The National Dredging Needs Study of Ports and Harbors-

Implications to Cost-Sharing of Federal Deep Draft Navigation Projects Due to Changes in the Maritime Industry

As authorized by Section 401 of the Water Resources Development Act of 1999

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Executive Summary

Study Purpose

This report is one of a series of interim reports produced as part of the U.S. Army Corps of Engineers work in response to Section 402 of the Water Resources Development Act of 1992, P.L. 102-580 (WRDA'92), which authorized the National Dredging Needs Study of U.S. Ports and Harbors (NDNS). This report presents a summary of NDNS findings regarding growth in container shipping with a particular focus on the rapid increase in containership sizes and an examination of the implications to cost-sharing formulas for deep draft navigation projects. In this regard, the report also responds to Section 401 of WRDA'99, P.L. 106-53 that called for an assessment of current deep draft navigation cost-sharing rules. The current cost-sharing formula is based on Section 101 of WRDA'86, P.L. 99-662. Overall findings of the Section 402 study are presented under separate cover in the final NDNS report.

Background

Prior to WRDA'86, the Federal government paid for general navigation costs associated with dredging at U.S. ports with project sponsor's responsible for providing lands, easements, rights-of-way and relocations. This included deepening channels (construction) and maintaining channel depths (operations and maintenance). Dredging for ship berthing areas was a local or private responsibility, as were all landside improvements including terminals and equipment.

With the passage of WRDA'86, costs for deepening channels changed to include a local or non-Federal share of the costs of a project's "general navigation features" (GNFs) that increases incrementally with channel depth. For projects less than 20 feet, non-Federal sponsors pay 10 percent of the GNF costs. For projects between 20 and 45 feet, they pay 25 percent and for depths greater than 45 feet local or non-Federal sponsors are responsible for 50 percent of the GNF costs. Non-Federal sponsors are also responsible for providing the lands, easements, rights-of-way and utility relocation (LERR) costs associated with the project, and for contributing an additional 10 percent of the GNF costs, for all depths, which may be financed over a period not exceeding 30 years. The sponsor's costs for LERR, except utilities, are credited against the 10 percent cash contribution. Likewise, maintenance dredging remained fully funded by the Federal government unless channels exceed 45 feet, although the Federal costs may be recovered 100 percent from deposits of the Harbor Maintenance Tax to the Harbor Maintenance Trust Fund. However, local sponsors are responsible for 50 percent of the incremental dredging costs associated with maintaining project depths in excess of 45 feet.

Cost-sharing for projects up to and including 45 feet was considered standard, with any deepening beyond 45 feet intended to address the specialized nature of those larger vessels not used for general cargo purposes. The rationale for establishing the 45 foot depth as the threshold for the 50 percent non-Federal share was based on the composition of the world merchant fleet in 1985, and a survey of international dredging financing practices at the time. In 1985, there were no containerships that required channel depths of more than 45 feet, and it seemed implausible that containerships would grow in size. Most maritime trade routes for "general cargo" that included containerized freight such as manufactured goods were heavily dependent upon the Panama Canal, and the maximum dimensions of the Canal restricted growth in the size of containerships. This was one of the primary reasons for the 45 foot limit on the standard 25 percent cost-share for general cargo channels.

WRDA'86 rules were also based on a 1985 report by the Committee on Merchant Marine and Fisheries (CMMF), which found that most foreign governments in developed nations financed navigation improvements to depths of 45 feet to accommodate general cargo vessels. At the same time, the CMMF found that these nations required local contributions for construction and maintenance of navigation projects that exceeded 45 feet. In essence, the CMMF wished to reconcile U.S. port development policy "with prevailing international practice." The channel depths used in Section 101 of WRDA'86 reflected the characteristics of general cargo ships in the world fleet in 1985, and the policy intent of the cost-sharing formulas in the legislation. However, those depths are not consistent with the intent of the legislation given the state of the world containership fleet today.

Summary of Key Findings

Since WRDA'86 was implemented, the world containership fleet has changed dramatically. Containership size is measured by the number of twenty foot containers a vessel can carry (Twenty Foot Equivalent Units or TEUs). In the 1980s, containerships of 2,000 to 3,000 TEUs were considered the norm. These vessels could navigate the Panama Canal fully loaded and were the mainstay of the fleet. However, in 1984 a company began a regular double stack container train service between Los Angeles, Chicago and New York. Rather than sail through the Canal, it became cost effective for ships to unload containers at either coast and use rail service to transverse the continental United States. The U.S. "land bridge" made the Panama Canal much less important for container shipping. Deregulation of the transportation industry in the 1980s also had a major impact on trends toward larger containerships. After deregulation, many ocean carriers formed partnerships ("alliances") or in some cases mergers that enabled them to better absorb the costs and risks of operating larger containerships. Since WRDA'86, carriers have been building ever larger containerships in pursuit of economic efficiency and increased competitiveness.

By the late 1980s, containerships that exceeded the maximum dimensions of the Panama Canal - "Post-Panamax" ships - had entered the world fleet. These vessels have capacities of about 4,000 to 4,500 TEU. Today, containership companies are introducing even larger containerships ranging in size from 6,000 to 6,690 TEUs and by 2002, the world fleet is expected to have approximately 75 mega-containerships operated by many containership companies. There are reported plans for vessels of 10,000 to 12,000 TEUs. Deployment of these ships to U.S. ports is more an issue of when they will arrive rather than if they will arrive. To operate economically, large containerships are designed to operate at full capacity. With a full load of cargo in terms of tonnage, most containerships with capacities of 6,000 TEUs or greater need channel depths of at least 50 feet, and today only a handful of U.S. ports can meet this requirement.

U.S. ports have reacted to increased pressures from growing container traffic and larger containerships by investing heavily in landside infrastructure. From 1946 to 1998, public ports have spent nearly $20 billion on improvements to port facilities with approximately one-third of that amount spent in the last five years. Over 40 percent of new construction has been spent on container terminals. In short, it appears that public ports are making substantial efforts to provide landside infrastructure to accommodate the anticipated growth of container traffic and larger containerships. However, harbor depth remains an obstacle for many ports, particularly those along the Gulf and Atlantic Coasts where major container ports have channel depths of 45 feet or less. Failure to provide full access to large containerships may result in port congestion, greater transportation costs for cargo and higher prices for imports and exports.

Since WRDA'86, financing practices among U.S. trading partners have also changed. In 1986, many foreign governments had a depth threshold for cost-sharing. However, based on the *Evaluation of International Dredging Financing Practices* report, this no longer appears to be the case, and many foreign governments heavily subsidize dredging at deep draft ports.[1] As was the case when WRDA'86 was implemented, justifications for national subsidies for harbor projects relate directly to investments in infrastructure as a means to improve national economies. Today, many of the worlds leading container ports are keeping pace with the growth in containership size by deepening general cargo channels to depths ranging from 48 to 55 feet.

Conclusion

International trade has become increasingly important for the United States. Since 1946, the value of foreign commerce has increased by a factor of almost twenty in real inflation-adjusted terms. In 1999, it was worth $1.7 trillion. International trade has also become an important engine for economic growth. In 1999, foreign trade comprised almost 27 percent of Gross Domestic Product (GDP). Approximately 95 percent of U.S. foreign trade is waterborne, excluding trade with Canada and Mexico. Containerships carry almost 55 percent of international cargo in terms of value, and this amount is expected to increase in the future. By 2010 the amount of cargo carried by large containerships is expected to equal the amount of 1996 cargo carried by all containerships. Historically, container throughput has doubled every ten years and is expected to continue to double by 2010. The size of vessels in the world containership

[1] U.S. Army Corp of Engineers Institute for Water Resource: Report 98-R-7, September 1998, Evaluation of International Dredging Financing Practices.

fleet has grown dramatically since 1985. Containership ports around the world are deepening their navigation channels down to 15 and 16 meters (49 to 52.5 feet) and beyond, with the financing subsidized by national governments. For the United States to maintain a competitive position in global markets, a first class port system fully capable of servicing new containerships is critical. The budgets of public ports are heavily burdened with providing necessary landside infrastructure to accommodate the anticipated growth of container traffic.

The Federal role in deepening navigation channels needs to be reexamined as a matter of national policy. Specifically, the rapid growth in the size of containerships in the world fleet has resulted in the 45 foot depth used in the WRDA'86 cost-sharing rules being inconsistent with the intent of the standard cost-sharing formula for general cargo projects. The upper limit for cost-sharing deep draft navigation projects greater than 45 feet should be eliminated in light of the rapid escalation of the size of general cargo vessels, the expected continued growth in the development of ever larger containerships, and recognizing that most nations are heavily subsidizing channel deepening to accommodate general cargo for depths beyond 45 feet.

An examination of a likely potential portfolio of channel projects indicates that nineteen projects at fifteen ports may involve deepening beyond 45 feet over the next twenty years. Such a portfolio includes projects which are authorized and programmed for construction along with projects that are currently in various stages of planning, engineering or design. Consequently this portfolio has projects of varying degrees of uncertainty regarding their actual construction and should represent an upper limit for analyzing budgetary impacts from changing the WRDA '86 cost-sharing rules. If the Federal government financed 65 percent of channel deepening beyond 45 feet rather than 40 percent, estimates indicate that it would require an additional annual expenditure of about $42 million for construction and roughly $51 million in maintenance dredging. Total expenditures for construction and maintenance ($93 million) would comprise about two percent of the Corps current annual budget.[2]

Changes in the maritime industry since WRDA '86 are significant enough that the three-tier cost-sharing policy should be revised for future growth considerations to a two-tier policy by eliminating the 45 foot threshold. Increased Federal investment in harbor deepening would promote the general welfare of the Nation through increased growth in international trade during a period when foreign trade is significantly contributing to the Nation's robust economic growth. Relieving non-Federal sponsors of the added cost to deeper channels will allow for the optimal allocation of national resources. The conditions under which Section 101, WRDA '86 was implemented have changed and need to be updated for the 21st Century.

[2] See Appendix B of this report for the assumptions and data that these estimates are based upon.

1. INTRODUCTION

Expansion of the global economy and other economic pressures are altering the structure of maritime transportation. Changes in the shipping industry and growing international trade have resulted in three important trends for ports in the United States, 1) more cargo, 2) larger ships and 3) greater competition among ports.

As of 1999, imports and exports accounted for 27 percent of gross domestic product, and foreign trade is expected to increase significantly in the 21st century. Today, the U.S. imports and exports represent about $1.7 trillion worth of goods. By the year 2010, this is expected to more than double, and by the year 2040 forecasts indicate that imports and exports will increase eightfold. With the exception of overland commerce between the U.S, Canada and Mexico, 95 percent of international cargo is transported by ocean, and over 90 percent of all international maritime trade, enters or exits the U.S. through federally maintained navigation channels at U.S. ports.

In response to a growing world economy, sizes of cargo ships have evolved over the years. For example, since the Second World War the size of oil tankers has grown significantly as global demand for petroleum has risen sharply. Today, tankers are among the largest vessels in the world, however the size of tankers peaked in the 1970s and 1980s. Ships that transport grain, coal and other dry bulk commodities have also grown significantly in the second half of the 20th century, but today there does not appear to be a trend toward larger bulk vessels. In contrast, ships that transport goods in containers are rapidly growing in size. Containership capacity is measured by the number of twenty-foot containers a vessel can carry (Twenty-Foot Equivalent Units or TEUs). Until recently, containerships of 2,000 to 3,000 TEUs were the mainstay of the containership fleet. In the mid 1990s, vessels of more than 4,000 TEUs became standard and ships of 5,000 TEU range were considered larger than average. Today, containership companies are introducing vessels that range from 6,000 to 6,690 TEUs, and there are reports of plans for ships in the 10,000 to 12,000 TEU ranges. Large ships are more economical, but they are limited in the ports they can enter because of draft constraints.

Ocean carriers are merging, forming alliances and establishing partnerships to strengthen their bargaining power and profitability. To reduce costs and raise profits, carriers are consolidating cargo onto larger ships and calling on fewer ports known as hubs or load centers. Ports that want to serve as hubs must have infrastructure capable of handling large volumes of cargo rapidly and efficiently. Channel depths are critical, particularly for ports that want to serve new generations of containerships. For example, in mid-1998, Maersk/SeaLand requested terminal facility plans for a hub center from the ports of New York/New Jersey, Halifax, Hampton Roads, Baltimore, Philadelphia and Quonset Point, Rhode Island. Maersk/SeaLand wanted up to 16 modern high-tech cranes with 6,000 feet of adjacent berth, on-dock or near-dock rail linkages, and the ability to handle 550,000 container lifts per annum. The Port of New York/New Jersey was selected to serve as a regional hub for Maersk/SeaLand. However, Maersk/SeaLand stipulated that the port must deepen its harbor channels to accommodate a new line of containerships being introduced by Maersk/Sea-Land. In 1996, Maersk/Sea-Land deployed the *Regina Maersk*. Longer than the Eiffel Tower is tall and equal in length to 3.5 football fields, the *Regina Maersk* was the first of a series of 21 of the world's largest containerships. Fully loaded by deadweight tonnage, she has a draft of 46 feet and requires channel depths of 51 feet. Currently, only a handful of ports in the United States have channels deeper than 50 feet. In 1998, Maersk/SeaLand launched its new "S" class of containerships, which are currently the largest containerships in the world. These ships have drafts of 47.5 feet and require channel depths of 53 feet.

Study Purpose

Section 402 of the Water Resources Development Act of 1992, P.L. 102-580, (WRDA'92) authorized the U.S. Army Corps of Engineers to conduct a study assessing dredging needs at deep draft ports in the United States. This report is one of a series of interim reports of the National Dredging Needs Study (NDNS) and presents a summary of NDNS findings regarding growth in the world containership fleet with a particular emphasis on the rapid increase in the sizes of containerships and an examination of the implications to cost-sharing for deep draft navigation projects. In this respect, the report also responds to Section 401 of WRDA'99, P.L. 106-53 that called for an assessment of current deep draft navigation cost-sharing, which is based on Section 101 of WRDA'86, P.L. 99-662. The overall findings of the Section 402 study are presented in the final NDNS report.

Current Cost-sharing Policy

Prior to WRDA'86, the Federal government paid 100 percent of "general navigation features" (GNFs) of harbor projects that consisted primarily of harbor dredging. Lands, easements, rights of way and relocations (LERRs), and dredging for berthing areas were a local or private responsibility, as were all landside improvements including terminals and equipment. All maintenance dredging was federally funded out of general revenue. With the passage of WRDA'86, cost-sharing for "general navigation features" changed to include a local or non-Federal share as shown in Table 1-1. Maintenance dredging remained 100 percent federally funded; however today Federal costs may be recovered 100 percent from deposits of the Harbor Maintenance Tax to the Harbor Maintenance Trust Fund. For projects greater than 45 feet, the Federal share is reduced to 50 percent of project cost. It should be noted that the additional non-Federal share of 10 percent in the form of cash can be offset by up to 10 percentage points by a credit for land, easements, rights of way and relocations, which are still a non-Federal responsibility. To the extent not offset, this 10 percent can be repaid over time. If non-Federal sponsors use this credit, the Federal/non-Federal shares at the time of construction usually are 90/10, 75/25, and, 50/50 respective to the different thresholds.

Table 1-1: Navigation Cost-sharing Rules of WRDA’86		
Channel Depth	Federal Share	Non-Federal Share
20 feet or less	80 percent	20 percent
20 to 45 feet	65 percent	35 percent
Over 45 feet	40 percent	60 percent

Note: Non Federal shares include 10 percent cash contribution requirement for all depths. The 10 percent cash contribution may be offset by a credit for lands, easements, rights of way and relocations, which are still a non-Federal responsibility. To the extent not offset, this 10 percent can be repaid over time. Source, United States Code, Title 33-Navigation and Navigable Waters, Chapter 36-Water Resources Development.

Organization of Report

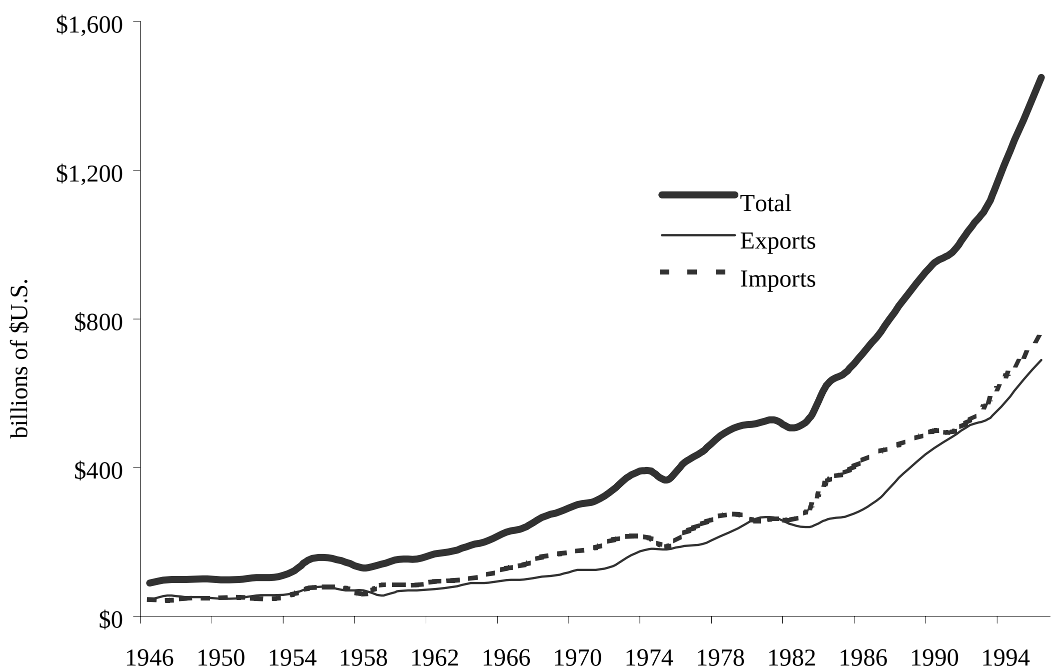
The remainder of this report is organized in five sections. Section 2 gives an overview of the benefits of international trade and Corps dredging. Section 3 provides a summary of the world containership fleet including an analysis of trends toward larger containerships and a discussion of draft requirements of these vessels. In Section 4, the legislative history of WRDA’86 cost-sharing is examined in light of trends toward larger containerships. Section 5 discusses potential financial constraints faced by the Nation’s ports authorities and assesses whether public ports can fully meet the capital requirements for landside and waterside improvements themselves to accommodate changes in the world fleet. Lastly, Section 6 presents a summary and conclusions.

2: INVESTMENT IN HARBOR CHANNELS: AN OVERVIEW OF THE BENEFITS

2.1 The Growing Importance of International Trade to the U.S. Economy

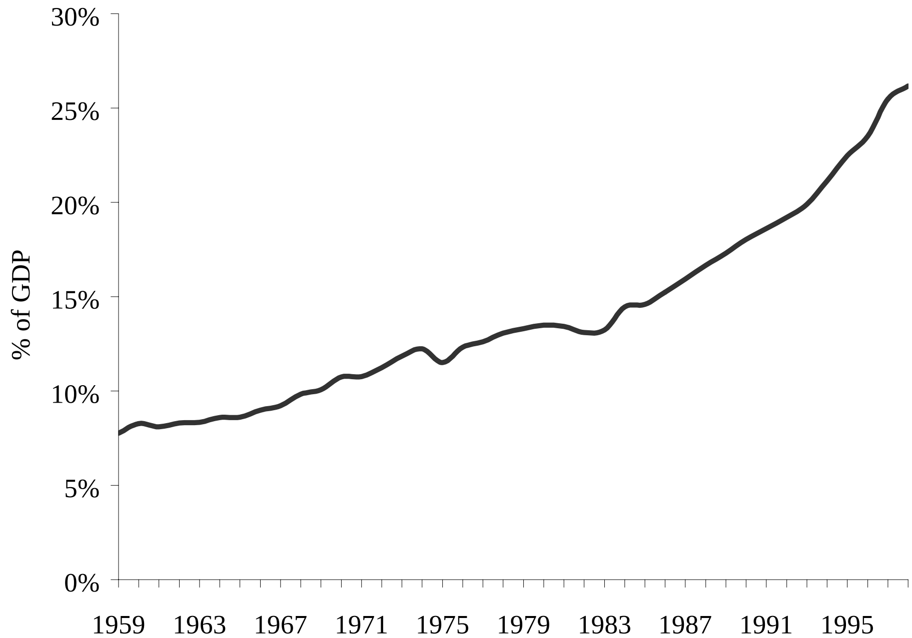
The value of international trade after World War II was minimal when compared with current levels. Since then, economic development, liberalization of trade policies and a general trend toward global integration of manufacturing industries have fueled international commerce. Figure 2-1 displays the real value of U.S. foreign trade from 1946 through 1996. In 1946, the value of foreign commerce was $88.2 billion, but by 1996 this had increased by a factor of almost twenty in real inflation-adjusted terms to $1.5 trillion. This represents an annual growth rate of about six-percent over the 50-year period. International commerce has also become an increasingly important engine for economic growth in the United States. For example, as shown in Figure 2-2, exports and imports accounted for only eight percent of GDP in 1959, but by 1998 foreign trade comprised almost 27 percent of GDP.

Figure 2-1: Real Value of U.S. Traded Goods: 1946-1996 (billions of 1996 dollars.)



Source: U.S. Bureau of Economic Analysis

Figure 2-2: Real Value of Foreign Trade as a Percentage of U.S. Gross Domestic Product: 1959-1998

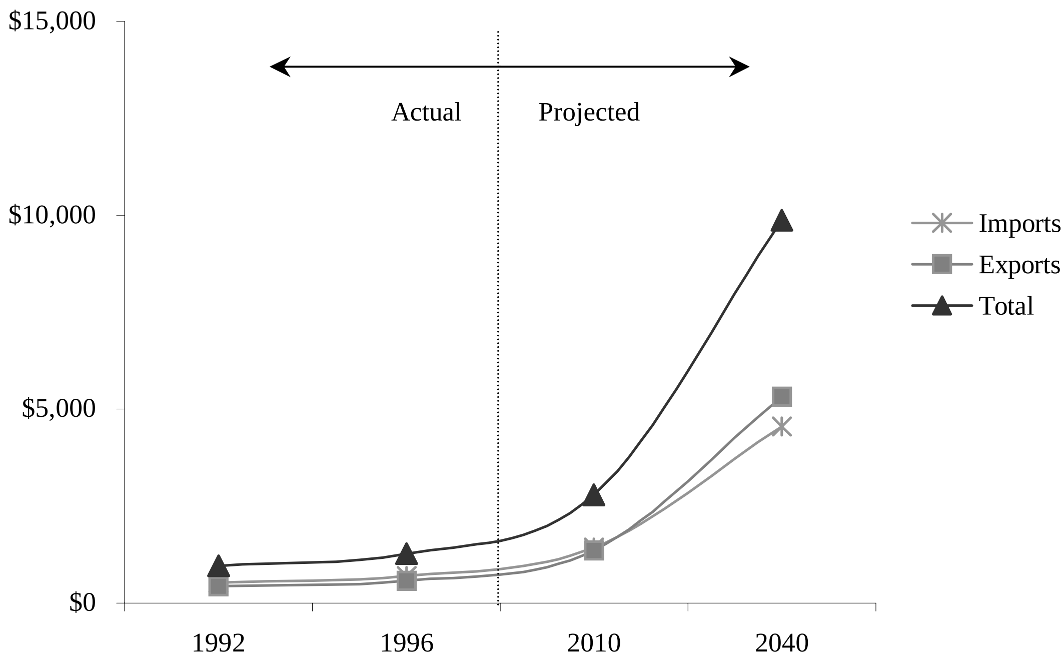


Source: Based on data from the U.S. Bureau of Economic Analysis

Forecasts indicate that upward trends in global commerce will continue. Table 2-1 and Figure 2-3 show projections for U.S. international trade based on value. By the year 2010, it is expected to more than double, and by the year 2040 forecasts indicate that imports and exports will increase eightfold. Trade is projected to continue to increase when measured as a percentage of GDP. National GDP is forecast to grow by about two to three percent per annum through the year 2010. In contrast, annual growth in the value of foreign trade is expected to be around six percent through the year 2010. Based on these forecasts, is it apparent that international trade is becoming an increasingly vital component of the national economy. The leading growth area for increases in global trade is container shipping. From the perspective of this study, containerships are a critical component of international trade. Since their inception in 1956, containerships have become a vital component of the U.S. maritime transportation system. Today, containerships carry about 55 percent of U.S. international maritime trade based on value, but only about eight percent in terms of tonnage (see Figure 2-4).

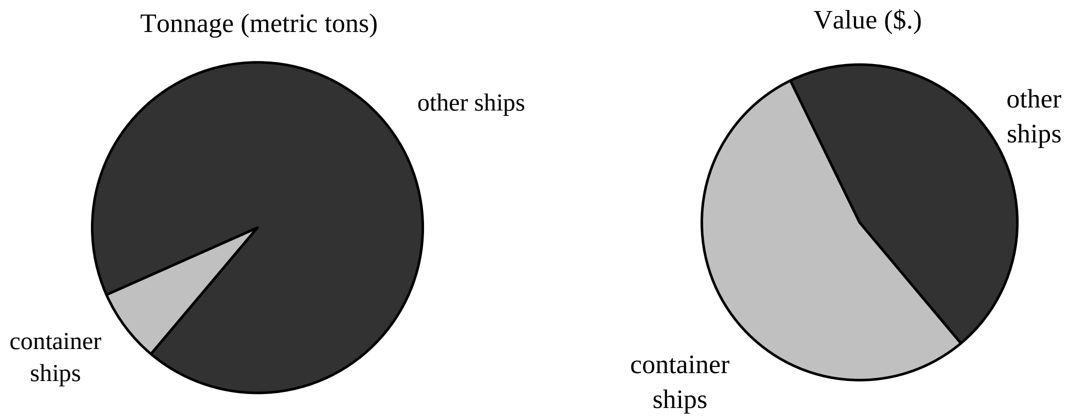
Table 2-1: Actual and Projected U.S. International Trade: 1992 through 2040 (billions of 1987 dollars)				
	Actual		**Projected**	
Imports	**1992**	**1996**	**2010**	**2040**
Annual value	$516	$703	$1,434	$4,550
	Actual		**Projected**	
Exports	**1992**	**1996**	**2010**	**2040**
Annual value	$441	$577	$1,352	$5,322
Source: WEFA, Inc.				

Figure 2-3: Forecasted U.S. International Trade: 1992 through 2040
(billions of 1987 dollars)



Source: WEFA, Inc.

Figure 2-4: Percentage of U.S. Foreign Trade Transported by Containerships
(metric tons and 1996 dollars)



Source: PMCL analysis of data from the USACE Waterborne Commerce Statistics Center

2.2 Benefits of International Trade and Corps Projects

2.2.1 *Traditional Navigation Benefits*

The Corps computes benefit to cost ratios for its Civil Works projects. Calculation of these ratios requires that acceptable benefits are well defined and that a methodology for their computation can be followed.[3] Many people are unaware of what is included in the benefits of a harbor project and more importantly, what is not. Navigation benefits are typically measured as the difference in transportation costs with and without channel deepening. If channels were deepened analysts must determine how transportation costs are affected. For example, if vessel operators can load more cargo on a ship and sail deeper, unit transportation costs decline. In terms of traditional navigation benefits, annual historical expenditures of approximately $700 million for Civil Works projects generated benefits of about $1.4 billion per annum using some simplifying assumptions.[4] These benefits - referred to as National Economic Development benefits or NED benefits - are very direct to navigation. However, NED benefits do not take into account intangible measures or secondary effects, both of which are very important, but for a variety of reasons are not included in traditional benefit to cost analyses.

[3] Regulatory guidelines for determining benefit-cost ratios can be found in the USACE ER1105-2- 100 Guidance for Conducting Civil Works Planning Studies.
[4] See Table 3, USACE Civil Works Program. 1998

2.2.2 *Other Tangible Benefits*

Indirect benefits of Corps projects include gains associated with international trade. Historical expenditures for harbor improvements facilitate international trade by providing ships more efficient access to the Nation's ports. International trade in turn creates and sustains jobs and generates Federal tax revenues. The exact method of computing income and employment associated with international trade is debatable, but one of the best techniques is to calculate the value added by U.S. businesses and households to imports and exports.[5] Computations reveal that nearly 20 percent of all U.S. jobs are directly associated with international trade. A slightly higher percentage of personal income would be associated with international trade because such jobs pay somewhat more than the U.S. average. In addition, about $553 million were collected for the Harbor Maintenance Trust Fund in 1999.

2.2.3 *Intangible Benefits*

Some benefits of harbor improvements are difficult or impossible to quantify. For individual projects these are given little attention. Policy decisions concerning project authorizations and appropriations should consider intangible benefits as well as tangible direct and secondary benefits. This idea is particularly applicable to international trade and specifically container trade. For example, America is such a big market, international trade gives the U.S. considerable leverage when dealing with foreign governments. Thus, international trade can enhance the United States' role as a world leader. National harbors are also a vital part of our military's power projection platform.

Economists believe in the law of comparative advantage, which states that nations benefit when they specialize in producing certain goods and services and then trade with each other rather than producing everything themselves. For example, most people perceive that the majority of foreign trade consists of consumer goods such as clothing and televisions. However, as shown in Table 2-2, a significant portion of U.S. foreign trade consists of semi-manufactured commodities and raw materials such as iron and steel or crude petroleum. These products are used to produce other goods, or are further processed in the importing country. For example, in the United States imported car parts are often used to produce exports of finished automobiles. Machinery and electrical equipment are often used the same way. Thus, efficient flow of international commodities is important for all nations including the United States.

[5] This is the method the Department of Commerce uses for exports. See U.S. Department of Commerce, "U.S. Jobs Supported by Goods and Services Exports, 1983-1994," November 1996. A similar effort for imports was made by The Trade Partnership published in their Imports and America: The Rest of the Story. August 1998.

Table 2-2: Top U.S. Foreign Trade Commodities by Value ($)	
Commodity Group	Percent of Total Trade Value ($)
Machinery and Electrical Equipment	18.8%
Transportation Equipment	10.6%
Textiles, Wearing Apparel and Leather	7.4%
Iron and Steel	5.3%
Crude Petroleum	3.7%
Synthetic Resins and Plastics	3.6%
Meat and Dairy	3.4%
Metal Products	3.4%
Non-Ferrous Metals	2.9%
Source: Journal of Commerce, PIERS 1996	

Global trade is very competitive and profit margins are thin. This is particularly true for maritime transportation including the container shipping industry. . Growth in U.S. foreign trade, even though it is substantial, is not as high as growth in total international trade, particularly with respect to containerships. It is quite possible for some U.S. trade to be diverted or to be serviced by less efficient ships. This may occur if American ports and the Federal government are not able to meet current challenges posed by developments in international trade.

2.2.4 *Lost Benefits*

There are lost benefits associated with delays in the construction of harbor improvement projects. Costs increase with delays, not only because of inflation but because the construction process becomes distorted by available funds. Costs associated with delays can and have been estimated. Typically, a year's delay in schedule leads to a penalty of more than 10 percent of project cost. This is sizable and should be considered when making cost-sharing policies. Cost-sharing policies should seek to insure that both public ports and the Federal government fund projects in a timely manner. There are also benefits foregone due to lost transportation cost savings with project delays.

Project delays affect the Nation in another way. Although these benefits are difficult to quantify, such effects are perhaps more important than those that can be measured. Delays create an uncertain atmosphere that can impact decisions to develop infrastructure elsewhere. Container ports are very capital intensive and require long term planning. Massive containerships are rapidly being put into service at ports throughout the world. Without a clear signal of intent to accommodate these vessels in the United States, necessary ports and facilities may be built elsewhere. Once major investments are made elsewhere, the full efficiencies of large containerships in the form of lower transportation costs for general cargo may be lost to the Nation for a long time to come.

2.3 Geographical Incidence of International Trade

Public ports generally have a regional or local economic development mandate along with authorizations to improve harbor facilities. This does not mean, however, that local economies near ports capture all or most of the benefits associated with international trade. For example, when a port unloads crude petroleum from a ship, it charges a fee that generates revenues for the port and the local community. But imported oil also fuels cars and homes throughout the Nation. Likewise, when a port loads grain or coal onto a ship for export, farmers in the U.S. heartland benefit as do coal miners in the hills of West Virginia, Pennsylvania and Kentucky. Container trade benefits all regions of the country as well.

As shown in Table 2-3, fifteen U.S. ports account for about 80 percent of international maritime trade in terms of value. These ports represent only ten states, however much of the cargo they handle flows to other regions. Table 2-4 shows the origin and destination of international cargo for each U.S. state measured in terms of value. On average, any given state uses the services of 15 different ports around the country. For example, the California ports of Los Angeles, Long Beach and Oakland collectively handle about $187 billion worth of cargo, but the state of California is the origin or destination of only $106 billion. While most container trade flows in and out of ports on the East and West Coasts, it is distributed throughout the Nation as shown in Tables 2-5 and 2-6. For instance, the Port of Charleston, S.C. handled about 800 thousand TEUs in 1996, but the state of South Carolina was the origin or destination of only 160 thousand of these TEUs. Similarly, the ports of Los Angeles, Long Beach and Oakland handled five million TEUs but only 2.5 million originated or were destined to sites within California.

Table 2-3: Top 15 U.S. Ports Based on International Cargo (billions of 1996 dollars)	
Port	$billions
Long Beach, CA	$87.0
Los Angeles, CA	$72.8
New York/New Jersey	$66.7
Houston, TX	$34.1
Seattle, WA	$34.1
Oakland, CA	$26.8
Charleston, SC	$26.0
Norfolk, VA	$24.6
Tacoma, WA	$20.6
Baltimore, MD	$19.3
New Orleans, LA	$16.0
Miami, FL	$15.2
Port of South Louisiana, LA	$13.9
Savannah, GA	$13.3
Port Everglades, FL	$10.5
Total	$480.9
Source: Waterborne Commerce Statistics Center, 1996	

Table 2-4: Origin and Destination of U.S. International Maritime Trade by State (billions of 1996 dollars)	
California	$106.0
New York	$65.9
Texas	$53.4
New Jersey	$47.3
Illinois	$35.9
Florida	$35.5
Georgia	$17.8
Washington	$17.1
Pennsylvania	$16.7
Michigan	$15.4
Ohio	$12.5
North Carolina	$12.2
Louisiana	$12.0
Virginia	$11.9
Connecticut	$10.9
Tennessee	$10.8
Massachusetts	$8.4
South Carolina	$7.7
Maryland	$7.0
Oregon	$6.2
Missouri	$5.8
Kentucky	$5.7
Minnesota	$5.6
Delaware	$4.3
Kansas	$3.8
Indiana	$3.6
Arkansas	$3.5
Wisconsin	$3.4
Alabama	$3.4
Mississippi	$3.3
Colorado	$2.0
Nebraska	$1.9
Oklahoma	$1.3
Arizona	$1.2
District on Columbia	$1.1
Maine	$1.1
Utah	$1.1
Rhode Island	$1.0
Hawaii	$1.0
Iowa	$1.0
West Virginia	$0.9
New Hampshire	$0.6
Nevada	$0.4
Idaho	$0.4
South Dakota	$0.1
Alaska	$0.1
Montana	$0.1
North Dakota	$0.1
Vermont	$0.1
New Mexico	$0.1
Total	$568.6
Source: Journal of Commerce, PIERS 1996	

Table 2-5: Top 15 U.S. Ports Based on International Container Cargo (thousands of TEUs 1996)	
Port	TEUs (thousands)
Long Beach, CA	2,357
Los Angeles, CA	1,873
New York	1,533
Seattle, WA	939
Oakland, CA	803
Charleston, SC	801
Hampton Roads, VA	723
Houston, TX	538
Tacoma, WA	506
Miami, FL	503
Savannah, GA	456
Port Everglades, FL	422
Baltimore, MD	276
Portland, OR	210
New Orleans, LA	204
Total	12,415
Source: Journal of Commerce, PIERS 1996	

Table 2-6: Origin and Destination of U.S. International Container Trade by State (thousands of TEUs 1996)	
California	2,542
New York	1,029
New Jersey	954
Florida	880
Texas	578
Illinois	529
Washington	514
Georgia	370
Tennessee	292
Pennsylvania	277
North Carolina	265
Ohio	263
Virginia	199
Massachusetts	198
Michigan	198
Connecticut	182
Oregon	177
South Carolina	160
Delaware	159
Missouri	120
Maryland	114
Kentucky	113
Arkansas	111
Mississippi	99
Minnesota	97
Wisconsin	88
Louisiana	80
Indiana	76
Alabama	65
Kansas	56
Colorado	47
Nebraska	46
Arizona	33
Iowa	25
Idaho	22
Rhode Island	17
Hawaii	16
Utah	15
Nevada	15
Oklahoma	13
New Hampshire	12
District of Columbia	10
Maine	10
West Virginia	9
North Dakota	3
Alaska	3
Vermont	2
New Mexico	2
South Dakota	2
Montana	1
Total	11,086

Source: Journal of Commerce, PIERS 1996

2.4 Conclusion

The benefits of harbor improvements are numerous. Expenditures for harbor improvements have facilitated international trade by providing ships more efficient access to the Nation's ports. International trade in turn creates and sustains jobs and generates Federal tax revenues. Foreign commerce has become crucial to the economic well-being of the United States. In 1946, U.S. international trade represented a relatively small portion of the U.S. economy, but today foreign trade accounts for 27 percent of U.S. gross domestic product. Harbor improvements also affect prices of U.S. imports and exports. With deeper channels vessel operators can load more cargo onto a ship and sail deeper, or they can use larger more efficient vessels. Unit transportation costs decline and lower transportation costs are reflected in commodity prices. Intangible benefits are also important. Free trade promotes international relations and stability and bolsters the United States' position as a world leader. Lastly, it is important to stress that the economic benefits of international trade are widespread and are not limited to a handful of coastal states.

3: CHANGES IN THE WORLD CONTAINERSHIP FLEET

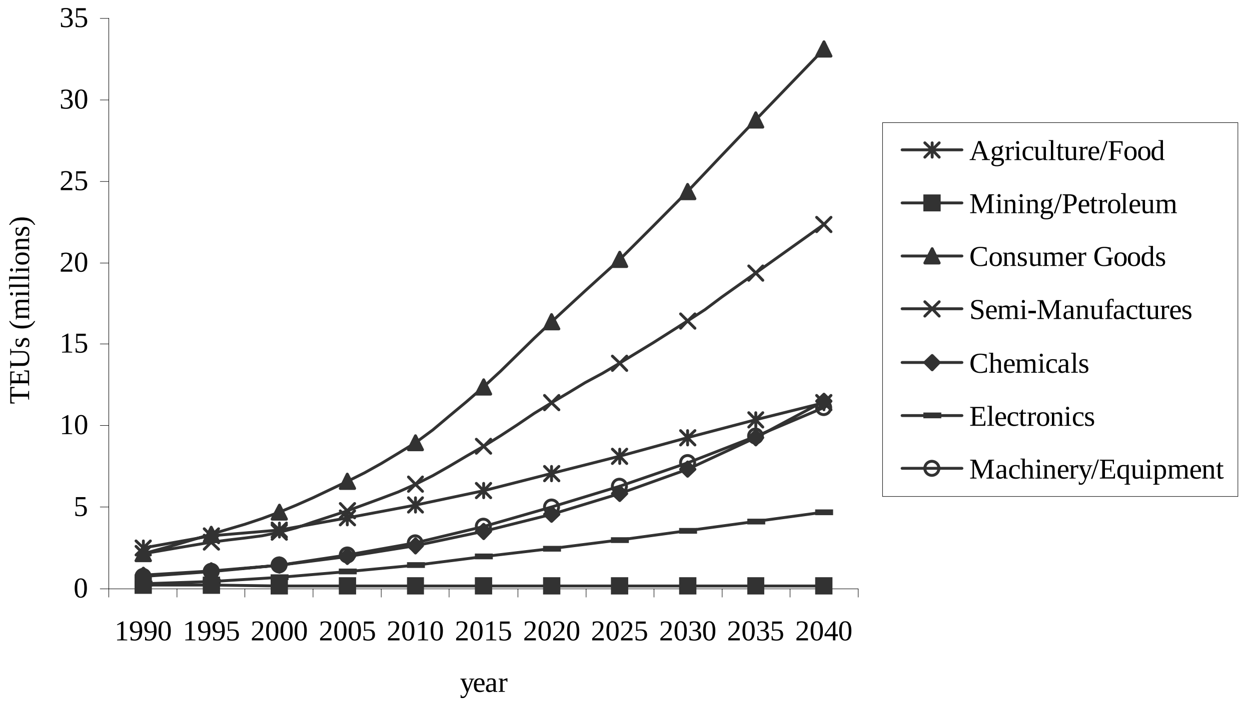
3.1 Increases in the Volume of Container Trade

Commodity flows can be measured in several ways including by weight and volume. Non-containerized cargo such as goods shipped in bulk (e.g. oil and grain) are measured in terms of tonnage and containerized cargo is measured in TEUs. These measurements are the best overall indicators of port infrastructure requirements such as loading and unloading equipment, storage areas and links to inland modes of transportation. The third way to measure traffic volume is by commodity value. This method is used primarily in assessing the importance of commodity flows with respect to issues such as national income and custom duties.

A recent report published by the U.S. Department of Transportation (DOT) projected a growth rate of 3.5 percent per annum in total tonnage of U.S. foreign maritime trade.[6] Container shipments measured by TEUs are forecast to increase at a rate of between seven and eight percent through the year 2002. Tonnage growth in world container trade is projected to grow at an eight to ten percent rate, which is even higher than container growth in the United States. NDNS estimates for per annum growth in U.S. container trade through 2020 are about 5.6 percent for TEUs and 4.9 percent for tonnage. Figure 3-1 displays NDNS historical and forecasted TEU throughput disaggregated by major commodity groups for the years 1990 through 2040. Growth rates are presented in Table 3-1. The important point is that TEU throughput in the U.S. doubled in the last ten years and is expected to double again every 10 to 15 years.

[6] U.S. Department of Transportation, An Assessment of the U.S. Marine Transportation System: A Report to Congress. September 1999.

Figure 3-1: Historical and Projected TEU Throughput by Major Commodity Groups
(1990 through 2040)



Source: WEFA Inc.

Table 3-1: Growth Rates for Historical and Projected TEU Throughput by Major Commodity Groups (1990 through 2040)	
Commodity Group	Annual Growth Rate
Agriculture/Food	3.1%
Mining/Petroleum	-0.6%
Consumer Goods	5.6%
Semi-Manufactured Goods	4.8%
Chemicals	5.4%
Electronics	5.7%
Machinery/Equipment	5.5%
Transport Equipment	1.8%
Total	4.8%

Based on forecasts of WEFA Inc. Growth rates were estimated over the forecasted period using logarithmic/ linear regression equations.

3.2 Larger Containerships

Increased volumes of containerized cargo emphasize a potential need for additional container facilities at U.S. ports. Much more important, however, is the size and nature of these facilities, which is driven by containership dimensions. Container shipping is a private sector industry that has been significantly deregulated and functions under the auspices of free trade. Under these conditions, competition thrives and profit margins are often narrow as each carrier tries to gain an edge over their competitors. Transportation costs per TEU for large containerships are substantially lower than for smaller ships. However, larger ships have higher operational and capital costs, and require fairly high shipping volumes in order to be profitable.

Until recently, the maximum dimension of the Panama Canal limited the size of containerships. However, development of the U.S "land bridge" has greatly reduced the importance of the Panama Canal for container shipping. Land bridging has made it cost effective to transport Asian imports by ship to the West Coast where they are unloaded and placed onto railcars for shipment across the continental United States. For example, the all-water route from Japan to New York through the Panama Canal is 11,500 miles, while the land bridge route to New York from Japan is only about 7,500 miles. After its journey across the U.S., cargo can be sold in East Coast markets or loaded onto ships for shipment on to Europe and other destinations. The dimensions of the Panama Canal did not restrict vessels operating on routes that relied on the U.S. land bridge, and many carriers began to build larger containerships to reduce costs.

Today, changes in the global economy combined with infrastructure problems along the U.S land bridge are accelerating further growth in the sizes of containerships. Throughout the 1980s, Japan and Korea were the dominant manufacturing centers in Asia. By the 1990s, the center shifted to Singapore, and today it appears to be moving to China, Southeast Asia and the Indian Subcontinent where textile production and other manufacturing industries are growing. As the center moves further east, it is becoming cost effective to transport U.S. bound cargo on transatlantic routes rather than on traditional transpacific routes. Growing congestion along the U.S. land bridge is acting as a catalyst. As trade with Asia continues to swell, rail connections and transfers are becoming increasingly strained resulting in delays and higher costs for shippers. Some container carriers are responding by rerouting Asian cargo through the Suez Canal on an all water route rather than landbridging it across the continental United States. For example, Neptune Orient Lines (NOL) found that it could reach the U.S. Atlantic Coast in two to four days less than it could on its conventional transpacific land bridge route, and there are no costs of rail shipment. From 1994 to 1998, container shipments via the Suez Canal to the U.S. East Coast have increased from 1.5 to 6 percent.[7]

Many containerships operating on routes from Asia via the Suez Canal are newer and larger. Lower unit costs on big ships allow substantial savings on the all water route from Asia. The size barrier needed to make the route lucrative is around 6,000 TEUs. Some experts estimate that a shift from a 3,000 TEU ship to a 7,000 TEU vessel would generate a 25 percent reduction in per-unit transportation costs from Hong Kong to New York via the Suez Canal, however, cost reductions gained from the land bridge route would be just five percent for the same vessels.[8] Carriers are recognizing this and are investing in new facilities to support these growing trade routes. For example, in late 1999, Maersk/SeaLand agreed to a 30-year concession with the Egyptian government to operate a new terminal at Port Said, which is located along the Mediterranean entrance to the Suez Canal. The facility will be able to service ships of up to 6,000 TEUs and eventually it will be capable of handling 8,000 TEU ships. The Egyptian government has already started to dredge the harbor at Port Said to 55 feet, and ultimately they plan to deepen it to 60 feet.

Figure 3-2 illustrates the reduced emphasis on the Panama Canal. Asian/Pacific routes already account for 44.5 percent of container traffic when measured as a percentage of metric tons. These routes are to the U.S. West and East Coasts, and neither requires the use of the Panama Canal. In addition, traffic on Asian/Pacific routes is expected to increase in the future. Forecasts from the NDNS projects that by 2040, 60.8 percent of U.S container trade will be with Asian/Pacific ports.

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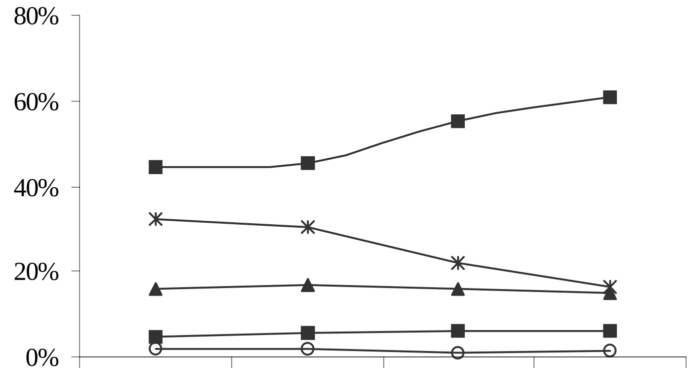
[7] Mongelluzzo, B. "Ports Predict 2000 will See Growth cross Trade Lanes." The Journal of Commerce, 15 February 2000.
[8] Brennan, T. "Suez Option to Bolster New York." The Journal of Commerce 25 March 1999.

Figure 3-2: Historical and Forecasted Market Share of U.S. Inbound Containerized Cargo by Trading Partner Region 1995 through 2040 (percentage of metric tons)



	year 1995	year 2000	year 2020	year 2040
Europe	32.5%	30.5%	22.1%	16.4%
Asia/Pacific	44.5%	45.3%	55.2%	60.8%
Latin America	16.1%	16.7%	15.9%	15.2%
Canada	2.1%	2.1%	1.1%	1.4%
Africa, Mid-East, Indian Subcontinent	4.8%	5.5%	6.2%	6.2%

Source: WEFA, Inc.

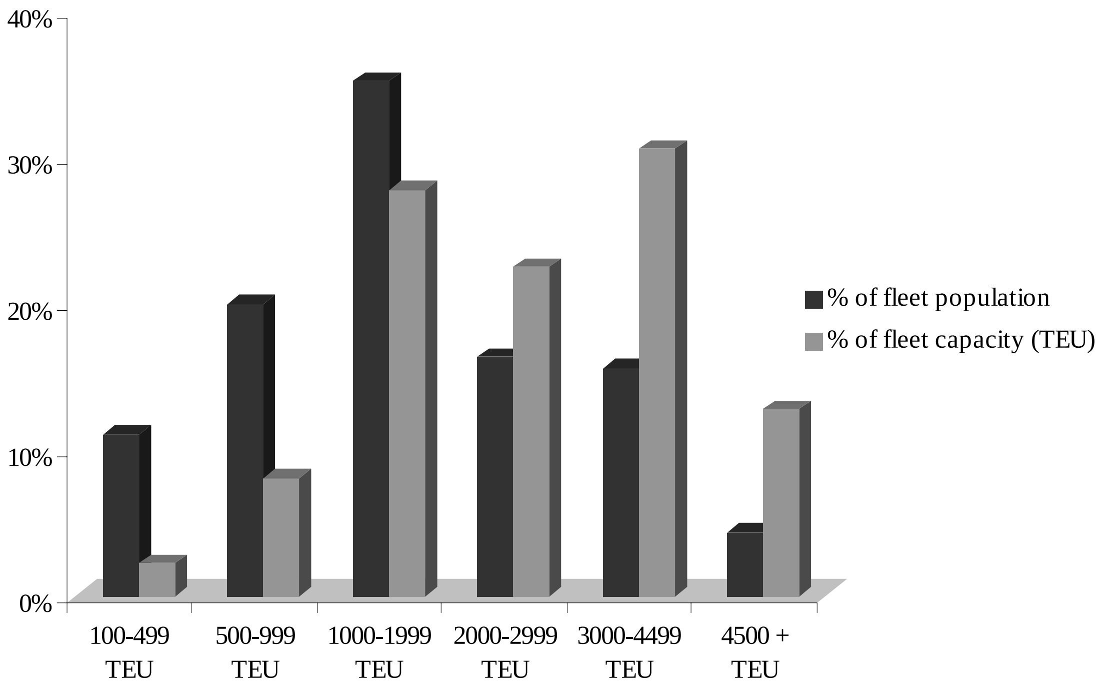
Containerships that are too large to navigate the Panama Canal are typically referred to as “Post-Panamax” vessels. Most Post-Panamax ships have capacities of at least 4,500 TEUs.[9] Figure 3-3 presents NDNS data on the distribution of containerships in the world fleet. Post-Panamax ships currently make up about four percent of the world fleet in terms of the total number of containerships. However, based on their share of cargo carrying capacity as measured by TEUs, Post-Panamax vessels comprise almost 13 percent of the fleet. Figure 3-4 emphasizes the growth in the containership fleet’s capacity since WRDA’86. Other sources confirm trends toward larger containerships. For example, in 1997 vessels with capacities of 4,000 TEU or more accounted for 35 percent of capacity on order, but in 1999 this had increased to 60 percent.[10] Table 3-2 summarizes the largest class of containerships on order for each of major containership lines.[11] All are expected to be in service by the end of the year 2000. Approximately 88 percent of new TEU capacity are in vessels of at least 4,000 TEU and about 73 percent are in vessels of at least 5,000 TEU.

[9]The relationship between TEU capacity and design draft is not directly proportional. Thus, based solely on TEUs there is not a specific threshold for the maximum size containership that can transverse the Panama Canal.

[10] Containerization International, February, 1999

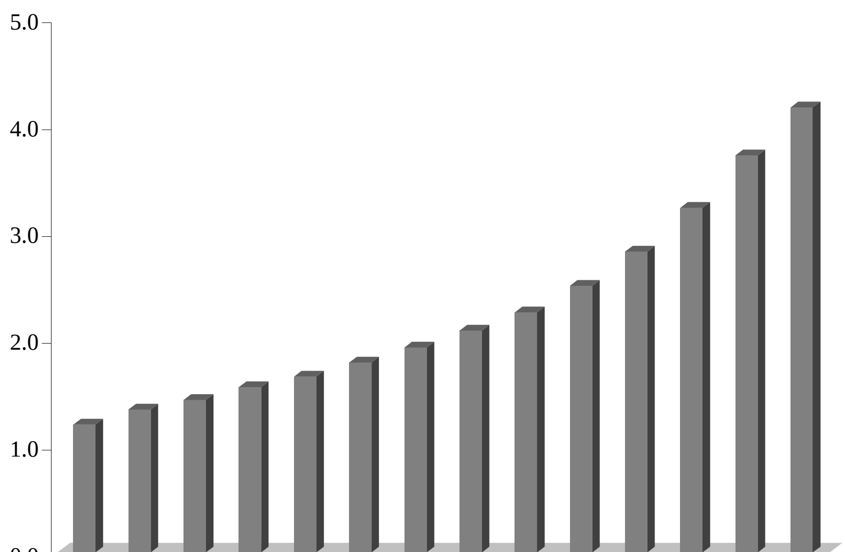
[11] Based on data presented by Baird, A.J. “Container Vessels of the Next Generation: Are Seaports Ready to Face the Challenge?” Paper presented at the 21st World Ports Conference of the International Association of Ports and Harbors, Port Klang, Malaysia, 15-21 May 1999.

Figure 3-3: TEU Capacity and Number of Vessels in the World Containership Fleet (1999)



Source: PMCL analysis of data from the Fairplay Ships Register

Figure 3-4: Growth in the World Containership Fleet Cargo Carrying Capacity
1986 through 1999 (millions of TEUs)



	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TEU (millions)	1.20	1.34	1.43	1.55	1.65	1.78	1.92	2.08	2.25	2.50	2.82	3.23	3.72	4.17

Source: WEFA Analysis of Clarkson Research Data

Table 3-2: Largest Size of Containership Scheduled for Delivery by the year 2000					
Carrier	No. of Vessels	Capacity (TEU)	Carrier	No. of Vessels	Capacity (TEU)
P&ON	4	6,690	NOL	4	4,918
Maersk	9	6,600	APL	6	4,832
Maersk	3	6,000	MOL	5	4,700
Sea-Land	9	4,354	Cho Yang	4	4,545
Sea-Land	6	6,200	DSR Senator	6	4,545
NYK	5	5,700	MISC	2	4,469
Hyundai MM	7	5,551	Hapag Lloyd	6	4,422
Evergreen	13	5,364	CMA/CGM	2	4,000
Hanjin	5	5,300	MSC	2	4,000
Cosco	6	5,200	UASC	10	3,800
Yang Ming	5	5,000	Zim	3	3,500
OOCL	8	4,960	K-Line	8	3,456

Total no. of Vessels: 138
Total Capacity: 681,101 TEU
73 % percentage of ordered capacity in vessels of at least 5,000 TEU
Source: Adapted from Baird, J.B. 1999

Trends toward larger containerships are accelerating. According to a report by the U.S. Maritime Administration (MARAD), in 1990 ships in excess of 4,500 TEUs made up only one percent of the world fleet. However, as of 1997, there were 45 such ships on order.[12] MARAD also projects that by 2010 ships of at least 4,000 TEU will carry 40 percent of containerized cargo to and from the United States, and ships of 6,000 TEU or more will haul nearly 10 percent. According to Fairplay Publications Ltd., discussions are underway for up to 52 additional vessels with capacity in excess of 6,000 TEUs per vessel. Comparing all sources, approximately 70 vessels with capacities of 6,000 TEUs or greater are expected to be operational by the year 2002.

[12] See, U.S. Department of Transportation, Office of Intermodalism, "Impacts of Changes in Ship Design on Transportation Infrastructure and Operations, Washington, D.C. February 1998.

Just as the trend toward Post-Panamax vessels was driven by economies of scale, so is the more recent trend toward vessels with TEU capacities of 6,000 or more. Because of increased competition among carriers, freight rates have been declining since the late 1970s. In real terms, rates received for cargo shipped on transpacific trade routes have dropped about 72 percent for eastbound freight and 67 percent for westbound freight. Atlantic routes have declined almost 60 percent for westbound cargo and 52 percent for eastbound cargo. In light of these dramatic decreases, carriers have been seeking ways of reducing costs. Assuming they can be filled to capacity, larger ships are better able to absorb a drop in rates. For example, if a 3,000 TEU ship barely breaks even at rates of $1,000 per container, then a 6,000 TEU vessel would still be profitable if rates fell to $500.[13] Thus, in markets where rates fluctuate considerably, bigger ships offer an economic advantage.

In addition to economic incentives, the general condition of the containership fleet is having an impact on trends toward larger vessels. Figure 3-5 displays the average age of containerships in the fleet according to size. The smallest vessels, those with capacities of 100 to 499 TEUs, are the oldest on average (15.4 years), and around 18 percent are at least 25 years old. The average age of containerships of 4,000 TEUs or more is only 3.4 years. The average service life of containerships is about 25 years, and older vessels built during the 1970's are reaching the ends of their useful lives. An estimated 12.3 percent of the global container fleet could be retired in the years 2000 through 2003, and upwards of 100,000 TEU capacity is expected to be scrapped in 1999. In addition, a substantial amount of slower diesel propulsion ships produced in the mid-1980s may become uneconomical sooner than their expected lifetime, which could lead to higher scrapping rates.[14] As shown in Figure 3-6, the vessels of the world containership fleet that call on U.S. ports are also aging. The largest size ships (45-foot design drafts or more) are the youngest.

Whether or not the size of containerships will continue to grow over the long term is a topic of debate. There are arguments on both sides of the issue. Some concede that because of inadequate infrastructure at ports, the size of containerships will plateau within the next few years at no more than 8,000 to 10,000 TEUs. Others question the ability to fill enough container space on large vessels to make them economical. One executive is quoted as saying, "…the line haul savings (of a 6,000 TEU ship) are minimal…(and) this advantage is quickly eaten up by landside diseconomies and by the need to cut rates to fill the ships." [15] Another shipping executive remarked, "Nobody can fill these monsters…you have to get your competitor to prop you up."[16] Then, there is the issue of vessel speed. Ships with capacities of more than 7,000 to 8,000 TEUs will find it harder to reach required speeds of around 24 knots with current ship propulsion technology. However, advances in propulsion or hull designs could overcome this barrier. Existing Post-Panamax containerships rely on a single engine with one shaftline and propeller. Larger ships will need bigger engines to maintain

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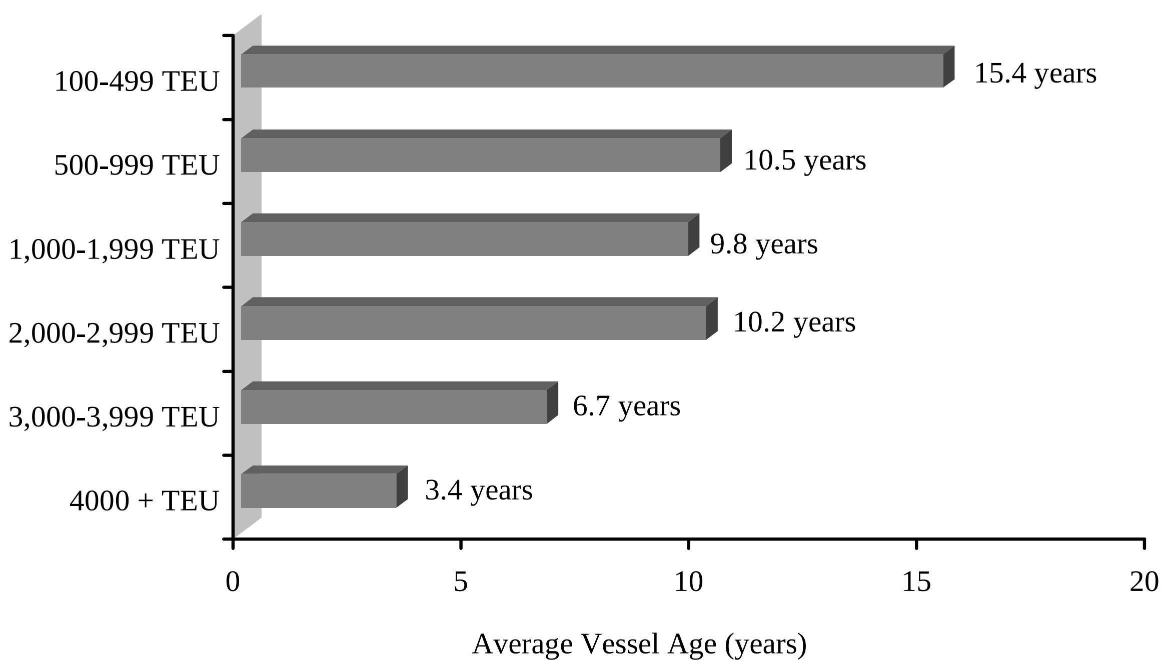
[13] Drewry Shipping Consultants, "Container Market Outlook: High Risk and High Stakes, Where is the Payback? London, October 1999.
[14] Baird, 1999.
[15] McLellan, R.G. Bigger Vessels: How Big is too Big? *Maritime Policy and Management.* 24(2), 193-211, 1997.
[16] Hanscom, J. "K-Line Breaks Ranks over Deregulation. *SeaTrade Review*. Pp. 33-35, April 1998.

required speeds, and it is questionable whether current single propeller engines are capable of absorbing such large amounts of power. However, ship and engine designers are currently exploring possible alternatives including large bore engines coupled with contra-rotating propellers or twin engine, twin screw propulsion systems that have already been adopted for large tankers.[17]

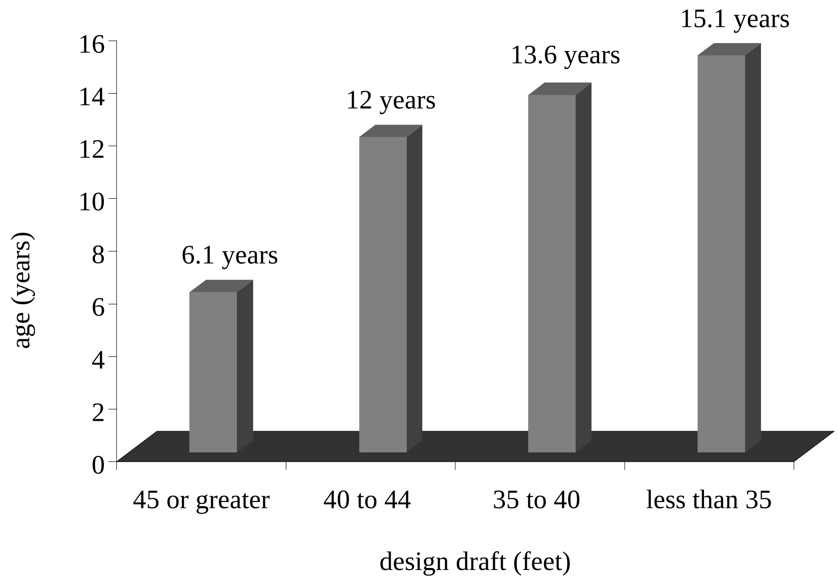
Figure 3-5: Average Age Distribution of the World Containership Fleet by Size (TEUs, 1999)



Source: WEFA Analysis of Clarkson Research Data

[17] See, "Fairplay Solutions." Issue No. 37, pp. 9-13, October 1999.

Figure 3-6: Average Age by Design Draft of Containerships Calling at U.S. Ports



Source: PMCL analysis of data from Lloyd's Maritime and the Waterborne Commerce Statistics Center.

3.3 Channel Depth Requirements for Containerships

An analysis of depth requirements of Post-Panamax ships is needed to obtain a range of channel depths that U.S. ports could require in the future. The smallest Post-Panamax vessels (4,000 TEUs) have design drafts of 40 feet and require 44 foot channels when fully loaded by deadweight tonnage. Depth requirements are deeper than design drafts because when a ship is under sail various physical and hydrostatic factors cause it to sit lower in the water than while the vessel is at rest. Thus, allowances of additional channel depth beyond design drafts are taken into account. Vertical ship movement while underway ("squat") may require an additional two feet. An extra foot is usually allowed for trim, which refers to loading practices that make a vessel ride lower in the water to improve handling, and lastly, a general safety margin of two feet - underkeel clearance - is allowed. Thus, a vessel with a design draft of 46 feet may require an extra four to five feet or about 10 percent of design draft at low water.

Table 3-3 summarizes landmarks in containership evolution. In 1972, the carrier OOCL introduced the Liverpool Bay class, which remained the largest class in terms of design draft until 1992 when carriers introduced vessels of 4,400 TEUs.[18] Upward trends in capacity continued throughout the 1980s and 1990s. In 1996, Maersk/SeaLand introduced the Regina Maersk with a capacity of 6,000 TEUs. The Regina Maersk is deployed on Maersk's "Suez Express Service", calling on the U.S. East Coast, Canada, the Mediterranean, the Middle East and the Far East. In 1998, Maersk/SeaLand launched its new "S" class of containerships with the inauguration of the Sovereign Maersk. These are currently the largest containerships in the world with lengths of 1,138 feet, widths of 141 feet, capacities of 6,600 TEU and design drafts of 47.5 feet. In 1998, the carrier P&O Nedlloyd introduced the first in a series of four 6,690 TEU containerships - the Southampton.

Vessels shown in Table 3-3 have design drafts ranging from about 43 to 47.5 feet. A fully loaded containership with a draft of 43 feet should need about a 47 foot channel to sail safely; a vessel with a 46 foot draft should need 51 feet of water and the largest containerships (47.5 feet) could require channels with about 53 feet of water. Thus, the current generation of Post-Panamax containerships requires channels from 45 to 53 feet and future generations may need even more. Of course, not every port will be able to justify such depths. Such justification must be part of thorough specific port studies. Nevertheless, available data leave little doubt that some channels of 50 feet and greater will be necessary based upon current and projected trends for the containership fleet.

[18] Baird, A.J. "Container Vessels of the Next Generation: Are Seaports Ready to Face the Challenge?" Paper presented at the 21st World Ports Conference of the International Association of Ports and Harbors, Port Klang, Malaysia, 15-21 May 1999.

Table 3-3: Landmarks in Containership Size Increases: 1972 through 2000			
Date of Vessel Delivery	Draft (feet)	Beam (feet)	Capacity (TEUs)
1972	42.7	105.3	3,000
1981	41.0	105.6	3,500
1984	39.4	105.0	4,300
1988	41.0	129.3	4,340
1991	41.3	105.6	4,400
1992	44.3	121.7	4,411
1994	42.7	121.7	4,743
1995	39.4	131.2	4,850
1996	45.9	140.4	6,000+
1998	47.5	140.4	6,690
2000	?	154.2	8,000
2000+	?	216.5	15,000
Adapted from Baird, J.B. 1999			

3.4 Channel Depths at Foreign Container Ports

There may not be a need to deepen U.S. ports if their foreign counterparts are not deepening as well. Conversely, if U.S. trading partners deepen their ports and the U.S. does not, then the larger ships may bypass U.S. ports or may use them less efficiently by not loading to full capacity (e.g. “light loading”). If vessels light load, transportation costs will increase, as will prices of U.S. exports, many of which are very price sensitive commodities such as grain and coal. Since international trade is very competitive, U.S. exports could lose market share. Imports could cost more to transport resulting in higher prices for consumers and manufacturers. Table 3-4 displays channel depths at some of the world’s key container ports. Trading partners of the U.S. have apparently decided to follow trends discussed in this chapter, and are providing channels to accommodate the new generation of containerships. Many container ports abroad have deepened channels in the last four or five years to depths ranging from 49 to 55 feet.

Table: 3-4: Channel Depths at Major World Container Ports		
Port	Channel Depth (meters)	Channel Depth (feet)
Gothenburg, Sweden	12	40
Rotterdam, Holland	16 - 17	53 - 55
Southampton, United Kingdom	12.8 - 15	42 - 50
Algeciras, Spain	15 - 16	50 - 53
Singapore	15	50
Port Raysut, Oman	15 - 16	50 - 53
Hong Kong	15	50
Kaohsiung, Taiwan	14 - 15	46 – 50
Kobe, Japan	12 - 15	40 – 50
Nagoya, Japan	15	50
Yokohama, Japan	12 - 14	40 – 46
Source: Containerization International Yearbook 1998		

3.5 Landside Facilities

Containership dimensions not only impact channel depths but also landside facilities. To accommodate Post-Panamax ships, ports must expand container storage capacity, provide intermodal connections - particularly rail connections - and they must invest in new wharf cranes. As containerships have become larger and wider, pierside cranes have evolved. Container cranes must be able to reach across the entire beam (width) of a vessel in order to remove containers stacked across a ship's deck. "Beyond Post-Panamax" cranes have outreaches of about 160 feet and can service the largest containerships in operation today. Table 3-5, shows the world container crane population in 1997 - both existing and on order. The vast majority of these cranes (83 percent) are being purchased to serve vessels with capacities of 6,000 TEUs or greater.

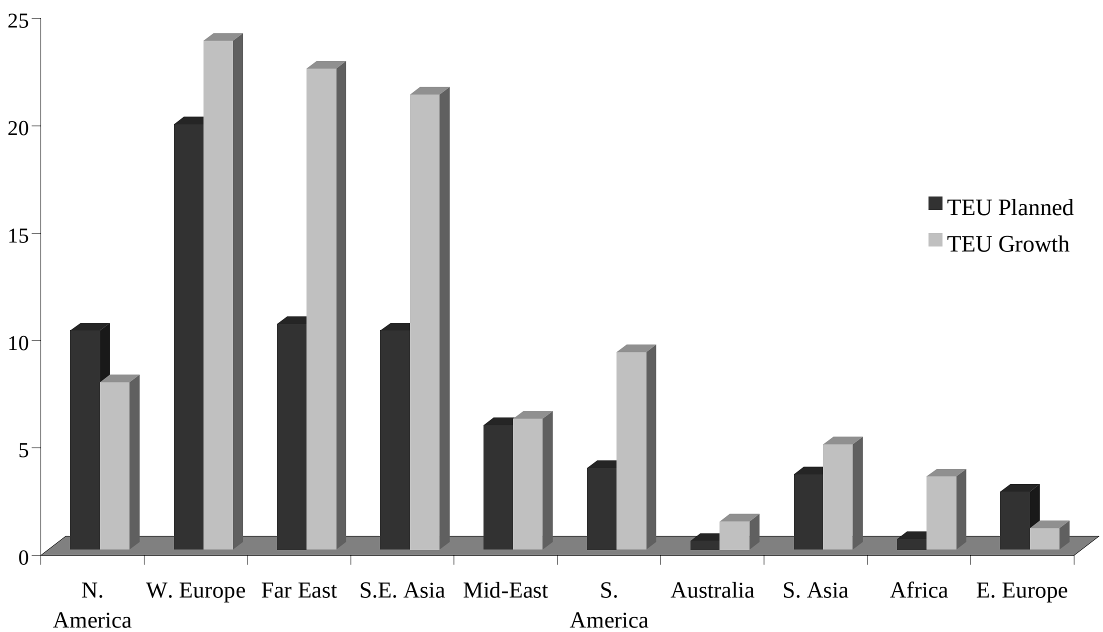
Table 3-5: World Crane Population (existing and on order)				
Crane Size	Ship Capabilities	Percentage of worlds crane population (1995)	Percentage of deliveries 1996-1998	U.S. and Canadian orders 1996-1998
Panamax (> than 144' outreach)	< 4,000 TEU	77%	30%	7
Post-Panamax (144' - 158' outreach)	4,000 – 6,000 TEU	19%	23%	4
Beyond Post-Panamax (> 158' outreach)	6,000 + TEU	3%	44%	55
Source: U.S. Department of Transportation, Office of Intermodalism, "Impacts of Changes in Ship Design on Transportation Infrastructure and Operations." Washington, D.C. February 1998				

Seamless connections to inland modes of transportation are also important. Large containerships require efficient and timely rail access to move cargo to and from inland markets. With the assistance of the U.S. Department of Transportation, many U.S. ports have sought to eliminate congestion related to port traffic. Most major U.S. ports are located in or near large urban areas where trucks and trains compete with commuters on crowded highways. In response, some ports are developing "transportation corridors" from ocean terminals to inland rail or highway junctions. For example, the Alameda Corridor in Los Angeles will consolidate operations of three freight railroad carriers into one high speed, high capacity corridor. According to the Los Angeles Ports Authority, the Corridor will remove all highway rail crossings, while combining 90 miles of branch line tracks into one 20-mile corridor. This will eliminate traffic conflicts at nearly 200 highway crossings of the tracks, saving an estimated 15,000 hours of delay per day for vehicles that must wait at crossings while trains pass. For the ports, this means cargo will move faster from ship to and from inland markets.

Overall, public ports in the United States and the private sector have done a good job of planning for future container traffic. Most leading container ports have sufficient infrastructure in place, or at minimum, are developing new terminals and intermodal connections. In fact, ports in North America appear to be well positioned to meet increases in container throughput. Figure 3-7 displays planned container terminal development measured in terms of TEU capacity and expected growth in TEU traffic for major world regions through the year 2005. As demonstrated, ports in North America and Eastern Europe represent facilities where planned capacity is greater than expected throughput. Planned terminal development in North America is currently 10.2 million

TEUs, while growth in TEU traffic through 2005 is forecast at 7.8 million.[19] Although North American ports appear to be ahead of other major world ports in terms of infrastructure, harbor depths remain an obstacle, particularly along the Gulf and Atlantic Coasts where most container ports have depths of 45 feet or less.

Figure 3-7: Planned Terminal Development and Forecasted Growth in TEU Throughput (millions of TEU)



Source: Drewry Shipping Consultants

3.6 Depth Constraints

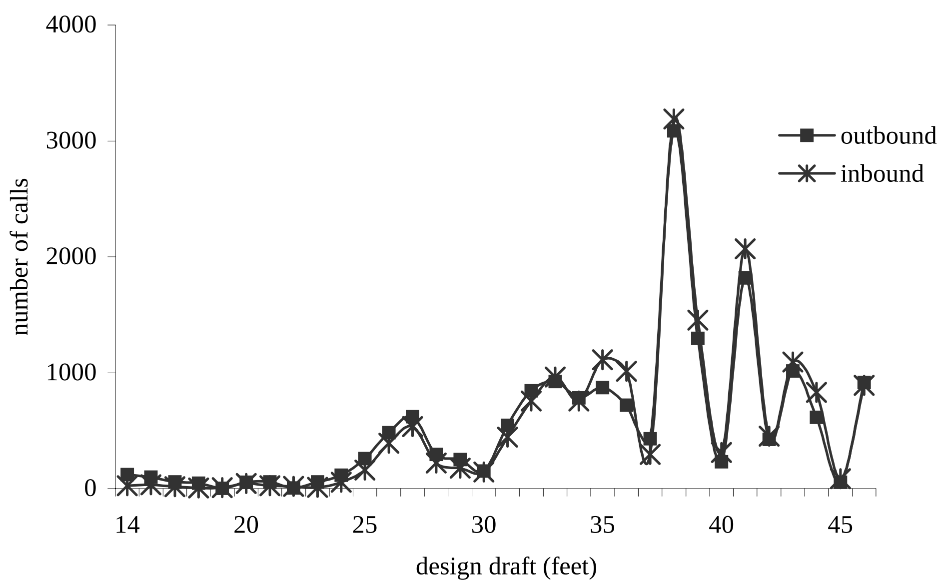
Trends toward large Post-Panamax vessels have port officials and industry experts concerned about the availability of adequate channel depths. For example, Moody's Investors Services reports that lack of harbor depth is a critical issue for the Ports of New York/New Jersey and Oakland. Neither port has channels that exceed 45 feet, due in part to environmental concerns regarding dredging. In the long term, officials at both ports may find themselves in a dilemma if they cannot deepen below 45 feet. Los Angeles and Tacoma have experienced loss of traffic according to Moody's, but this is primarily attributed to port congestion - a reminder that the public ports face serious challenges both on the landside and waterside. Maersk/SeaLand selected the Port of New York/New Jersey as a regional hub port, but depth constraints have apparently

[19] Drewry Shipping Consultants, "World Container Terminals: Global Growth and Private Profit." London, England, April 1998.

hampered efficient operations. Recently introduced Post-Panamax vessels of Maersk must lighten their loads at the Canadian port of Halifax before entering New York Harbor. Rerouting of discretionary cargo to deeper ports is referred to as "cargo diversion." Dredging is often cited as a chief factor affecting cargo diversion from East Coast ports to Canada.[20] U.S. transshipments via Canada have increased as a percent of liner trade every year from 1993 to 1998, however, there are still more goods shipped through U.S. ports to or from Canada than vice versa.[21]

Figure 3-8 shows that the distribution of U.S. containership traffic based on design draft is heavily weighted towards larger vessels. Containerships with drafts of 40 feet or greater make up 31 percent of movements, while vessels with design drafts of 45 feet or greater comprise six percent. This will increase as more Post-Panamax vessels are introduced. Table 3-6 lists maximum channel depths at major U.S. container ports. As discussed earlier, a fully loaded containership with a design draft of 40 feet could require a channel with about 44 feet of water. Only seven major U.S. container ports have channels of 44 feet or greater, and only two have channels that can accommodate fully loaded vessels with design drafts of 46 feet or greater. As for the future, Moody's and shipping experts anticipate an increase in global competition for the lucrative container market. Channel depths are only a part of the issue, but they are an increasingly important factor as the size of containerships grow faster than the rate at which U.S. harbor channels are deepened.

Figure 3-8: Inbound and Outbound U.S. Calls for Containerships by Design Draft, 1999



Source: PMCL analysis of data from Lloyd's Maritime and the Waterborne Commerce Statistics Center.

[20]Other elements can have an impact including but not limited to landside costs, labor practices, taxes and user fees. See, Study of the Causes of East Coast Cargo Diversion and International Competitiveness Enhancements. U.S Department of Transportation, Washington, D.C. October 1997.
[21] U.S. Maritime Administration, U.S. Exports and Imports Transshipped via Canadian Ports. 1998

Table 3-6: Maximum Channels Depths at Major U.S. Container Ports	
Selected U.S Container Ports	Maximum Channel Depth
Long Beach, CA	60
Los Angeles, CA	81
New York	45
Seattle, WA	40*
Oakland, CA	42
Charleston, SC	42
Hampton Roads, VA	50
Houston, TX	40
Tacoma, WA	50
Miami, FL	42
Savannah, GA	42
Port Everglades, FL	42
Baltimore, MD	50
Portland, OR	40
New Orleans	45
Jacksonville, FL	38
San Juan, PR	36
Gulf Port, MS	36
Wilmington, NC	38
Palm Beach, FL	33

*Channel depths cited are for Federally maintained channels at mean low water (MLW). Sources: AAPA, USACE and individual port statistics. Seattle harbor is 52 feet deep.

3.7 Conclusion

The most important conclusion of this section is the significant trend toward larger containerships. Since WRDA'86, containership dimensions have grown rapidly, and today vessels of 4,000 to 6,000 + TEUs are more common. By the year 2010, about 30 percent of containerized tonnage is expected to be shipped on vessels of 4,000 to 6,000 TEUs, and more than nine percent on vessels of 6,000 to 8,000 TEUs.[22] This number is even more impressive considering that, according to NDNS forecasts, from 1996 through 2010 container trade is projected to increase by nearly six percent per annum. In 1996, containerships carried 70 million metric tons of cargo to and from the United States. This means that by 2010, tonnage carried on Post-Panamax vessels will almost be equal to total U.S. container tonnage in 1996. These ships require depths of at least 45 feet and many require 50 feet or more - particularly the most recent generation of Post-Panamax containerships (6,000 + TEUs). America's trading partners have recognized this and many have deepened container channels to 50 feet or more. Port authorities here and abroad are investing in the necessary landside improvements to meet anticipated increases in container shipping demand, but in the U.S. harbor depths remain an obstacle.

[22] U.S. Department of Transportation, "The Impacts of Changes in Ship Design on Transportation Infrastructure and Operations." Washington, D.C., Feb. 1998.

4: LEGISLATIVE HISTORY OF COST-SHARING

4.1 Legislative History of Cost-sharing

Before 1986, the Federal government paid 100 percent of "general navigation features" of harbor projects that consisted primarily of harbor dredging. Section 101(a) of WRDA'86 changed cost-sharing for "general navigation features" to include a local or non-Federal share as shown in Table 4-1. WRDA'86 mandated the following requirements for channel construction:

> " The non-Federal interests for a navigation project for a harbor or inland harbor, or any separable element thereof, on which a contract for physical construction has not been awarded before November 17, 1986, shall pay, during the period of construction of the project, the following costs associated with general navigation features:
>
> > (A) 10 percent of the cost of construction of the portion of the project which has a depth not in excess of 20 feet; plus
> > (B) 25 percent of the cost of construction of the portion of the project which has a depth in excess of 20 feet but not in excess of 45 feet; plus
> > (C) 50 percent of the cost of construction of the portion of the project which has a depth in excess of 45 feet." [23]

For operations and maintenance (maintaining channel depths) Section 101(b) of WRDA'86 stipulated that:

> "The Federal share of the cost of operation and maintenance of each navigation project for a harbor or inland harbor constructed by the Secretary pursuant to this Act or any other law approved after November 17, 1986, shall be 100 percent, except that in the case of a deep-draft harbor, the non-Federal interests shall be responsible for an amount equal to 50 percent of the excess of the cost of the operation and maintenance of such project over the cost which the Secretary determines would be incurred for operation and maintenance of such a project if such a project had a depth of 45 feet." [24]

[23] United States Code, Title 33, Chapter 36, Subchapter I, Section 2211.
[24] *ibid.*

Table 4-1: Navigation Cost-sharing Rules of WRDA'86		
Channel Depth	Federal Share	Non-Federal Share
20 feet or less	80 percent	20 percent
20 to 45 feet	65 percent	35 percent
Over 45 feet	40 percent	60 percent
Note: Non Federal shares include 10 percent cash contribution requirement for all depths. The 10 percent cash contribution may be offset by a credit for lands, easements, rights of way and relocations, which are still a non-Federal responsibility. To the extent not offset, this 10 percent can be repaid over time. Source, United States Code, Title 33-Navigation and Navigable Waters, Chapter 36-Water Resources Development.		

Relevant legislative history for WRDA'86 is contained in a report by the Committee on Merchant Marine and Fisheries (CMMF) that accompanied House Resolution 6 - the predecessor to WRDA'86. In the report, the CMMF explains why it recommended a larger local cost-share for channels greater than 45 feet:

> "The Committee has surveyed the manner of financing navigation projects in most developed countries. Based upon its survey, the Committee found that most of the national Governments in those countries financed general navigation improvements, including main and entrance channels to a depth of 45 feet to accommodate general cargo vessels."

The CMMF went on to explain:

> "At the same time, most of those countries require local contribution to the cost of construction and maintenance of navigation projects in excess of that depth (45 feet) to accommodate larger, specialized vessels increasingly operating in liquid and dry bulk trades."

In essence, the CMMF wished to reconcile port development policy "with prevailing international practice" and noted:

> "This is accomplished through the establishment of 45 feet as the maximum standard depth for ports not designed to accommodate deep draft vessels, and the declaration of channel depths in excess of 45 feet as deep draft ports."

In summary, the CMMF established 45 feet as the maximum depth for general cargo vessels including containerships. Depths of more than 45 feet were needed only for deep draft vessels that specialized in liquid and dry bulk cargo. Thus, for local sponsors, costs of deepening general cargo channels below 45 feet increased substantially.

At the time, the CMMF accurately portrayed the types and sizes of vessels calling on U.S. ports, and they did not expect containerships to grow in size for a number of reasons. First, as discussed in Section 3 of this report, containerships did not require depths greater than 45 feet because most containerized trade passed through the Panama Canal. Although there were trade routes for general cargo that did not rely on the Panama Canal, most carriers were reluctant to order larger containerships. At the time, most general cargo ships operated like a rental car service where a ship, like a car, was hired or chartered for a single voyage or period. Thus, flexibility with respect to trade routes was very important. If vessels were too large to navigate the Canal, flexibility in responding to shipping demand would be greatly reduced.[25] Finally, the introduction of larger containerships was fraught with uncertainty because of the need for new port infrastructure including loading and unloading facilities, adequate intermodal connections and deeper harbors at many ports in the United States and abroad.

For all of these reasons, the CMMF concluded that containerships were not going to get bigger and that channel depths for containerships would not need to exceed 45 feet in the indefinite future. Given the limits of the Panama Canal, 45 feet seemed generous. Thus, for several years the only U.S. channels deepened beyond 45 feet were ones designed to accommodate specialized dry bulk vessels and petroleum tankers. For example, channels at Baltimore and Norfolk were deepened to 50 feet to handle most of the Nation’s coal exports.

Although the CMMF acted on the best information at the time, it has turned out that their key assumptions regarding growth in the size of general cargo vessels including containerships were short of the mark. In retrospect, this is what appears to have happened. Technology to build larger containerships had always existed and the potential economic gains from using them were well understood. But, at the time of WRDA’86 there were not enough incentives for carriers to build larger ships. Deregulation of transportation industries spurred companies to consider how they might use larger ships to gain an edge over their competitors. Deregulation encouraged mergers, as well as shared trade routes, vessels and equipment. The formation of shipping alliances and mergers was particularly important.

As international trade increased and demand for container services grew throughout the 1980s, competition among carriers for the increased demand resulted in numerous companies offering the same services on identical routes. At the same time, many carriers were purchasing larger vessels to increase efficiency. The end-result was

[25] At the time, the concept of cargo vessels operating in regularly scheduled sequences of ports (liner services) was not well entrenched. However, today most large container carriers operate as liner services.

an oversupply of ship space in an already crowded market. In an attempt to restrain costs and increase efficiency, operators began the “rationalization” of their ships. Carriers wanted to avoid sailing a vessel unless it was full of cargo, because empty container space does not generate revenue for carriers. Rather than sailing ships that were partially full, carriers began renting container space to each other (“slot-sharing”). Eventually, carriers formed partnerships that were based not only on slot-sharing, but also on co-investments in ships and terminals. However, unlike mergers, each company remained separate with individual marketing and management departments. Overall, formation of alliances has allowed carriers to:

- combine their containership fleets,
- eliminate duplicate voyages,
- increase the frequency of voyages,
- expand global coverage,
- make more efficient use of ship space, and
- increase their shares of the shipping market.

Each of these factors eased competition, reduced costs and fueled trends toward larger containerships. As individual companies, carriers were reluctant to invest in larger vessels because of the risk and sizeable capital venture involved. There were no guarantees that shipping demand would be sufficient to keep larger vessels full. However, with slot-sharing through alliances, an individual carrier has a greater degree of confidence that a ship can be filled to capacity. An example of this trend was an agreement by two of the world’s largest container carriers - Maersk and SeaLand. The two companies allied themselves in a load sharing arrangement so that both could lower costs and use ship space more efficiently, which in turn, reduced capital costs and risks of purchasing or leasing large containerships. The alliance between Maersk and SeaLand proved so successful that the companies merged under the name Maersk/SeaLand. Today, the company operates some of the world’s largest containerships. Maersk/SeaLand has 92 containerships, and of these, eleven have capacities of 6,600 TEU (“S-Class”) and six have capacities of 6,000 TEU (“K-Class”). All of these vessels have been built since 1996. Once a few industry leaders such as Maersk committed to larger containerships as their competitive edge, other operators followed suit. For example, since 1997 P&O Nedlloyd has introduced four 6,690 TEU containerships. In total, there are about 45 vessels greater than 6,000 TEU being built around the world.

Strong trade encouraged this trend. Port operators along trade routes serviced by major carriers began to deepen channels and purchase necessary container cranes and other landside facilities. Improvement to landside facilities has begun in the United States. As a final step, port authorities are approaching Federal agencies and Congress to inform them that a significant portion of general cargo will be carried on ships that require 45 feet or greater of channel depth.

4.2 International Dredging Finance Practices

As demonstrated in Section 2 of this report, many of the world's leading container ports have or are deepening harbors to service new containerships. Thus, it is important to understand how foreign ports finance dredging projects and whether there have been significant changes in how foreign nations fund harbor improvements.

A report by the Corps analyzed financing practices among 19 nations that represent about 50 percent of world trade based on tonnage. This report was reviewed to determine whether any changes in financing practices had occurred since 1985. Only one nation, Australia, appears to have privatized and decentralized its port program including dredging. Argentina has also privatized, but has had to heavily subsidize private companies for key waterway development to account for past neglect.

Other nations surveyed retain a strong and continuing national presence in funding new construction dredging, and distinctions between general and bulk cargo appear to have diminished. None of the nations reviewed in the report distinguished between bulk and general cargo when allocating funds for dredging projects. Although some foreign governments finance various forms of landside development, most do not. One caveat should be noted. Virtually every country surveyed is attempting to find sources for funding port development that are more targeted than are direct port revenues. This is consistent with recent history in the United States. Port authorities in the U.S. are relying on port revenue bonds more and on general obligation bonds less.[26] However, the attempt to steer away from direct port revenue funding has not lead most foreign countries to lessen financing of dredging and other port improvements. The report concludes:

> "The international evaluation of dredging practices has highlighted the wide variety of approaches in other countries. However, in most cases a single theme runs through the policy. That is, that national governments via ministries of transport, maritime affairs or commerce generally take responsibility for dredging of ports. The dredging activity is regarded as an investment in the national infrastructure."

[26] General obligation bonds commit the credit of large municipalities or state entities and are often backed by tax warrants or similar property tax guarantees. Port revenue bonds are backed primarily by expected returns from port operations. See Section 5 of this report for a comprehensive discussion of port financing mechanisms.

4.3 Conclusion

WRDA'86 imposed a 50 percent cost-share for the channel deepening increment beyond 45 foot depths based on the assumption that such depths would continue to be necessary to accommodate only specialized liquid and dry bulk vessels. The Act mandated a lower cost-share for general cargo channels including those for containerships. Based on composition of the fleet in 1985 and a survey of international dredge financing practices, the dividing depth between deep draft and general cargo was estimated to be 45 feet. Since 1985, the composition of the world containership fleet has changed significantly, and today required depths for some general cargo channels are between 50 and 55 feet. In the future, required depths may be greater because it remains difficult to predict with certainty whether or not containership dimensions will continue to grow. Just as the world general cargo fleet has changed since WRDA'86, so have dredging financing practices among U.S. trading partners. In 1986, there was a depth threshold for cost-sharing, but today this no longer seems to be the case. Foreign governments continue to take responsibility for harbor improvements including deep draft dredging. As was the case when WRDA'86 was implemented, justifications for harbor projects relate to investments in national infrastructure.

5: POTENTIAL FINANCIAL CONSTRAINTS FACED BY U.S. PORT AUTHORITIES

5.1 Patterns of Port Investment

Port authorities play a much greater role in financing overall port infrastructure (both landside and waterside) than does the Corps through the dredging of Federal channels. Port investment has risen sharply during the post-WRDA'86 period, and this trend is expected to continue. As shown in Table 5-1, from 1946 to 1998 public ports have invested $19.8 billion in capital improvements for facilities and related infrastructure.[27] In contrast, the Federal government has spent about $2.8 billion on harbor construction from 1963 to 1998.[28] From 1988 to 1998, a period roughly corresponding to the post-WRDA'86 time frame, port investments totaled $10.9 billion, rising from $500 million during 1988 to $1.4 billion in 1998. Over the same period, the Federal government has spent $1.2 billion on harbor construction. Further, and most importantly, 55 port authorities indicate that they plan to spend a total of $9.1 billion over the next five years - an average of $1.8 billion per annum. In the past, actual expenditures on port improvements exceeded planned expenditures.

Table 5-1: Port Expenditures on Capital Improvements (1946 through 1998)

Region	Expenditures ($millions)	Percent of Total
North Atlantic	$3,590	18.2%
South Atlantic	$2,802	14.2%
Gulf Coast	$3,507	17.7%
South Pacific	$5,938	30.0%
North Pacific	$2,368	12.0%
Great Lakes	$557	2.8%
Alaska, Hawaii, Puerto Rico and Virgin Islands	$821	4.1%
Guam and Saipan	$93	1.0%
Total Expenditures	$19,775.4	100.0%

Source: U.S. Maritime Administration

[27] U.S. Maritime Administration, United States Port Development Expenditure Report. Maritime Administration, November 1999.

[28] Federal expenditures for dredging are only available from 1963 onward.

Table 5-2 displays capital expenditures according to the type of cargo service. Each category includes outlays for berthing, storage facilities and handling equipment, but does not include expenditures for dredging. While ports are developing and modernizing operations, they appear to be focusing on improving general cargo and container facilities. Public ports plan to allocate about 60 percent of capital expenditures for general cargo, primarily container facilities. Since not all ports compete for container business, this number is strikingly high and has been for many years.

Table 5-2: Distribution of Current and Projected Expenditures by Cargo Type

Type of Facility	Actual Expenditures (1998)	Planned Expenditures (1999 through 2003)	Relative Change
General Cargo	46.7	59.2%	12.5%
Dry Bulk	6.4%	2.0%	-4.4%
Liquid Bulk	0.2%	1.2%	1.0%

Source: U.S. Maritime Administration, United States Port Development Expenditure Report, November 1999.

5.2 Financing Mechanisms for Port Development

There are three general mechanisms for financing port development 1) general obligation bonds, 2) revenue bonds and 3) port revenues (See Table 5-3). General obligation bonds (GO) commit the full faith and credit of large municipalities or state entities and are often backed by tax warrants or similar property tax guarantees. This method financed 30.6 percent of all port expenditures during the 1970s but has declined to 6.6 percent in the 1990s. The disparity has been taken up through the use of port revenue bonds and port revenues.

Port revenue bonds are backed primarily by expected returns from port operations. During the 1990s, revenue bonds became principal funding sources (41 percent) for port infrastructure. In the past, most landlord port authorities could support revenue bonds out of lease payments.[29] However, for container facilities this is more difficult. Container terminal operators have greater discretion in choosing a location and leases are often structured to give operators considerable control over levels of cargo traffic and hence lease amounts. Operator port authorities have the same problems. In any event, port authorities plan to decrease reliance on revenue bonds by 33.2 percent. Port authorities plan to use port revenues to make up the difference. They anticipate

[29] Port agencies can be “operating” ports or “landlord” ports. Operating ports are agencies that physically build, operate and have ownership of port infrastructure. Public ports that are built and leased to a private company for operation are considered landlord ports.

paying for about 41 percent of capital improvement out of port revenues through 2003. Port revenues are "retained earnings," and like revenue bonds, they come from a narrow revenue base relative to general obligation bonds. In order to have retained earnings, a port must generate profits.

Although GO bonds, revenue bonds and direct port revenues account for most port financing, other avenues are available such as grants, state trust funds and appropriations and tax revenues. These sources increased throughout the 1990s and should continue to rise in the next few years. However, they are still generally limited in amount and availability.

Table 5-3: Distribution of Actual Port Development Financing Methods for 1973 through 1998 and Planned Expenditures through 2003

	Actual Capital Expenditures			Planned Capital Expenditures
Financing Method	1973 -1978	1979 - 1989	1990 - 1998	1999 - 2003
Port Revenues	26.7%	47.7%	33.8%	41.1%
General Obligation Bonds	30.6%	14.8%	6.6%	8.9%
Revenue Bonds	29.1%	27.9%	40.9%	33.2%
All others*	13.6%	10.5%	18.7%	16.8%

* Other funding category includes all financing sources that were not described above, such as state transportation trust funds, state and local appropriations, taxes (property, sales), and lease revenues. Source: Adapted from, U.S. Maritime Administration, United States Port Development Expenditure Report, November 1999.

5.3 Port Profitability and Self-Sufficiency

Since the two major sources of port investment - revenues and revenue bonds - depend upon profits, available literature was reviewed to determine if ports could easily absorb increased dredging costs despite current obligations for landside improvements. Three preliminary points should be made. First, most port authorities are public agencies and are not profit driven. Second, in terms of infrastructure, U.S. ports have done an excellent job in keeping the Nation competitive in world markets including those for commodities shipped in containers. Third, it is very difficult to determine whether a port authority can afford improvements. Port authorities, like most agencies, perceive that they can find ways to fund whatever is needed, and, more practically, they will not act in a manner that may affect future credit ratings.

A study published by MARAD concluded that from 1988 the 1992 there was not a trend toward financial self-sufficiency or increased profitability at public ports.[30] In 1992, one-half of the 55 responding ports were not self-sufficient or were "narrowly" self-sufficient. All of these ports suffered net losses before taxes and contributions. In 1998, after a long period of economic growth, over one third of responding ports reported that they were not self sufficient or only "narrowly" self-sufficient and all ports recorded net losses.[31] Table 5-4 compares data for 1992 and 1998.

Table 5-4: Net Income Comparison of Public Ports 1992 through 1998 ($millions)

Port respondents	1992	1998	Percent Change
Operating Income	$1,379	$2,113	+50%
Bond Interest Payments	-$168	-$300	+80%
Net Income before taxes and contributions			
Total	$178	$207	+16%
Per Port	3.0	2.8	-0.6%

Source: U.S. Maritime Administration

Table 5-4 highlights some important trends. Bond interest indebtedness has grown very rapidly from 1992 to 1998, which was a period of economic vitality in the United States. As noted previously, ports relied on revenue bonds extensively in the 1990s, but in the future they plan to shift more toward other sources including direct revenues. However, port profitability was virtually unchanged and very low from 1992 through 1998. If ports are planning on using revenues for future capital improvements, profits will have to increase.

In summary, the data suggest that public ports are heavily burdened by capital demands and they appear to be meeting them well. However, there is reason to question whether public ports can continue to meet these demands through using port revenues and revenue bonds, particularly since many are barely breaking even.

[30] U.S. Maritime Administration, Public Port Financing in the United States, July 1994.
[31] U.S. Maritime Administration Public Port Finance Survey for FY 1998, Maritime Administration, December 1999.

5.4 Credit-Worthiness of Ports

Analysis of port credit is an excellent indicator of the potential challenges confronting the Nation's ports. Data from Moody's Investor Service confirm these challenges and reveal that cost pressures facing ports dominate the industrys assessment. Analysts at Moody's rate bonds of virtually every sector of the world economy, including the $10.5 billion worth of debt issued by or on behalf of port authorities around the world.[32] Moody's assessment of specific bonds or their economic outlook for an industry can have a dramatic impact on a bond issuer's ability to find customers. A low rating implies that issuers will have to offer higher interest rates to attract customers, while a high rating allows issuers to offer lower interest rates. Moody's latest outlook for U.S. ports concluded that the industry appears to be stable despite increasing competitive pressures nationwide. As a result, Moody's retained an average A1 rating for large container ports. A1 is lower than other ratings and indicates that ports:

> "possess many favorable investment attributes and are to be considered as upper medium grade obligations. Factors giving security to principal and interest are considered adequate, but elements may be present that suggest a susceptibility to impairment some time in the future."

The "susceptibility" that concerns Moody's refers to increasing port competition, the growth of container trade and related infrastructure issues including dredging. In Moody's opinion, some of the greatest competitors of the Nation's ports are not other U.S. ports, but ports in Canada, the Caribbean and possibly Mexico. For example, Moody's estimates that the Port of New York/New Jersey has lost about 10 percent of its Chicago bound discretionary cargo to the Canadian port of Halifax. In the Caribbean, Freeport, Bahamas is strategically located to serve as a transshipment hub for the East and Gulf Coasts of the United States, the Caribbean and South America. Freeport serves trade lanes to Europe, the Mediterranean, the Far East and Australia.[33] If Post-Panamax ships are not able to access U.S. ports because of depth constraints, transshipment at Freeport could become a very viable option for many of the larger carriers. Carriers servicing east-west or north-south trade routes could reroute large containerships to Freeport and bypass U.S East Coast ports. Feeder services could be used to transfer cargo to East Coast ports.

Moody's remains optimistic that U.S. ports can meet new challenges, but they believe the situation needs close attention. Clearly any downgrading of bond ratings would be severe, since the next lower bond (Baa) contains speculative elements.

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[32] See, Moody's Port Ratings/Outlook. June 1998, and The Rating Methodology /Analytical Framework for Ports Ratings. February 1999.

[33] Freeport has several advantages. It located just 65 miles from the coast of Florida, and it has deep water with one of the deepest harbors in the region at 52 feet. Container terminals are now operational and taking regular calls from major carriers. Since 1996, TEU throughput at Freeport has increased by over 1000 percent.

5.5 Impact of WRDA'86 Cost-Sharing

The impact of WRDA'86 on port planning for capital expenditures can be illustrated by a straightforward example. Suppose a port authority has agreed to cost-share a deepening project. If there is a cost increase, the port authority and its cost-sharing partner will suffer the same percentage increase. Likewise, if the port authority wants a deeper project, but one less than 45 feet, then it expects to pay its proportional share of the increase. If the cost increase is 100 percent, the port authority expects that its portion of the cost will go up 100 percent. This illustrates the intent of WRDA'86, which sought to impose some of the costs of deepening upon a local sponsor. By doing so, there would be less demand for large projects fully funded by the Federal government.

WRDA'86 established cost-sharing rules that are progressive with depth. Specifically, a cost-sharing threshold is set at 45 feet, above which (i.e., shallower) a local sponsor would pay 25 percent and below which (i.e., deeper) local sponsors would pay 50 percent plus 10 percent cash and LERR of project GNF costs. To illustrate the impact on local sponsors, assume that a Federal feasibility study determines that deepening a channel beyond 45 feet to accommodate larger containerships would provide an optimal level of benefits to the Nation. For depths greater than 45 feet, increases in dredging costs fall disproportionately on the non-Federal sponsor (i.e. port authorities). There are two reasons why this result is not desirable. First, it is not equitable and second it gives local sponsors the wrong signal by providing them an incentive to stop at sub-optimal depths. If a sponsor is under considerable financial stress, this signal is more pronounced.

5.6 Direct Costs of Not Deepening Harbors to Accommodate Larger Ships

The direct costs of not deepening harbors to accommodate larger ships could be measured as cargo diverted to a foreign port and higher per unit transportation costs which would result in higher commodity prices making imported goods more expensive and exported goods and less competitive in world markets. These types of impacts could dampen international trade that has significantly contributed to the Nation's recent economic expansion. The potential impacts of these costs are best demonstrated with an example. Assume a fully loaded 6,000 TEU containership is sailing on a trade route from Rotterdam to New York. Fully loaded the ship sails at a draft of 46 feet and requires water depths of about 51 feet to safely navigate. To sail into New York, which is assumed to have a 45 foot channel, the vessel would likely offload cargo at the Canadian port of Halifax. Sailing with a lighter load results in a 35 percent cost increase per TEU.[34] This substantial increase in transportation costs could result in a vessel operator bypassing the constrained port altogether, at least for discretionary hinterland cargo. The point is that under such circumstances there is a significant impact on port

[34] See Appendix A for the methodology used to calculate the unit cost of light loading under this hypothetical scenario.

competitiveness and depending on location and other factors, trade may be lost to the Nation. At the very least, the constrained port would be used inefficiently resulting in higher transportation costs that are ultimately reflected in commodity prices, and a loss of revenue for the port and local economies.

5.7 Conclusion

The United States needs to maintain its competitive position in the global marketplace by providing an efficient port system fully capable of servicing new generations of containerships. Public ports in the U.S. have allocated huge sums of capital in an effort to prepare their facilities for growing container trade and larger containerships. Given the cost pressures facing the Nation's ports and since ports have taken a major step in securing an efficient maritime transportation network, perhaps the Federal role in deep draft navigation channels should be expanded as a matter of national policy.

6: SUMMARY AND CONCLUSION

National economies worldwide have become strongly intertwined as barriers to free trade are removed and the process of globalization accelerates. Economic growth in the United States has become ever more dependent on international commerce. In 1946, the value of foreign trade was $88.2 million, but by 1996 this had increased by a factor of almost twenty in real inflation-adjusted terms to $1.5 trillion. This represents an annual growth rate of about six-percent over the 50-year period. International trade has also become an increasingly important component of the U.S. economy. In 1959, exports and imports accounted for only eight percent of GDP, but by 1999 foreign trade comprised approximately 27 percent of GDP.

Ninety-five percent of U.S. foreign trade, excluding trade with Canada and Mexico, is seaborne and containerships carry the majority of cargo in terms of dollar value. Today, containerships transport 55 percent of foreign trade based on value. Short-term forecasts indicate that through the year 2002, seaborne container shipments to and from the U.S. should increase at a rate of between seven and eight percent per annum. Long term forecasts show growth in containers to increase by about six percent per annum through the year 2020. From the perspective of harbor and channel improvements containerships are critically important. Ports in the U.S. have invested huge sums of capital in landside infrastructure in response to growing demands for container shipping and larger containerships. Since World War II, public ports have spent about $20 billion on improvements to port facilities with approximately one-third of this allocated during the last five years. Over 40 percent of new construction has been invested in container terminals. Given that the budgets of public ports are heavily burdened with providing necessary land infrastructure, the Federal role in deepening navigation channels should be reconsidered. Since the introduction of WRDA’86 and its cost-sharing rules, containerships have grown rapidly in size, and new generations of vessels have design drafts that exceed channel depths at many U.S. container ports.

Current cost-sharing formulas under WRDA’86 were also based upon a survey of international dredging financing practices at that time. A congressional committee found that developed countries financed general cargo navigation improvements to depths of 45 feet. This made sense, because at the time there were no general cargo ships that required channels in excess of 45 feet, and given the state of the fleet in 1985, this was not expected to change. Based on a recent survey dredging financing practices among U.S. trading partners have changed since WRDA’86. Foreign nations no longer have a depth threshold for cost sharing, and foreign governments continue to take responsibility for dredging their national harbors. As was the case when WRDA’86 was implemented, the justification for harbor projects directly relates to investments in national infrastructure.

WRDA’86 imposed a 50 percent non-Federal cost-share on “deep draft” channels that accommodated specialized liquid and dry bulk vessels. The threshold depth that distinguished deep draft channels from general cargo channels was estimated to be 45 feet. Today, in light of changes in the containership fleet, this threshold has risen to depths of 50 to 55 feet. Containerships will probably continue to grow in size, and no one can predict with certainty what the fleet will look like in 10 or 20 years. Consequently, future thresholds may continue to change as fleets and international markets continue to grow and expand. Given the past dramatic and unexpected changes that have taken place in the fleet, it would be most prudent not to establish a threshold depth for cost-sharing.

Relative to the growing importance of international trade for the United States, the potential costs of changing the cost-sharing policy may be minimal. A review of potential projects needing greater than 45 feet was conducted to determine the most likely portfolio of projects that might be constructed over the next twenty years. This portfolio review identified nineteen possible projects at 15 ports that might be impacted by any change in the WRDA '86 rules (see Appendix B). Varying degrees of uncertainty are affixed to these projects since they include some projects authorized and programmed for construction along with other projects that are in various stages of planning, engineering or design. Including a particular project not yet authorized into this portfolio does not imply predetermination of economic, environmental or engineering feasibility. Their inclusion was made to set an upper bound on the potential increase in Federal expenditure that would likely occur from changes in the cost-sharing threshold.

Analysis of the portfolio of projects focused on estimating the Federal costs from two alternative changes to the WRDA '86 cost-sharing rules. One alternative considered changing the threshold from 45 feet to 55 feet. The second alternative looked at eliminating the threshold altogether and having only a two-tier cost-sharing system. Since none of the nineteen projects involved dredging deeper than 55 feet the budget impacts from both alternatives are the same. Changing WRDA'86 to reduce the non-Federal cost-sharing to 25 percent of project costs is expected to require (per annum) an additional $42 million in construction and about $51 million in operations and maintenance over a 20 year period. These amounts are moderate in comparison to the current Corps budget. In total, the estimated costs of changing cost-sharing formulas comprise approximately two percent of the Corps' current annual budget.[35]

The cost-sharing threshold for deep draft navigation projects greater than 45 feet, as established by Section 101, WRDA '86, should be considered for change by eliminating the increase in cost-sharing for those General Navigation Features beyond 45 feet. The conditions under which Section 101, WRDA '86 was implemented have changed and need to be updated for the 21st Century. The importance of international trade for the U.S. economy has reached significant proportions that make U.S. ports critical conveyors of national well being and national benefits to domestic consumers and manufacturers alike. Requiring local communities to invest a greater share of local finances for deeper channels that benefit the Nation could result in resource allocations that are less than optimal from a national perspective. Since the general welfare of the Nation is increased through cheaper goods and services a slightly higher Federal

[35] See Appendix B for the assumptions and data that these estimates are based upon.

expenditure for deeper harbor channels will provide for continued growth in international trade and achieve optimal national resource allocation. Given that the growth in larger containerships is expected to continue as globalization of trade expands and foreign nations no longer maintain cost-sharing thresholds, the current cost-sharing rules establishing a 50/50 cost-share for channels dredged deeper than 45 feet should be considered for elimination.

APPENDIX A: CALCULATION OF A HYPOTHETICAL LIGHT-LOADING SCENARIO

A 6,000 TEU containership is sailing from Rotterdam to New York. Loaded to deadweight capacity, she needs to draw 51 feet of water. To enter New York harbor operators must reduce sail draft to 40 feet. This assumes she needs to sail at 10 percent less than design draft (46 *.10 = 4.6 feet). To reduce draft the vessel lightens at the Canadian port of Halifax.

Ship Characteristics:

TEU:	6,000
DWT:	82,000
Design Draft:	46 ft.
Total Daily Operating Cost:	$60,197
TPI:	279

Total Daily Operating Costs:

- Assume constant revenues per TEU
- Assume constant unit weight for TEU (13.8 tons)
- 3,348 tons per foot = 243 TEUs per foot
- Light loading from 46 feet to 40 feet necessitates a reduction in sailing draft of 6 feet and TEU at 40 feet = [(6000 – (243*6.)] = 4, 542 TEU
- Unit daily fixed cost fully loaded = $10.03 per TEU
- Unit daily fixed cost light loaded = $13.25 per TEU
- Percentage increase in unit cost per TEU: 32%

APPENDIX B: COST ESTIMATION OF A POTENTIAL CHANGE IN COST-SHARING FOR DEEP DRAFT NAVIGATION PROJECTS

In late 1999, the U.S. Army Corps of Engineers' Institute for Water Resources (IWR) compiled a list of deep draft navigation projects with project elements that had the potential to include channel deepening to depths greater than 45 feet. This portfolio not only includes deepening projects programmed for construction within the USACE ten-year budget plan (FY 2000 Budget Request), but also potential projects that are in various stages of planning or engineering design. Such deepening projects were included in the portfolio based on an assessment whether they *might* be constructed during the period from the year 2000 through 2020. Corps District personnel estimated the construction costs of each project and the Federal and non-Federal share of construction costs. Estimating the costs of dredging for depths below 45 feet is a key component of the portfolio of projects. This critical information was used to determine the financial impact of any potential revision to a deep draft navigation cost sharing formula. A list of the 19 navigation projects (within 15 ports) with features that might be affected by changing cost-sharing was developed and is included as Tables B-1 and B-2. *This list of projects does not represent any Administration policy or decisions made regarding the actual construction of any individual project.* Each and every project must meet feasibility standards based on the Water Resources Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* that reflect national engineering, economic and environmental criteria. The list should not be interpreted as a pre-decision on the feasibility or budget priority of any project that has not been specifically authorized.

Note that this list is considered to represent the universe of deepening projects that have a potential to be implemented within the next twenty years. Since there is degree of uncertainty regarding the actual construction of each and everyone one of these projects this portfolio was established as a reference point from which further discussions could be conducted regarding the implications of revisions to current deep draft navigation cost-sharing formula. A simplified representation of actual future events is presented using a concept of average annual costs. The actual impact of any revised cost-sharing formula for deep draft projects in any given year may vary greatly from the displayed average annual estimate of fiscal impact depending on the construction schedules of the projects in the portfolio. There may be peaks or spikes in the required levels of Federal funding whenever construction schedules from several projects overlap.

The estimated project costs are based on data collected from various sources that included:

(1) FY 2000 budget justification documents or the latest budget justification documents available for a project if the FY 2000 budget document was not available,

(2) estimates from USACE District office personnel, if budget documents were not available,
(3) cost estimates from USACE District feasibility reports or Annual Reports as prepared by the Districts,
(4) and in the case of projects where planning studies have not yet begun, estimates developed by IWR staff.

Deep draft navigation projects were separated into the following categories:

1) Authorized by Congressional legislation,
2) Projects where planning activities are underway,
3) Other projects

Each category of projects is discussed below.

1) Projects authorized by Congressional legislation: Those navigation projects that had already been authorized by Congress to depths greater than 45 feet include the following:

- Baltimore Harbor and Channels – 1970 Modification - authorized by the River and Harbor Act of 1970 (H. Doc. 181, 94th Cong., 1st Sess.) and the Supplemental Appropriations Act of 1985 (Public Law 99-88));

- Baltimore Harbor Anchorages and Channels, Maryland – authorized by the Water Resources Development Act of 1999 (Public Law 106-53);

- Mississippi River Ship Channel, Gulf of Mexico to Baton Rouge, Louisiana – Phase III - authorized by the Supplemental Appropriations Act of 1985 (Public Law 99-88), the Water Resources Development Act of 1986 (Public Law 99-662) and the Water Resources Development Act of 1988 (Public Law 100-676));

- Mobile Harbor Deepening, Alabama - authorized by the Supplemental Appropriations Act of 1985 (Public Law 99-88) and the Water Resources Development Act of 1986 (Public Law 99-662);

- Norfolk Harbor and Channels (Deepening), Virginia - authorized by the Supplemental Appropriations Act of 1985 (Public Law 99-88) and the Water Resources Development Act of 1986 (Public Law 99-662).

- Oakland Harbor, California - authorized by the Water Resources Development Act of 1999 (Public Law 106-53)

- Savannah Harbor, Georgia and South Carolina – authorized by the Water Resources Development Act of 1999 (Public Law 106-53)

2) Projects where planning activities are underway

- Corpus Christi Ship Channel, Texas - a reconnaissance report recommending deepening the Corpus Christi Ship Channel was completed in 1994. A feasibility study is currently be conducted by the District.

- East Waterway, Seattle Harbor, Washington, Phase II - planning for improvements to the waterway are being conducted by the District.

- Los Angeles Harbor, Main Channel Deepening, California – expedited planning for improvements to the waterway are being conducted by the District under Section 203 of the Water Resources Development Act of 1986.
- New York and New Jersey Harbor, New York and New Jersey - a feasibility study was completed in December 1999 and preconstruction engineering and design activities were initiated by the District.

- New York Harbor Anchorages Areas, New York – improvements to three anchorage areas within the Port are being investigated by the District.

- Sabine – Neches Waterway, Texas - planning for improvements to the waterway is being conducted by the District.

- San Francisco Bay, California – planning for improvements are being conducted by the District.

3) Other Projects

- Blair Waterway (Tacoma), Washington – construction is being performed under Section 107 of the River and Harbor Act of 1960

- Charleston, South Carolina – deepening to a depth of 50 feet is assumed by IWR staff to occur sometime during the period from 2000 to 2020

- East Waterway, Seattle Harbor, Washington, Phase I – construction is being performed under Operations and Maintenance authority

- Southampton Shoal Channel, California – investigation of improvements to the waterway are not currently underway by the District, however cost information was obtained from District personnel.

- Texas City Channel, Texas – a project to modify the existing channel by deepening to a depth of 50feet was authorized by the Water Resources Development Act of 1986 (Public Law 99-662), however, the project was placed in “deferred” status in 1989. A review of the project was conducted in Fiscal Year 1998 to determine removal of the project from “deferred” status.

Total cost for all projects are given in Table B-1. Projects included in the analysis are listed in Table B-2. The most relevant data in Table B-2 show the Federal share of dredging requiring a 50/50 split under current rules. Under a revised policy, this share would be 75 percent Federal and 25 percent non-Federal. All other columns of the chart remain the same. As shown in Table B-1, a revised policy would cost a total of about $832 million. Allocated over a 20-year period, this amounts to an average of nearly $42 million per annum. Given that this figure is probably inflated, it is satisfactory from a policy standpoint. For the most part, costs of maintenance dredging to depths greater than 45 feet are small, perhaps $1 million per annum. A notable exception is the Mississippi River Ship Channel Project that has an incremental cost of $50 million per annum. Hence, a policy change would appear to cost about $51 million a year in operation and maintenance, with over ninety percent of the increase associated with one project.

Table B-1: Comparison of Potential Changes in Non-Federal and Federal Costs under a Revived Cost-sharing Scenario ($millions)				
	Total Cost for all Projects	Federal Cost (general construction)	Non-Federal Cost (general construction)1/	Federal Cost (annual maintenance)
Current Policy (50/50 cost-share)	$5,066.7	$2,123.5	$2,943.2	$0.0
Revised Policy (25/75 cost-share)	$5,066.7	$2,955.6	$2,111.1	$51.4
Change	$0.0	+ $832.1	- $832.1	+ $51.4
Change allocated over a 20 year period	$0.0	+ $41.6	- $41.6	+ $51.4

1/ Non-Federal cost (general construction) includes expenditures for lands, easements, rights of way and disposal.
Source: Based on portfolio of projects listed in Table B-2.

Table B-2: Future Projects where Deepening beyond 45' is Authorized, Programmed or Planned ($millions)														
Project or Study Title	Estimated Project Cost	Estimated Federal Cost	Estimated Non-Federal Cost	Total Cost of General Navigation Features (GNF) Requiring 75/25 Split	Federal Share of GNF Requiring 75/25 Split	Non-Federal Share of GNF Requiring 75/25 Split	Total Cost of GNF Requiring 50/50 Split	Federal Share of GNF Requiring 50/50 Split	Non-Federal Share of GNF Requiring 50/50 Split	Other Federal Costs (1)	Non-Federal Other Costs (2)	Non-Federal Lands, Easements, Rights of Way, Relocations	Non-Federal Reimburse ment	Incremental Maintenance Above 45 Ft.
Baltimore Harbor and Channels - 1970 Modification	$84.1	$42.0	$42.1	$23.9	$17.9	$6.0	$48.2	$24,100	$24.1	N.A.(3)	$12.0	N.A.	N.A.	N.A.
Baltimore Harbor Anchorages	$29.3	$19.3	$9.9	$25.5	$19.1	$6.4	$1.7	$855	$.9	N.A.	$0	$2.1	$.6	N.A.
Blair Waterway (Tacoma), WA	$4.6	$2.0	$2.6	-	-	-	$4.0	$1,976	$2.0	N.A.	$.6	N.A.	N.A.	N.A.
Charleston, SC	$345.0	$132.0	$213.0	-	-	-	$330.0	$165,000	$165.0	N.E.M. (4)	$15.0	N.E.M.	$33.0	N.E.M.
Corpus Christi Ship Channel, TX	$152.0	$50.2	$101.8	-	-	-	$100.4	$50,241	$50.2	N.A.	N.A.	$51.5	$0	$176
East Waterway (Seattle), WA - I	$7.1	$3.2	$4.0	$1.8	$1.4	$.5	$3.6	$1,800	$1.8	N.A.	$1.7	$0	$0	N.A.
East Waterway (Seattle), WA - II	$30.0	$14.0	$16.0	-	-	-	$28.0	$14,000	$14.0	N.A.	$2.0	N.A.	N.A.	N.A.
Los Angeles Main Channel, CA	$148.9	$47.6	$101.3	-	-	-	$95.2	$47,589	$47.6	N.A.	$41.6	$12.1	$0	N.A.
Mississippi River Ship Channel, Gulf to Baton Rouge, LA - Phase III	$557.0	$144.0	$412.9	$5.7	$4.3	$1.4	$277.1	$138,561	$138.6	$1.2	$272.5	$.4	$0	$49.7
Mobile Harbor, AL	$567.5	$251.1	$316.4	$100.9	$75.7	$25.2	$452.9	$226,457	$226.5	$4.3	$9.3	N.A.	$55.4	$1.3
New York - New Jersey Harbor	$1,781.2	$7440	$1,037.3	$324.8	$243.6	$81.2	$1,321.1	$660,549	$660.5	N.A.	$135.3	N.A.	$160.2	N.A.
New York Harbor Anchorages	$56,.6	$28.3	$28.3	-	-	-	$56.6	$28,293	$28.3	N.A.	N.A.	N.A.	N.A.	N.A.
Norfolk Harbor, VA	$221.6	$106.1	$115.6	$72.0	$54.0	$18.0	$124.0	$62,000	$62.0	$.5	$22.5	$2.6	$10.4	N.A.
Oakland Harbor, CA	$252.3	$128.1	$124.2	$73.6	$55.2	$18.4	$70.9	$35,435	$35.4	$38.0	$55.9	$13.9	$.6	$.1
Sabine - Neches Waterway, TX	$260.0	$86.0	$174.0	-	-	-	$172.0	$86,000	$86.0	N.A.	$88.0	N.A.	N.A.	N.A.
Savannah Harbor, GA & SC	$223.9	$143.2	$80.7	$94.4	$70.8	$23.6	$32.1	$16,032	$16.0	$66.9	$28.4	$2.1	$10.6	$.08
San Francisco Bay, CA	$65.7	$26.3	$39.4	-	-	-	$65.7	$32,850	$32.9	N.A.	N.A.	N.A.	$6.6	N.A.
Southampton Shoal Channel, CA	$82.2	$32.9	$49.3	-	-	-	$82.2	$41,100	$41.1	N.A.	N.A.	N.A.	$8.2	N.A.
Texas City, TX	$197.7	$123.3	$74.4	$122.6	$91.9	$30.6	$62.8	$31,389	$31.4	N.A.	$11.6	$.8	N.A.	N.A.
Total	$5,066.7	$2,123.5	$2,943.2	$845.2	$633.9	$211.3	$3,328.5	$1,664,227	$1,664.2	$111.0	$696.5	$85.5	$285.7	$51.4

Notes:
(1) Examples of Other Federal Costs include the Federal share of the cost of mitigation, ecosystem restoration, historic preservation, and aids to navigation.
(2) Examples of Other Non-Federal Costs include the Non-Federal share of the cost of mitigation, ecosystem restoration, historic preservation, the provision of local service facilities such as berthing areas (if not specifically identified in a project) and lands, easements, rights-of-way, relocations and dredged disposal sites (if not specifically identified in a project).
(3) N. A. - Not Available
(4) N.E.M. - No Estimate Made

Sources of Cost Figures:

Baltimore Harbor and Channels - 1970 Modification	FY 1990 Budget Justification Sheet. Cost figures shown are the unscheduled Federal and non-Federal Construction costs associated with the remaining items of work.
Baltimore Harbor Anchorages	Feasibility Report, October 1997. Project costs refer to authorized portions of project (channel widening, anchorage deepening, and constructing a turning basin).
Blair Waterway (Tacoma), WA	Estimate from District, December 1999. It is the understanding of IWR that this project is being carried under the auspices of Section 107 of the R&H Act of 1960.
Charleston, SC	IWR Estimate based on 2.5 times cost of GNF of deepening project currently underway (estimated to be $131 million), 2 times cost of local service facilities (estimated to be $7.5 million) and 10% reimbursement of GNF
Corpus Christi Ship Channel, TX	Corpus Christi Ship Channel, TX 50 Foot Project Reconnaissance Report, September 1994
East Waterway (Seattle), WA - I	Estimate from District , December 1999. It is the understanding of IWR that this project is being carried out under the auspices of the Operations and Maintenance Program.
East Waterway (Seattle), WA - II	Estimate from District , December 1999
Los Angeles Main Channel, CA	Economic Appendix, Port of Los Angeles Main Channel Deepening Project, November 1999
Mississippi River Ship Channel, Gulf to Baton Rouge, LA - Phase III	FY 2001 Budget Justification Sheet, dated 7 February 2000
Mobile Harbor, AL	FY 2001 Budget Justification Sheet, dated 7 February 2000
New York - New Jersey Harbor	IWR Estimate based on information provided by the District, December 1999
New York Harbor Anchorages	IWR Estimate based on information provided by the District, December 1999 and assumed 50-50 cost share of project.
Norfolk Harbor, VA	FY 2001 Budget Justification Sheet, dated 7 February 2000
Oakland Harbor, CA	Project Review Document dated 19 April 1999
Sabine - Neches Waterway, TX	Estimate from District , December 1999
Savannah Harbor, GA & SC	Project Summary Document dated 30 July 1999, Cost sharing apportionment calculated by IWR Staff

San Francisco Bay, CA	Estimate from District , December 1999
Southampton Shoal Channel, CA	Estimate from District , December 1999
Texas City, TX	IWR Estimate based on information contained in District Annual Report Fiscal Year 1997