoonover and Muller 2002, 5)

The above analysis would fit well with the Army Corps of Engineers argument for expansion; the Great Lakes/St. Lawrence Seaway has potential to attract Asian markets for one of its dominant waterway industries, and could possibly spur Asian commerce in other industries. However, as the U.S. ACE would argue, the Great Lakes/St. Lawrence Seaway region cannot attract significant commerce from Asian countries because Seaway size limits prevent the entry of Asian countries' primary mode of transporting international waterway commodities.

However, Michael Bomba, a researcher at the University of Texas, conducted an analysis of China's trading patterns, and his analysis revealed that the West Coast (i.e., Pacific Coast in Bomba's analysis) not only dominated in attracting Chinese imports, but also dominated in exporting goods to China. In 2003, the Pacific Coast ports handled over $100 billion worth of goods in the U.S./China trade, in comparison to around $24 billion at the Atlantic Coast (i.e., East Coast) ports, and around $5 billion at the Gulf Coast ports (Bomba 2004). Percentage wise, this means that with respect to exports to China, Pacific Coast ports handled 54.2%, while Atlantic coast handled 24.8%, and the Gulf Coast handled 20.9%; with respect to Chinese imports, the Pacific Coast received 83.2%, in contrast to 16.0% and 0.8% handled at Atlantic and Gulf Coast ports, respectively (Bomba 2004). Nor is preference for the West Coast merely a matter of the West Coast having the infrastructure to manage Chinese containerships and the Atlantic and Gulf Coasts lacking the adequate infrastructure. This point is illustrated in Figure 6 below. The graph shows that the Atlantic and Gulf Coasts were able to attract some Chinese containerships, but the Pacific Coast dominated containership imports from China.

Figure 6. Percentage of Containerized U.S. Maritime Imports from China by Coast, 2000 versus 2003



Note: 2003 data are preliminary

Source: Derived from the Waterborne Databank, U.S. MARAD, 2004.

(Bomba 2004, 11)

The bar graph and analysis of Chinese waterway statistics show that the limiting factor for East Coast ports attracting Chinese commerce was not merely the infrastructure to handle containerships, but some other reason must have played a role in making Pacific Coast more attractive to the Chinese than the other coastal ports. This reason may be geography and the proximity of the Pacific Coast to the Asian countries. As discussed in the previous paragraphs, coastal ports typically attract more international commerce than the Great Lakes ports; given this condition, if the Atlantic and Gulf Coast ports have a smaller share in attracting Chinese trade and cannot attract more Chinese trade possibly because the geographical preference for West Coast ports, then it remains uncertain whether expanded St. Lawrence Seaway ports could attract a significant amount of Chinese trade. Seaway expansion may not overcome the impact that

geography has in attracting significant containership traffic. Because China and other Asian countries are significant and dominant sources of foreign containership traffic in the United States, the expanded Seaway would potentially attract lower levels of containership traffic than the U.S. Army Corps of Engineers projected. Due to the fact that the Army Corp used its traffic projections to justify expansion, if the containership traffic is lower than these projected numbers, then the Army Corps's economic argument for expansion (i.e., attracting a greater number of containerships and thus greater commerce to the Great Lakes/St. Lawrence Seaway region) loses its foundation. Hence, the above analysis of China demonstrates that the expanded Seaway's limitation is attracting sufficient containership traffic to make expansion economically justifiable.

As demonstrated with the China example, geography may be a key component in the attraction of international commerce and containership traffic to certain regions of the United States. If one looks at international waterway commerce trends, then the geographic pattern will become even more apparent. The U.S. Bureau of Transportation's report "America's Freight Transportation Gateways" indicates that the Great Lakes ports are at a disadvantage in attracting international commerce beyond Canada because of their geographic position. The U.S. Bureau of Transportation's report is based on 2003 statistics and listed the Top 25 International Gateways from all modes (land, water, and air.) This report demonstrates that, although nations such as Germany, Brazil, and Trinidad are among the top three countries importing to the top eastern gateways for water commerce such as New York, Baltimore, and Norfolk, VA, the number one source of imports for these ports was Canada. Among the top Western gateways for water commerce such as Los Angeles, Long Beach, and Oakland, the top countries from which they import are China (mainland), Japan, and Hong Kong (U.S. Bureau of Transportation

Statistics 2004). The West Coast is significantly closer to the Asian countries than to the Eastern Coast. Hence, these statistics further demonstrate the role that geography plays in determining the international traffic. In sum, the established preference for coastal ports and the geographic location of the Great Lakes ports work to the disadvantage of the Seaway attracting international commerce from outside Canada.

Aside from geography, globalization also plays a role in affecting international commerce and world fleet traveling trends. An earlier analysis showed that the Great Lakes/ St. Lawrence Seaway region would have difficulty attracting significant portions of containership traffic (i.e., international prospects) for one of its dominant industry for waterway commerce, agricultural products. The argument could be made that if the Great Lakes/St. Lawrence Seaway region cannot attract world fleet through its grain industry, then the region should focus on attracting international commerce through its other main (waterway commerce) industry, mining. However, globalization also limits any prospects of increasing world fleet in the Great Lakes/St. Lawrence Seaway region**.** The mining products are mainly traded regionally, i.e. between Canada and the United States; according to the Great Lakes United commissioned report, the United States and Canada will likely never experience a dramatic increase in the international export of iron ore, salt, and other mined products "no matter what expansion projects are conducted on [the] ports." (Schoonover and Miller 2002, 8) The Great Lakes United asserts that the large number of lower-cost producers around the world will restrict the growth of the industry, and that expansion of the Seaway could actually harm regional mining operations by introducing substantial competition (Schoonover and Miller, 9). Thus, despite an expansion, due to the availability and choice in a wide variety of lower-cost producers, i.e. globalization, the mining industry would not necessarily generate increased international commerce and traffic**.**

There are other ways that globalization, and not necessarily Seaway size, affects international commerce in the Seaway region. For example, the Seaway may expand to become the largest navigation system in the world, but since globalization has opened countries to one another, if country X can ship cheaper to country Y's port, country X will take this opportunity rather than shipping to the Seaway. Even without expansion, this scenario has already occurred in the Great Lakes region and expansion may not be able to reverse this effect of globalization. In the Great Lakes United commissioned report (referenced earlier in the section), the Institute for Agriculture and Trade Policy made the following analysis of globalization and the other factors that have affected the Great Lakes region:

> "Globalization and the trend toward Third World manufacturing, less labor requirements in manufacturing, a sustained farm crisis, U.S. population migration toward Sun Belt and West Coast and many other issues have collectively affected the Great Lakes region to a greater degree than most other regions. There are no signs that these trends are abating and expanded navigation can neither profit from nor reverse these developments."
>
> (Schoonover and Muller, 7)

Though Great Lakes United opposes the Seaway expansion and therefore may have had other intentions when making the above assertion, the analysis reiterates the ideas that there are a wide variety of factors affecting the Great Lakes economy and raises the possibility that these economic forces may diminish or negate the effect that expansion may have on the Great Lakes/ St. Lawrence Seaway economy and its ability to attract more containerships and other world fleet traffic through expansion. If the above Great Lakes United claims are true, then expansion of the Seaway may have limited effects in increasing international commerce in the Great Lakes region. Thus, as the analysis of globalization and geography has shown, a mere focus on Seaway size as the hindrance to attracting international commerce and containership traffic ignores the other factors that are at play in determining containership and other world fleet traffic trends. These

factors may play a greater role in determining international commerce and fleet traveling trends than Seaway size.

Aside from geography and globalization, there are other issues that affect a nation's decision to use a coastal port rather than a Great Lakes port; time, for instance, is one component of the decision. Earlier it was mentioned that the primary containerized cargo, based on 2001 statistics, was all from Asian countries. For these Asian countries**,** it may be quicker and cheaper to ship directly to a West Coast port rather than circling around the United States to ship products to Great Lakes ports.

Another component of a nation's decision to use coastal ports may be the type of market in the port region. Certain goods are marketable in one region than another region because consumer preferences vary from region to region and city to city. Europe may ship only certain goods via water transportation, and these goods may have a greater demand and profitability in the coastal port region than in the Great Lakes region.

Two other possible components of the decision to use coastal ports are the ports' distance from the final destination of the goods and the established relationship between the port and the country involved. A product's final destination is not always at the port at which it arrives, but a nation may choose the port that is closest to the product's final destination. Hence, if a product's final destination is Las Vegas, then a nation would more likely ship it to the Los Angles port or other Gulf Coast port than to a Great Lakes port; the Seaway expansion will not make it less likely for the nation to ship to the Great Lakes port when a coastal port would be closer to the product's final destination.

In addition to a product's final destination, a nation's relationship with a port also influences its decision to use a coastal port. If a nation has had an established practice of

shipping to the coastal port, then it is doubtful whether the company will suddenly change its trading patterns as a result of expansion. The bottom line for international commerce decisions is increasing profits and decreasing costs to the exporting and importing nations, and the nations choose to export to U.S. coastal ports because it provides them with the most economic benefits. A nation may not be willing to sacrifice established, known economic benefits of shipping at a costal port to unknown and possibly limited benefits at the expanded St. Lawrence Seaway.

All the above mentioned factors may account for the reasons that the coastal ports are more profitable and attract more world fleet/international commerce than the Great Lakes/St. Lawrence Seaway ports. Seaway expansion may not change these trends right away. As stated above, these factors are independent of Seaway size; Seaway size may play some role in a nation's decision making process, but other factors, such as time, product destination, and regional market, contribute just as greatly, or even more, to a nation's decision making process.

In the near future, the abovementioned factors or other variables that currently favor coastal ports may alter to favor the Great Lakes ports. For example, traffic congestion is becoming problematic at West coast ports, and the traffic congestion may lead some ships to go to Great Lakes ports. It is important to note that the shift to the Great Lakes ports would be the result of traffic level at the West Coast ports and not necessarily due to Seaway expansion. When discussing the previous example and the other previously mentioned issues that influence port traffic, the point to keep in mind is that the Seaway size is not the only factor in the decision to use coastal ports, and thus it is difficult to say that the Seaway expansion will have enough effect to counter the other factors at play.

In sum, this section used waterway commerce statistics and Seaway trading patterns to establish the uncertainty of increased international commerce through Seaway expansion. I further

supported this doubt about greater international commerce by pointing to the roles that geography and large scale economic factors (such as globalization) limit international commerce in the Great Lakes region and by outlining the reasons that expansion may not be able to alleviate the effects of these conditions.

However, now that the economic arguments against expansion have been presented in this and the previous section, some readers may have the following unaddressed points:

1) Containerships don't carry the goods that are dominant on the Seaway because they currently cannot enter the Seaway. An expansion would allow containerships to go through the Seaway and containerships could possibly carry the dominant Seaway commodities.

2) The presented arguments assumed that transport traffic would shift from the current Great Lakes fleet to the containerships, but an expansion could possibly allow local fleet to continue to transport local commodities as usual while adding containerships as additional traffic.

3) An expansion may make containerships a cheaper and quicker mode of transport of goods moving from one U.S. region to the Midwest. For example, currently, China may ship goods via containerships to the West, and from there, the goods may go by rail or truck to the Midwest. However, if an expansion were to take place, then rather than lie upon rail or truck modes to get the ship goods to the Midwest, China could possibly ship directly to the Midwest using containerships.

All of these points are valid, but, as I lacked the data, I could not construct the economic models to determine whether, given the chance to enter the Seaway, containerships would indeed be a cheaper mode of transport or carry dominant Seaway goods. Though my economic analysis remains incomplete, the arguments I have made thus far serve to question the extent to which containership and international trade patterns can be changed.

In addition to attracting more world fleet, the Army Corps's other justification for expansion is that jobs will be created in the Great Lakes region. In the next section, I will further explore this claim. In addition, I will highlight some issues that may be overlooked when

discussing benefits of the St. Lawrence Seaway expansion- though the Great Lakes region may reap economic benefits from the expansion, expansion may also result in economic and environmental losses, and place a disproportionate burden on some groups of people. The following two sections will explore to what extent these negative effects of expansion may undermine the expansion policy.

Job benefits and potential economic losses

In its Reconnaissance Report, the U.S. Army Corps of Engineers projected increases in employment if the Seaway were expanded to accommodate vessels with a 35 feet draft, 110 feet width, and 100 feet length. In projecting the increases in employment, the U.S. ACE assumed that the expansion would increase the container and bulk freight traffic at Great Lakes ports and the larger traffic would result in direct and indirect job opportunities on the Seaway system. The following table shows the US ACE's projected total employment benefits from an improved Seaway.

Table 6. Total Production, Income, and Employment Annual Benefits

	Production ('000$)	Income ('000$)	Employment
Direct and Indirect Impacts			
U.S. Great Lakes	$ 465,177	$ 91,377	2,040
Ontario	$ 198,357	$ 46,718	1,472
Quebec	$ 73,215	$ 18,524	623
Sub-Total Great Lakes	$ 736,749	$ 156,619	4,135
Eastern United States	$ (43,651)	$ (5,450)	-237
Western United States	$ 38,719	$ 5,901	132
Central United States	$ 394,248	$ 90,953	2,841
Eastern Canada	$ 6,973	$ 2,048	72
Western Canada	$ 111,106	$ 25,015	794
US, Can.(includes Great Lakes)	$ 1,244,144	$ 275,085	7,737
Imports	$ 102,485	$ 17,181	333
Total US/Can Direct & Indirect	$ 1,346,630	$ 292,267	8,070

(U.S. Army Corps of Engineers 2002, Appendix: 6-22)

The table does not specify the types of new job opportunities, but I will make a rough analysis of the possible direct and indirect job opportunities that may arise from the St. Lawrence Seaway expansion. If the expanded Seaway attracted more containerships and consequently more international commerce, then direct job opportunities would include management of containership and other world fleet traffic and unloading and transporting goods to land modes of transportation. Possible indirect job opportunities would include those in the truck and rail industry; with a theoretical increase in commodities transported on the expanded Seaway, there would be a greater demand for land modes of transportation (i.e., rail and truck) to transport the additional quantity of goods from the St. Lawrence Seaway region. Furthermore, if an expanded Seaway increases commerce in the Great Lakes region, then this prosperity may boost the local economies at the Seaway ports, and better economies may spur jobs opportunities in sectors not directly related to the Seaway.

However, job projections are often difficult to make because there are a wide variety of social and economic factors, (e.g., labor and production costs) that affect job creation and job projections do not always reflect the conditions and the scale of the factors that will be interacting when the policy is implemented. Seaway expansion would theoretically provide jobs but if, when expansion is completed, labor costs are high or the national economy is down, then the number of jobs created may be on the lower end. Thus, job projections may sometimes overestimate the number of employment opportunities, and this makes the Army Corps of Engineers' job projections speculative at best.

It is therefore uncertain the amount of employment opportunities that expansion would really create. Expansion may actually result in job losses. The Army Corps predicts an increase in the number of jobs in the Great Lakes/St. Lawrence Seaway regions, but the increase in

employment opportunities may be only in that region and in particular business sectors, and may come at the expense of other regions in the United States or other business sectors. In the Reconnaissance Report, the Army Corps of Engineers addresses this problem. The Army Corps states that the expansion would induce traffic to shift from such ports as New York/New Jersey, Baltimore, and Philadelphia to Seaway ports (i.e., Buffalo, Chicago, and Detroit) but the overall net national impact would be zero as the Great Lakes/St. Lawrence Seaway region would benefit to the disadvantage of the other U.S. and Canadian ports (U.S Army Corps of Engineers). The following table illustrates the potential loss to different regions of the United States if the expansion were to induce a shift in port traffic. Thus, the expansion would not be adding any economic value to the nation, but rather shifting the position and economic value of jobs from one region to another.

Table 7. Economic Impacts of Shift-of-Port Activity

	Production ($1000 dollars)	Income ($1000 dollars)	Employment (jobs)
Direct and Indirect Impacts in the United States and Canada			
In the Great Lakes region			
U.S. Great Lakes	180,862	30,476	672
Ontario	9,678	2,115	39
Quebec	-17,360	-2,948	-75
Total regional impacts	173,180	29,643	636
Outside of the Great Lakes			
Eastern United States	-114,484	-19,440	-419
Western United States	-5,663	-1,170	-21
Central United States	-113,311	-19,050	-419
Eastern Canada	-8,702	-1,465	-32
Western Canada	27,631	4,981	128
Total outside impacts	-214,529	-36,144	-763
Total United States and Canada impacts (includes GLNS/SLS)	-41,349	-6,501	-127

Data Source: U.S. Army Corps of Engineers, *Information Paper: Great Lakes Navigation System Review, Economics Appendix, Attachment 6*, June 2002.

(U.S. Army Corps of Engineers, Appendix: 6-22)

In addition to the negative employment effects in non-Great Lakes regions, certain job sectors and industries in Great Lakes would be adversely affected by the expansion. For example, expansion would facilitate the increased entry of invasive species. Invasive species would pose a threat to recreational and commercial industries by reducing the ability of the Great Lakes food web to produce the same volume and type of fish and outright eliminating economically important fish species (Schoonover and Muller 2002, 15). (The full economic and environmental effects of invasive species to the Great Lakes region will be discussed in the following section.) Because the recreational and commercial industries generate $4 billion per year and support 81,000 jobs, the greater number of invasive species in the Great Lakes/St. Lawrence Seaway region would likely result in economic losses to these industries. Therefore, though the expansion would produce more employment opportunities at ports and also in overland transportation, the expansion would result in a loss of jobs and revenue in other sectors in Great Lakes region that are dependent upon the Great Lakes/St. Lawrence ecosystems (Schoonover and Muller 2002, 15).

In addition to effects on job sectors and regions, specific groups of people might be adversely affected by the expansion. One of these groups was mentioned in the background/theory section: the Mohawk Council of Akwesasne. At the stakeholder meetings in 2004, the Mohawk Council of Akwesasne testified about the impacts that the current Seaway system has had on their lifestyle; based on their past and current history with the Seaway, I can project the impact an expanded Seaway may have on this group**.** For instance, in their testimony, the Akwesasne state that the commercial traffic in the navigation channel of the Seaway has resulted in shoreline erosion, and the erosion of shoreline property has resulted in significant costs to the individual landholder and to the community at large (Mohawk Council of

Akwesasne). Therefore, after the Seaway was expanded, the potential increase in containership and other world fleet traffic would potentially increase shoreline erosion and would impose greater costs on individuals and the community at large. Furthermore, according to the Mohawk Council of Akwesasne, the Seaway construction resulted in the degradation of the aquatic environment and transformation of the St. Lawrence ecosystems and this has resulted in significant disruption of the Mohawk fishery, a key component of the Mohawk economy (Mohawk Council of Akwesasne). The Seaway construction also changed the water levels of the St. Lawrence River, and the change in water levels has led to a reduction in waterfowl and forage for cattle for the Akwesasne (Mohawk Council of Akwesasne). Thus, the current Seaway has already had significant negative environmental and economic impacts on the Akwesasne, and these impacts can lead one to conclude that the Seaway expansion may further degrade the environmental and economic components that are pivotal to their lifestyles.

This section has shown that expansion may result in a negative impact to different regions in the United States as well as to certain industries and people who depend upon the Great Lakes for their survival. The mere fact that expansion would not add economic value to the United States is enough proof to discredit the U.S. Army Corps of Engineers' arguments for expansion. However, the environmental costs can also show why the Seaway expansion would not be beneficial. The next two sections will focus on the environmental impacts of expansion and specifically delve into the economic and environmental effects of invasive species.

Environmental impacts of expansion: The expansion process and containerships.

Earlier, I stated that the organizations Great Lakes United and Save the River were opposed to the expansion on an environmental basis. A few of their arguments will be presented in this

section, and their argument concerning invasive species will be considered separately in the following section.

Analysis of environmental effects of expansion must begin with the expansion process itself. The Army Corps of Engineers seeks expansion to accommodate Panamax size ships; these ships are 1000 feet long, 110 feet wide, and have a 35 foot draft (U.S. Army Corps of Engineers). According to Great Lakes United and Save the River**,** the following adjustments would have to be made:

1. "[The] St. Lawrence River and dozens of harbors will need to be deepened as much as 9.5 feet.

2. In areas of soft bottom, the shipping channels (which include St. Lawrence, Detroit, St. Clair and St. Mary's Rivers) will need to be widened to as much as 60 feet to stabilize the deeper ditch.

3. Islands bordering the current ship channel will have to be blasted in order to accommodate larger vessels. "
(Lake Ontario Keeper 2002, 23)

To execute the above adjustments to the Seaway, the Army Corps of Engineers states that dredging would be required and could generate hundreds of millions of cubic yards of material requiring placement (Lake Ontario Keeper 2002, 23). In one of their opposing arguments to the expansion, Great Lakes United and Save the River state that dredging will have short and long term adverse impacts on the environment. (Lake Ontario Keeper 2002, 23) According to the organizations, the short-term impacts of dredging hundreds of millions of cubic yards of river bottom would include destruction of valuable fish habitat and re-suspension of contaminated sediments into the water column (Lake Ontario Keeper, 23). The long term effects would include the necessity of maintaining the deeper channels on a regular basis and this maintenance would limit the chance of regeneration of fish habitat and would repeatedly re-suspend contaminated

sediments (Lake Ontario Keeper, 23). The U.S. Environmental Protection Agency (EPA) supports their claim about the negative environmental effects of dredging. In a 1999 report on the environmental impacts of transportation, the EPA writes:

> "Maintenance dredging… entails dredging a particular channel periodically to sustain a prescribed depth, can prohibit recovery. Dredging can also alter natural water circulation patterns, which can affect ecosystems in a variety of ways, such as through increased or decreased salinity. Dredging (and other navigation improvements) results in the accumulation of extensive amounts of material from the bottoms of bodies of water."
>
> (U.S. Environmental Protection Agency 1999, 147)

As the above analysis shows, dredging for expansion would not be a one time activity that would have short term environmental impacts, but rather, would be a repeated activity because the deeper channels would require maintenance dredging. Because a one time dredging activity negatively affects an ecosystem, repeated maintenance dredging would consistently alter the ecosystems and thus have a long-term impact on the modified portions of the Seaway.

The EPA provides more detail on other environmental effects of dredging. The EPA states that there are two main disposal methods for dredged material: land disposal or open water disposal. Since the EPA provides a more in-depth analysis of the latter, only its impacts will be presented below:

> "Disposal of dredged material has the potential to cause far-reaching environmental impacts … Disposal in open water can alter bottom habitats, decrease water quality, and harm marine organisms. Repeated disposal at a site can form mounds in bottom habitats, because most material sits where it is dumped. Disposal of dredged material in open waters can affect water quality by physical means, such as increasing turbidity, or chemical means, such as raising pollutant concentrations. Open water disposal can harm marine organisms in a number of ways. Benthic organisms can be killed by physical burial under dredged material. A more widespread effect of disposal on marine fauna is uptake of toxics. Contaminants may impact the benthic community even if dredged material is capped, and larger animals may ingest contaminants either directly or indirectly through feeding on smaller animals."
>
> (U.S. Environmental Protection Agency 1999, 148)

The EPA's analysis demonstrates that the dredging required for expansion will be harmful to the environment and would likely have far-reaching short and long-term effects.

Great Lakes United and Save the River's other environmental objection against expansion involves the effects of deeper and wider channels on the Great Lakes/ St. Lawrence River ecosystems. Great Lakes United and Save the River's opposition to the deeper and wider channels is that they would significantly modify the hydrologic system by increasing flows through connecting channels and cause major modifications to lake levels throughout the system (Lake Ontario Keeper 2002, 23). According to Great Lakes United and Save the River, the modifications to the lake levels would result in lower levels of Great Lakes upstream of river channels and the greater amount of water flow throughout the system would increase the risk of flooding wetlands and low lying shorelines in downstream areas (Lake Ontario Keeper 2002, 23). To prevent flooding of the downstream areas, Great Lakes United and Save the River claim that the government would need to build compensating works such as dams; however these structures, in particular dams, would affect water temperature and dissolved oxygen concentrations, two of the most important physical factors affecting all aspects of fish life stages (Lake Ontario Keeper 2002, 23) Thus, the environmental impacts of the expansion process itself raise serious doubts about whether a Seaway expansion would be beneficial to the Great Lakes region.

The second aspect of the environmental assessment will focus on the traffic component of the Seaway expansion. Expansion of the Seaway will theoretically result in drawing containership traffic and increasing other types of vessel traffic. Indeed, this increased traffic is main reason the Army Corps of Engineers is in favor expanding the Seaway. In the background/theory section, I had pointed to the potential environmental benefits of the greater

vessel traffic; if, as the U.S. Army Corps of Engineers claim, an expanded Seaway would induce traffic to shift from overland modes to the Great Lakes routing (i.e., train/rail shipment to containership or other vessel shipment) then, as I had claimed, the shift would be environmentally beneficial because containerships, in particular, would carry more cargo per trip than trucks and rail and thus there would be less air pollution due to a lesser number of trucks and trains on the highway and rail systems[1]. However, there are two problems with this scenario. First, as discussed earlier, it is not clear if the shift from land modes to containership shipment would occur and there needs to be more research on whether significant amount of diversion and significant amount of diversion would be needed to greatly reduce air pollution. In the Reconnaissance Report, the U.S. Army Corps of Engineers themselves acknowledged that a complete shift form land mode to water mode would be highly unlikely. Thus, it is difficult to state with certainty if the environmental benefits of a shift would be realized given the doubt on how much traffic would divert from land to water mode.

The second problem is that containerships themselves are a bigger source of air pollution than trucks and automobiles and are also a source of other environmental problems. Containerships, and other cargo vessels, are a leading source of smog-forming nitrogen-oxides (Welch). Their exhaust contains dozens of known carcinogens and is high in particulate matter (fine particles of pollution that lodge in lungs), which leads to asthma, respiratory problems, and death (Welch). The following numbers put into perspective the amount of pollution that containerships produce: sixteen containerships produce as many smog forming emissions as one

[1] Though the Army Corps of Engineers wants to attract a greater number of world fleet ships (which includes a wide variety), I will focus primarily on containerships as the main thrust of the Army Corps of Engineers argument for expansion is to accommodate containerships. However, some of the environmental effects of containerships can be attributable to marine vessels in general, and this will be noted in the results section. Furthermore, to understand the potential environmental effects of containerships, I will again have to suspend the argument made in the first section of the results portion about the types of commodities that containerships transport and the types of fleet used to transport the primary waterway commerce commodities in the Great Lakes region. Therefore, I will assume that containerships will transport a wide variety of goods.

million cars (Blue Water Network). Thus, the use of containerships in the Seaway region would *increase,* not decrease, pollution in the Great Lakes region.

Los Angeles, CA is proof of the negative environmental impacts associated with containerships. As mentioned earlier, Los Angeles is top containership port in the United States. In 2004, the American Lung Association listed L.A. as the most polluted city by year round air particle pollution, and some of this air pollution may be attributed to the containership and other vessel traffic at the ports. Because Los Angeles attracts high amounts of containerships, the high emissions stemming from the large number of containerships has been one of the contributing factors of increasing the cancer risk among residents of Los Angeles (as well as in Long Beach, CA which also attracts high containership traffic), specifically those living near the ports (Blue Water Network).

Another effect of containership emissions is climate change. Containerships and other maritime vessels release greenhouse gasses such as carbon dioxide (CO2), methane (CH4), and nitrous oxides (NO_x) into the atmosphere**,** and as these gases are responsible for increasing temperature on the earth; therefore, containerships and other maritime vessel emissions contribute toward global climate change (U.S. Environmental Protection Agency). Global climate change, in turn, increases the possibility of rising ocean levels and increased catastrophic weather activity (U.S. Environmental Protection Agency).

Containership air emissions also indirectly increase water pollution; the fine particles from the containership exhaust and other potentially toxic particulate matter air pollution may deposit into drinking water soils or surface waters, where they are taken up by plants and ingested by animals and are eventually magnified up through the food chain. (U.S. Environmental Protection Agency) Thus, the air particulate from containerships emissions can

lead to water pollution, which consequently affects human health and leads to disruption of ecological relationships.

A 1999 Environmental Protection Agency (EPA) report entitled "Indicators of the Environmental Impacts of Transportation" fully delineates the negative environmental effects of containership and other marine vessels. According to the EPA report, wakes from large (such as containerships) or fast-moving vessels can cause erosion and vegetative in confined or shallow waters (U.S. Environmental Protection Agency 1999, 166). Furthermore, wakes can cause strong wave propagation that can stir up bottom sediments in shallow areas (U.S. Environmental Protection Agency 1999, 166). Sedimentation is particularly problematic for vegetation because it reduces the amount of sunlight available for photosynthetic processes (U.S. Environmental Protection Agency 1999, 166). The EPA also states that the impacts of wakes are local in nature and likely to be more pronounced in confined, high traffic areas (U.S. Environmental Protection Agency 1999, 166). As the Army Corps of Engineers anticipates the Seaway expansion attracting higher traffic, wakes from containership and other vessel traffic will therefore be highly disruptive to the local port and regional (i.e., Great Lakes) ecosystems in the St. Lawrence Seaway.

The addition of containership traffic and greater vessel traffic would also raise the probability for oil and non-petroleum spills to occur in the Great Lakes/St. Lawrence Seaway region. Releases of hazardous materials, especially petroleum products, from vessels are one of the most publicized impacts of maritime transportation (U.S. Environmental Protection Agency 1999, 167). Oil spills have a detrimental impact on both the aquatic and human environment. When an oil spill occurs, toxic hydrocarbons, such as benzene and toluene, are released into the aquatic environment and cause immediate wildlife deaths (U.S. Environmental Protection

Agency 1999, 168). In the 1999 report, the EPA listed some of the environmental effects of oil spills:

> "Shellfish and non-migratory fish, especially those in the larval stage, are the most susceptible to these chemicals. Other chemicals form sticky, tar-like globs on the surface that adhere to marine wildlife such as birds, otters, and seals, as well as to sand, rocks, and almost all other substances. Many animals that come into contact with such chemicals die from drowning or loss of body heat. Heavy components of oil that sink to the bottom of bodies of water may have the most profound impacts on ecosystems. Such pollution can kill or damage benthic organisms and adversely affect food webs. Studies of some oil spills have shown that it takes most species of marine life three years to recover from exposure to large quantities of crude oil. Recovery times may be much longer (10 or more years) for exposure to refined oil, especially in areas with weak currents or cold waters."
>
> (U.S. Environmental Protection Agency 1999, 168)

As per EPA analysis, the oil spills that result from vessel activity have a lasting ecological impact that cannot be easily remedied. With the greater number of containership and other vessel traffic in the Great Lakes /St. Lawrence Seaway region, there would be a greater risk of severe oil spills, which could have drastic effects on the Great Lakes ecosystem.

The EPA also discusses the impact that oil spills and other non- petroleum spills would have on human communities and on ecosystems:

> "Oil pollution in the vicinity of shorelines can cause ecological harm in coastal ecosystems. Humans also experience health effects from oil spills. Exposure is dependent on how much oil washes ashore and how much seafood is contaminated and eaten. Some of the chemicals resulting from spills, such as benzene, are highly toxic to humans. Ecosystems and humans also experience impacts from maritime spills of non-petroleum hazardous waste. Such spills can lead to wildlife kills, unswimmable and unfishable waters, shellfish bed closures, and human exposure through contact and food."
>
> (U.S. Environmental Protection Agency 1999, 168)

The above analysis would thus make clear that though there may be some environmental benefits from a shift in the domestic mode of commodity transport to the water mode, these environmental benefits from a modal shift would likely be outweighed by the negative

environmental effects of containership and increased traffic in the Great Lakes region. To sum up this section, I have shown that the expansion process and the increased containership traffic would likely inflict damages to the environment. These environmental costs must be weighed in evaluating whether expansion is justifiable. In the following section, I will look more closely at the biggest environmental threat that expansion poses: increase in invasive species.

Environmental effects of expansion: Invasive species

Opponents of expansion, including Great Lakes United and Save the River, use the negative impacts of invasive species to support their case. In the analysis of the negative economic impacts of expansion, I had discussed that expansion would result in increased entrance of invasive species into the Great Lakes region and that invasive species would have environmental and economic consequences, such as disruption of the food web and the elimination of economically significant fish. Below, I will provide further information on how invasive species arrive in the Great Lakes, establish that invasive species are already a problem in the Great Lakes region, and prove that expansion would only compound the problem. I will also use current policy problems to demonstrate that expansion will not be beneficial in aiding the Great Lakes in their fight against invasive species.

To review, invasive species are non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human health (U.S. Environmental Protection Agency). Once established, it is extremely difficult to control their spread (U.S. Environmental Protection Agency).One of the primary sources of invasive species is the ballast water of boats. About 30% of current non-indigenous introductions can be definitely attributed to a ship source, and the majority of this percentage is considered to be ballast water introduction (Claudi and

Wiley 1999, 207). Again, in review, ballast water is internal water tanks located in various locations in the ship. These tanks are filled or emptied according to amount of cargo that the ship carries, providing balance and buoyancy when required. The water is taken in through underwater intake ports, and discharged at final destination spot (Claudi and Wiley 1999, 205). Throughout this process of water intake and discharge, invasive species are taken in from one location and transported to another destination. Thus, because of the use of ballast water by ships, boat activity has facilitated and continues to facilitate the introduction of invasive species into the Great Lakes region. In turn, as will be illustrated through specific examples, some of these invasive species that have entered via vessel activity have resulted in permanent alterations in the Great Lakes ecosystem and have become some of the biggest environment and economic problems to the Great Lakes region. It then follows that if invasive species are already a problem in the Great Lakes region, and if the Army Corps's claims are true that an expanded seaway would draw more containerships and increase boat traffic, then, given the fact that ships are one of the main sources for entrance of invasive species, the increased traffic will bring with it more invasive species into the Great Lakes region.

The Great Lakes history of introduction of invasive species through marine vessel activity demonstrates the potential problems of increased traffic in the region. The introduction of invasive species into the Great Lakes is a result of the canals that were built in the early 1800s as well as to the opening of the St. Lawrence Seaway. The advent of the canal building fever in North America in the early 1800s resulted in Lake Erie being accessible from the Hudson River by 1825 and Lake Ontario from the St. Lawrence by 1847 (Claudi and Wiley 1999, 204). The opportunity was provided for organisms to be transported upstream on vessels using these canals (Claudi and Wiley 1999, 204).

In their essay, “Freshwater Nonindigenous Species: Interactions with Other Global Changes,” Cynthia Kolar and David Lodge (2000) provide a historical example of an invasive species and the effects of its introduction into the Great Lakes. Kolar and Lodge write that the sea lamprey was one of the first high impact species to enter the Great Lakes via canals and most probably gained access through its attachment to the hull of ships. The sea lamprey is a parasitic fish that attaches to a large fish and sucks its fluids. It was first discovered in Lake Erie in 1921 and Kolar and Lodge (2000) state that by 1946, the sea lamprey became established in all the Great Lakes, and had contributed to dramatic declines in lake trout populations and localized extinctions of lake trout in 415 lakes. They also preyed heavily on burbot fish and larger whitefish species and this predation led to their extinction of these species (Kolar and Lodge 2000, 8). As a result of its predatory behavior, the sea lamprey distorted the historical food web. Figure 7 shows the historical food web and the changes that the sea lamprey and other invasive species have caused to this food web.

Figure 7. Historical Food Web versus Modern Food Web (with invasive species)

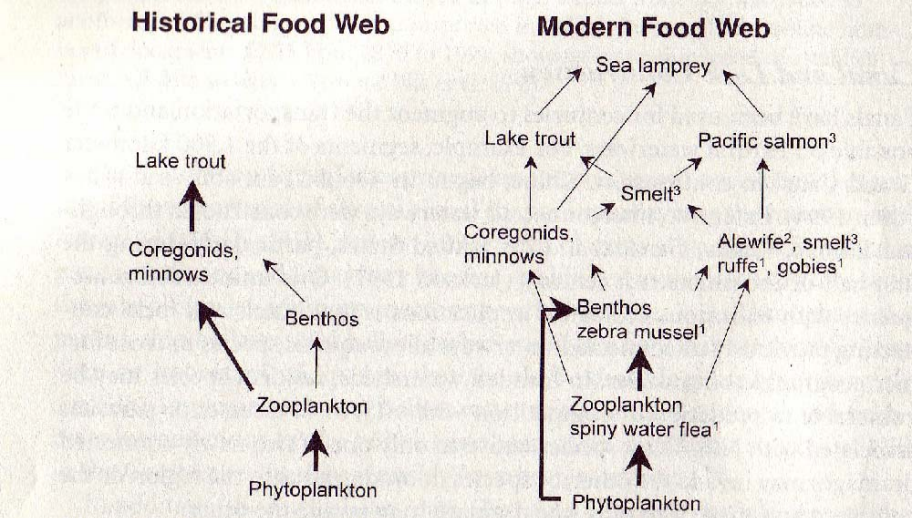


Figure 1.2. Major taxa in the historical and current food webs in the Laurentian Great Lakes, emphasizing the many NIS in the current food web. Bolded components show primary pools and flows (arrows) of energy, which have been transformed by NIS. Superscripts indicate global change that allowed introduction of NIS: 1 = shipping; 2 = canals; 3 = fisheries management.

(Kolar and Lodge 2000, 8)

The figure above thus shows the effect that a relatively small number of invasive species have had on the ecological relationships in the Great Lakes; the figure can be used as an indicator of what might happen if containerships and other world fleet are coming from different ecosystems that vary from the Great Lakes region and bringing along with them species that do not fit into the ecosystem dynamics of the Great Lakes region. Furthermore, even though these vessels may introduce a relatively small number of new species, the above figure shows that even small number of species can have profound effects.

The effects after the St. Lawrence Seaway opening is further proof of the link between greater vessel traffic and greater invasive species in the Great Lakes region**.** The opening of the St. Lawrence Seaway in 1959 also helped to increase the rate of non-indigenous aquatic introductions into the Great Lakes. The Seaway opening allowed transoceanic ships to enter and also brought down the economic barriers to entry of ships carrying ballast (Claudi and Wiley 1999, 207). Because ballast water is one of the primary means of transporting invasive species, the increase in ballast water carrying ships, along with the increase in the number of ships entering the Great Lakes region, contributed towards increasing invasive species in the Great Lakes region (Claudi and Wiley 1999, 207). For example, in the century and a half between 1810 and 1959 there were only 90 introductions of invasive species; however, upon the opening of the Seaway and increased vessels with ballast, in the thirty years between 1960 and 1990, there were 43 introductions (Claudi and Wiley 1999, 207). In another words, 90 introductions of invasive species in 149 years is roughly .60 species/ year, while 43 introductions in 30 years is roughly 1.43 species a year. These statistics demonstrate that the rate of invasive species introductions from 1960 to 1990 is 2.4 times the rate of introductions from 1810 to 1959. Thus, the above data demonstrate the significance that greater amounts of foreign vessel activity have had on the introduction of invasive species into the Great Lakes region**.**

Invasive species bring not just ecological costs, but also economic ones, as we can see from the case of the zebra mussel. The Seaway's opening to transoceanic vessels enabled zebra mussels to enter the Great Lakes region. The zebra mussel was first introduced into Lake St. Clair in 1985 or 1986 via ballast water and spread to the Great Lakes region within just two years (U.S. Environmental Protection Agency). Zebra mussels are currently one of the most environmentally and economically detrimental species to the Great Lakes region**.** Its

environmental effects include nearly eliminating the clam population, reducing the available food and oxygen for native fauna, and disrupting the food supply through its feeding processes (U.S. Environmental Protection Agency). Zebra mussels are also responsible for clogging water intake pipes, water filtration plants, and power generating plants, and as a result, municipalities and larger industries in the Great Lakes each pay, on the average on average, $360,000 per year to control zebra mussels, with documented cumulative basin-wide costs of $120 million from 1989 to 1994 (U.S. Environmental Protection Agency). Furthermore, the U.S. Fish and Wildlife Service estimates the potential economic impact of zebra mussels at $5 billion over the next ten years to U.S. and Canadian water users within the Great Lakes region alone (U.S. Geological Survey).Given the economic and environmental costs the Great Lakes region faces from just one species, zebra mussels, increased vessel traffic will likely add to these costs significantly because they will bring dozens of new invasive species into the region.

The above paragraphs have thus shown why increased world vessel traffic will likely contribute to the increase in invasive species in the Great Lakes region and subsequently a rise in the region's environmental and monetary costs. These costs will likely be exacerbated by the lack of effective federal and regional policies to cope with invasive species.

For instance, in 2003, the U.S. Government Accountability Office (GAO) presented and released a report entitled "Invasive Species: Federal Efforts and State Perspectives on Challenges and National Leadership." Highlights from the report are presented below:

1) "while national management plan calls for many actions that are likely to preventing and controlling invasive species in U.S., does not provide specific long-term goals towards which the government should strive."

2) "current federal efforts are not adequate to prevent the introduction of invasive species into the Great Lakes via the ballast water of ships. Although federal official believe that more should be done to protect the Great Lakes from ballast water charges, their plans

for doing so depend on the development of standards and technologies will take many years."

3) "More recently, state officials who responded to the GAO's survey identified a number of gaps in or problems with, existing legislation addressing invasive species and other barriers to managing invasives. Many states identified the lack of legal requirements for controlling invasive species that are already established or widespread as key gap in legislation addressing both aquatic and terrestrial invasive species. State officials also recognized ineffective standards for ballast water as a major problem in aquatics legislation. Regarding barriers to managing invasive species, state officials identified a lack of federal funding for state invasive species efforts, public education and outreach, and cost-effective control measures as major problems."

(U.S. Government Accountability Office 2003, 2-5)

The current federal policy problems in the management of invasive species would make it difficult to adequately address and combat the invasive species that would arrive if the Seaway were expanded. The new invasive species in the Great Lakes region would increase the policy problem of invasive species because targeted management programs would have to be developed to address the specific environmental impacts of the new invasive species. Furthermore, while these management programs are being constructed, the new invasive species would increase the environmental and economic costs to the Great Lakes region.

The above paragraphs have demonstrated how greater containership and world fleet traffic in the Great Lakes/St. Lawrence Seaway would increase the number of invasive species in the Great Lakes region. Furthermore, I showed how invasive species already have negative environmental and economic impacts on the Great Lakes region and that an increase in invasive species from greater international fleet traffic would compound these effects. The current problems of invasive species management would make it difficult to adequately prevent or address the threat of any new invasive species. Therefore, the threat of greater invasive species into the Great Lakes region demonstrates that Seaway expansion would not be beneficial.

Conclusion

The U.S. and Canadian governments are not now considering expansion in their current studies of the Seaway, but they may consider expansion in the near future. Based on the arguments I have presented above, my policy recommendation is that the U.S. and Canadian governments not consider Seaway expansion in the near future. By assessing the U.S. Army Corps of Engineers' justifications for expansion, I was able to show that expansion is not sound on either an economic or an environmental basis. The U.S. Army Corps of Engineers want to expand the Seaway to accommodate containership traffic, but as I have shown, the Great Lakes region would likely not attract significant containership traffic even if the Seaway were expanded. A few of the reasons that the Great Lakes region would not attract large containership traffic include the difference between the dominant commodities transported on the Great Lakes/St. Lawrence Seaway System and those carried by containerships, the current containership preference for coastal traffic, and the Great Lakes/St Lawrence Seaway System's geographic location.

Another reason that expansion is not justified is due to its potential economic and environmental costs. The economic costs would include loss of employment of certain job sectors, a reduction of employment opportunities in certain regions of the United States, and the impact on the Great Lakes' fishing industry. Some of the environmental costs of expansion include habitat destruction, greater air and water pollution, and disruption of the ecological relationships in the Great Lakes region. Thus, for economic and environmental reasons, the St. Lawrence Seaway expansion is unjustifiable.

The arguments I presented here were based on current available data and are by no means complete. To solidify a case against the Seaway expansion, an economic model will need to be

constructed to determine whether containerships will be the cheapest method of shipping goods to and from the Midwest. Another economic model will have to focus on the likelihood that dominant Seaway goods would change from transport on current fleet to containership transport if expansion were to take place. Statistics about individual ports on the Seaway and the markets at those ports would also be useful in a cost benefit analysis of the proposed expansion. Aside from further research into the economics of expansion, more data must be collected on containership air pollution and on how containership air pollution compares with pollution from a diesel truck and train engine. These statistics would enable us to make a better assessment of which mode of freight transport causes the least amount of environmental damage. Furthermore, a model must be developed to determine whether there would be substantial diversion of land traffic to water traffic, and if so, to what extent this diversion would offset any environmental impacts of containership emissions.

In addition to further research into the economic and environmental effects of expansion, the U.S. and Canadian governments should continue to focus on the improvements that can be made to the current Seaway infrastructure and on ways the Seaway can increase commerce in the region. In the paper, I mentioned that a great deal of commerce in the Seaway is domestic or bi-national. Rather than trying to increase international commerce, perhaps the United States and Canadian governments should focus on how to increase Seaway trade between the two nations and to attract economic interest from different regions of both nations.

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