

U.S. Port and Inland Waterways Modernization: Preparing for Post-Panamax Vessels

Report Summary



Institute for Water Resources

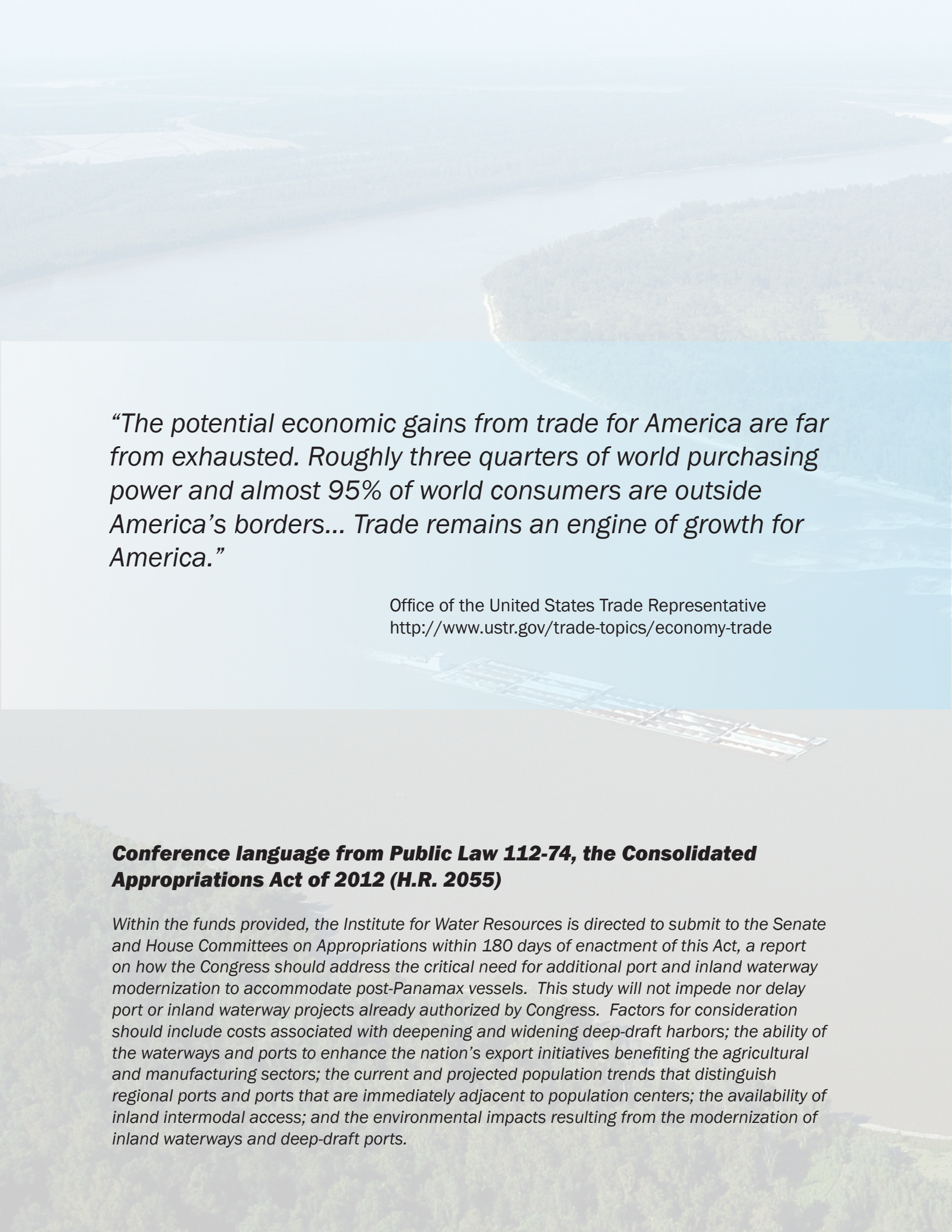
U.S. Army Corps of Engineers



US Army Corps
of Engineers®

June 20, 2012





“The potential economic gains from trade for America are far from exhausted. Roughly three quarters of world purchasing power and almost 95% of world consumers are outside America’s borders... Trade remains an engine of growth for America.”

Office of the United States Trade Representative
<http://www.ustr.gov/trade-topics/economy-trade>

Conference language from Public Law 112-74, the Consolidated Appropriations Act of 2012 (H.R. 2055)

Within the funds provided, the Institute for Water Resources is directed to submit to the Senate and House Committees on Appropriations within 180 days of enactment of this Act, a report on how the Congress should address the critical need for additional port and inland waterway modernization to accommodate post-Panamax vessels. This study will not impede nor delay port or inland waterway projects already authorized by Congress. Factors for consideration should include costs associated with deepening and widening deep-draft harbors; the ability of the waterways and ports to enhance the nation’s export initiatives benefiting the agricultural and manufacturing sectors; the current and projected population trends that distinguish regional ports and ports that are immediately adjacent to population centers; the availability of inland intermodal access; and the environmental impacts resulting from the modernization of inland waterways and deep-draft ports.

FOREWORD

The United States is a maritime nation. From its origin as 13 former colonies to its place as the preeminent world power today, our Nation's success has been dependent on our coastal ports and inland waterways to conduct trade. Recognizing the importance of transportation to trade, the Nation had made a strong intergenerational commitment to develop its transportation networks. From the building of roads and canals in the early days of our Nation, to later construction of the transcontinental railroad and to the creation and development, just within my lifetime, of the Interstate Highway System, the Nation has committed the time and resources to enable and facilitate the large scale movement of raw materials and finished goods from their origin to manufacturer or market, both within our borders and internationally.

These networks of highways, railways and inland waterways connect the interior of our country to our ports, which connect us to the rest of the world. These transportation networks have contributed to our success by providing a cost-efficient and environmentally sustainable means to transport large quantities of cargo over long distances and across oceans, keeping this Nation competitive in world trade.

Population and income drive demand for trade, and trade drives the demand for transportation services. The U.S. population is expected to increase 32 percent, or almost 100 million people, in the next 30 years. The greatest population growth will occur in the South and West. Per capita income is expected to increase 170 percent in the same time period. These increases will drive increased trade, with imports expected to grow more than fourfold and exports expected to grow more than sevenfold over 30 years. The recent U.S. Navy Commercial (<http://www.youtube.com/watch?v=EEtZ5rOCiYI>), which states that 70% of the world is covered by water, 80% of all people live near water, 90% of all trade travels by water, highlights the importance of waterborne commerce to the Nation and the world.

Our interconnected transportation networks, built in the last century or earlier, resulted in a competitive trade position for this Nation. In order to pass on to future generations the benefits of our competitive trade position, the Nation needs to ensure effective, reliable, national transportation networks and interconnections for the 21st Century. However, as Admiral John C. Harvey, Jr., Commander of the U.S. Fleet Forces Command, put it, "...many of our citizens have taken our maritime services for granted – we are no longer a 'sea conscious' Nation – even though we live in a global economy where 90% of all commerce is still transported by ship..." Despite this, I believe we have an opportunity as a Nation to strategically position public and private investments to become again a world maritime leader.

The Nation is taking steps to seize that opportunity. The Conference Report for the Consolidated Appropriations Act of 2012 (Public Law 112- 74) requested a report from the Institute for Water Resources on how Congress should address the critical need for additional port and inland waterway modernization to accommodate *post-Panamax* vessels. *Post-Panamax* vessels are a reality today. They make up 16% of the world's container fleet, but account for 45% of the fleet's capacity. The efficiencies of scale they provide drive the deployment of more and more of these vessels. By 2030, they are expected to make up 27% of the world's container fleet, accounting for 62% of its capacity. This report provides an analysis of the broad challenges and opportunities presented by the increasing deployment of *post-Panamax* vessels and outlines options on how the Congress could address the port and inland waterway infrastructure needs to accommodate those vessels.

This Nation must address the need and the challenges of a modern transportation system and evaluate potential investment opportunities. This report advances that objective. It contributes to an ongoing public discussion, which is already underway, and will help inform current and future decisions on the maintenance and future development of our ports and waterways and their related infrastructure.

Major General (MG) Michael J. Walsh
United States Army Corps of Engineers
Deputy Commanding General for Civil Works and Emergency Operations



PREFACE

The U.S. Army Engineer Institute for Water Resources (IWR) welcomed the opportunity provided by the Consolidated Appropriations Act of 2012 (P.L. 112-74) to prepare this report, *U.S. Port and Inland Waterways Modernization: Preparing for Post-Panamax Vessels*. We approached this assignment in a manner befitting the trust and confidence in IWR's work that is reflected in the Committee's designation for this important study.

The resulting document was developed as a true team effort, with the collaborative participation of not only IWR's own in-house specialists and visiting scholars, but also from experts in USACE's various navigation mission specialties from across the organization including the National Planning Centers of Expertise in Deep Draft Navigation and Inland Navigation, located at USACE Mobile and Huntington Districts, respectively, and cost specialists from Walla Walla District and USACE Headquarters. The Institute's efforts were also supported via contracts with the private sector and through a robust public outreach process administered by its Conflict Resolution and Public Participation Center. The Center helped to facilitate openness and transparency as the study progressed, providing public listening sessions and opportunities for input and comment from the navigation community and other interested parties.

Nevertheless, providing advice on "how the Congress should address the critical need for additional port and inland waterway modernization to accommodate *post-Panamax* vessels," as requested in P.L.112-74, implies that the Committee has substantial expectations regarding the certainty and utility of such advice. Let me clarify those expectations at the front and acknowledge that if the history of maritime transportation is any indication – despite what we think we know – uncertainty will persist in the years immediately after the opening of the expanded Panama Canal as to how the Canal's new capacity will specifically drive the future direction of intermodal freight logistics in the U.S., particularly with regard to the timing of the resulting infrastructure needs that will ultimately manifest.

As Christopher Koch, President and CEO of the World Shipping Council, testified earlier this year before the House Transportation and Infrastructure Committee's Water Resources and Environment Subcommittee, "There is neither a single issue nor solution to how to prepare for future maritime transportation infrastructure needs... There is a plethora of studies, opinions and prognostications about what the effects of the new [Panama Canal] locks will be on trade flows, ship sizes, volumes, transshipment port development, and which U.S. ports will benefit by the new locks...It will probably take some years before it is clear exactly what changes to cargo flow, and its supporting transportation network, will result from the new locks."

What we do know is that the world economy is changing, with the pace and scope of these changes accelerating and expanding in unpredictable ways. Shifts in global alliances and political structures, the critical role of emerging technologies, the waxing and waning of the wealth of nations, and even changes to the climate and the natural environment that are impacting agricultural production and the availability of water, are all manifesting right before our very eyes.

But that is the challenge – often we don't pick up the signals that announce many of these changes, nor truly appreciate the significance of the shifts while they are happening or understand the long-term implications associated with these permutations. It is only later, in retrospect, that we recognize some of these changes as transformative "game-changers" to the status quo we mistakenly assumed would continue into the future ad infinitum.

In fact, although many now trace the existence of today's modern containerships to the vision of American truck magnate Malcom McLean, who deployed the first container vessel in the U.S., the converted T2 tanker *Ideal X*, who among us realized that when the *Ideal X* carried 58 containers from Port Newark, NJ to Houston, TX on its maiden voyage on April 26, 1956 that we were witnessing the beginning of a revolution in modern shipping that represented a mega-shift in world trade? In his book "The Box," author Marc Levinson points out that "absolutely no one anticipated that containerization would open the way to vast changes in where and how goods are manufactured, that it would provide a major impetus to transport

deregulation, or that it would help integrate East Asia into a world economy that previously had centered on North America.”

By undertaking the current expansion, Panama will double the Canal’s capacity. The resulting economy of scale advantage for larger ships will likely change the logistics chains for both U.S. imports and exports. Despite the uncertainties in timing and port-specific implications that still need to play out, the certain injection of successive new generations of *post-Panamax* vessels into the world fleet could be a “game-changer” for the U.S. over the long term, as it has the potential to not only provide a cost-effective complement to the intermodal transport of imports via the U.S. land bridge, while also re-shaping the service from Asia to the Mediterranean and on to the U.S. East Coast, but may also affect the highly competitive transport price structure along the Midwest to Columbia-Snake route for grain and other bulk exports bound for trans-Pacific shipping. Inland waterways play a key role in the cost efficient transport of grains, oilseeds, fertilizers, petroleum products and coal. Gulf ports play key roles in the transport of these commodities, such as New Orleans being the dominant port for the export of grains from the U.S. Therefore the expanded canal could provide a significant competitive opportunity for U.S. Gulf and South Atlantic ports and for U.S. inland waterways – if we are prepared.

Through effective planning and strategic investment the U.S. can be positioned to take advantage of this opportunity. The railroad industry has been investing \$6-8 billion a year over the last decade to modernize railways and equipment, and U.S. ports plan public and private-sourced landside investments of the same magnitude over each of the next five years. Annual spending on waterside infrastructure has been averaging about \$1.5 billion.

While the U.S. has ports on the West Coast (Los Angeles, Long Beach, Oakland and Seattle/Tacoma) and East Coast (New York, Baltimore and Hampton Roads) expected to be ready with *post-Panamax* channels in 2014, there is currently a lack of *post-Panamax* capacity at U.S. Gulf and South Atlantic ports – the very regions geographically positioned to potentially be most impacted by the expected changes in the world fleet. The Corps currently has 17 studies investigating the opportunity to economically invest in deep draft ports. At the Port of Savannah, USACE has identified an economically viable expansion to accommodate *post-Panamax* vessels. This project is estimated to cost \$652 million dollars. It is possible that several of the remaining studies will also show economic viability and, if so, the challenge will be to fund these investments. In addition, justified investments in inland waterway locks and dams will be needed to allow the waterway transport capability to take advantage of an expanded canal for U.S. exports. This emphasizes the strategic need to address the revenue challenge within the Inland Waterway Trust Fund.

Given this opportunity presented by the deployment of *post-Panamax* vessels, it is critical that the U.S. develop and move forward with a strategic vision for a globally competitive navigation system that sets the context for ensuring adequate investment in maintaining current waterside infrastructure and also facilitates the strategic targeting of investments to ensure the U.S. is ready for *post-Panamax* vessels and “cascade” fleet deployments consistent with the growth in global trade that is anticipated over the next twenty years.

Constrained Federal funding both for harbor channels and inland waterways can be expected due to overall economic and fiscal conditions and concerns about the deficit. This underscores the need to consider new and innovative public and private funding sources and financing methods with long-term reliability that can finance the navigation system maintenance and expansion that will be necessary to ensure a globally competitive U.S. navigation system. The Institute stands ready to support USACE, the Administration and Congress in realizing this 21st Century vision.

Robert. A. Pietrowsky
Director, Institute for Water Resources

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Executive Summary

The health of the U.S. economy depends, in part, upon the vitality and expansion of international trade. International trade depends upon the Nation's navigation infrastructure, which serves as a conduit for transportation, trade, and tourism and connects us to the global community. Marine transportation is one of the most efficient, effective, safe and environmentally sound ways to transport people and goods. It is a keystone of the U.S. economy. Ninety-five percent of our international trade moves through the Nation's ports.¹

Cargo carriers, seeking to service this global trade more efficiently and lower costs, are commissioning the building of ever larger ships, known as *post-Panamax* vessels. These vessels are currently calling at U.S. ports and are expected to call in increasing number. The completion of the Panama Canal in 2014 will influence the timing of their arrival at certain ports. However, *post-Panamax* vessels will dominate world trade and call at U.S. ports regardless of the Panama Canal expansion as they are expected to represent 62 percent of total container ship capacity by 2030.

How the Nation invests in the maintenance and modernization of its navigation infrastructure presents financial challenges to be met and economic opportunities to be seized. Sustaining a competitive U.S. navigation system that can enhance economic opportunities for future generations without significant harm to the environment will require a coordinated effort between government, industry and other stakeholders.



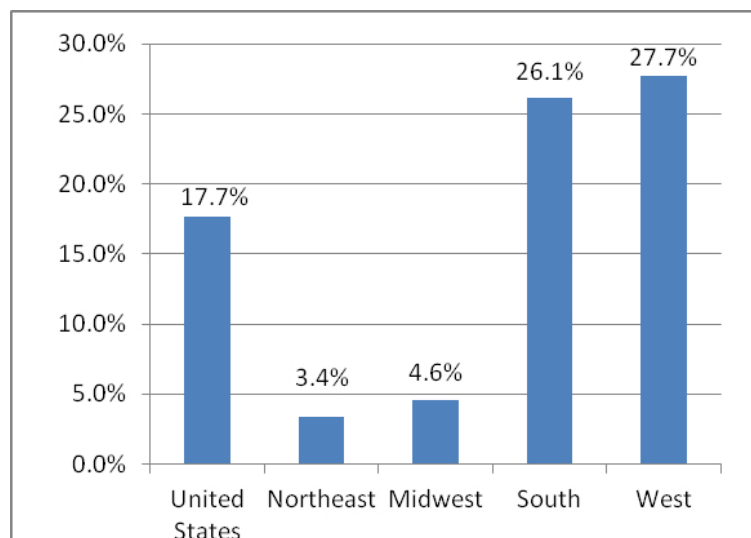
Identifying Capacity Maintenance and Expansion Issues Associated with *post-Panamax* Vessels

Congress directed the USACE Institute for Water Resources to submit to the Senate and House committees on appropriations a “report on how the Congress should address the critical need for additional port and inland waterways modernization to accommodate *post-Panamax* vessels.” This report fulfills that request. This report identifies capacity maintenance and expansion issues associated with the deployment of *post-Panamax* vessels to trade routes serving U.S. ports. This identification has been accomplished through an evaluation of the future demand for capacity in terms of freight forecasts and vessel size expectations and an evaluation of the current capacity of the Nation’s inland waterways and coastal ports.

Despite the recent worldwide recession, the expected general trend for international trade is one of continued growth as the world’s population and standard of living grow. As international trade expands, the number of *post-Panamax* vessels is expected to increase. The Nation’s ability to attract these vessels and allow efficient use of their capacity is the key to realizing the transportation cost savings these vessels represent. For example, the Corps investigation of the Port of Savannah indicates a \$652 million dollar investment where the benefits far exceed the cost.

Growth is expected in overall trade and deployment of *post-Panamax* vessels to U.S. ports is

Figure 1: Percent Change in Population by U.S. Region 2000-2030



Source: U.S. Census Bureau, Population Division; 2005 Interim State Population Projections

certain for multiple trade routes. The expansion of the Panama Canal, currently underway, will accelerate the timing of the deployment of these vessels to more U.S. ports. There is, however, uncertainty in the port specific details: at which ports they will call; when these vessels will arrive in large numbers; how deep these vessels will draft arriving and departing; and the supporting infrastructure needed (channel depth and width, number and sizes of cranes, size of available container storage area). Despite the lack of port specific certainty, the Nation can move forward identifying individual projects using established risk informed decision making methods.



The Panama Canal expansion is scheduled to be completed in 2014 and will double its existing capacity. The new locks will be able to pass vessels large enough to carry three times the volume of cargo carried by vessels today. The availability of larger, more efficient vessels passing through the new locks on the canal is expected to potentially have at least three major market effects. (1) Currently, there is significant freight shipped to the eastern half of the United States over the intermodal land bridge formed by the rail connections to West Coast ports. The potential for reduced cost of the water route through the canal may cause freight traffic to shift from West Coast to East Coast ports. (2) To take full advantage of the very largest vessels that will be able to fit through the expanded canal but may be too large to call at most U.S. ports, a transshipment service in the Caribbean or a large U.S. port may develop. The largest vessels would unload containers at the transshipment hub for reloading on smaller feeder vessels for delivery to ports with less channel capacity. (3) On the export side the ability to employ large bulk vessels is expected to significantly lower the delivery cost of U.S. agricultural exports to Asia and other foreign markets. This could have a significant impact on both the total quantity of U.S. agricultural exports and commodities moving down the Mississippi River for export at New Orleans.

There is uncertainty in the port specific details of when such vessels will arrive in large number, which ports they will call, how deep vessels calling will draft and, consequently, how deep navigation channels must be. Over time these uncertainties will reduce as experience

“I’ve talked a lot about the expansion of the Panama Canal in the last couple of years...but the one thing I’ve learned is that nobody really knows what’s going to happen.”

–Ricky Kunz, Port of Houston Authority’s vice president for origination, as quoted in the *New York Times*, February 18, 2012.

Table 1: Forecast East Coast Container Fleet 2012-2035

	2012	2015	2020	2025	2030	2035
0.1 - 1.3 k TEU	24	11				
1.3 - 2.9 k TEU	34	12	6	4	3	3
2.9 - 3.9 k TEU	28	12	10	4	4	2
3.9 - 5.2 k TEU	140	95	78	58	42	29
5.2 - 7.6 k TEU	86	114	153	156	159	168
7.6 - 12.0 k TEU	26	61	96	155	227	322
12.0 k TEU +		3	13	42	82	136

Note: post-Panamax vessel bands shaded in yellow.

Source: Maritime Strategies International, Limited

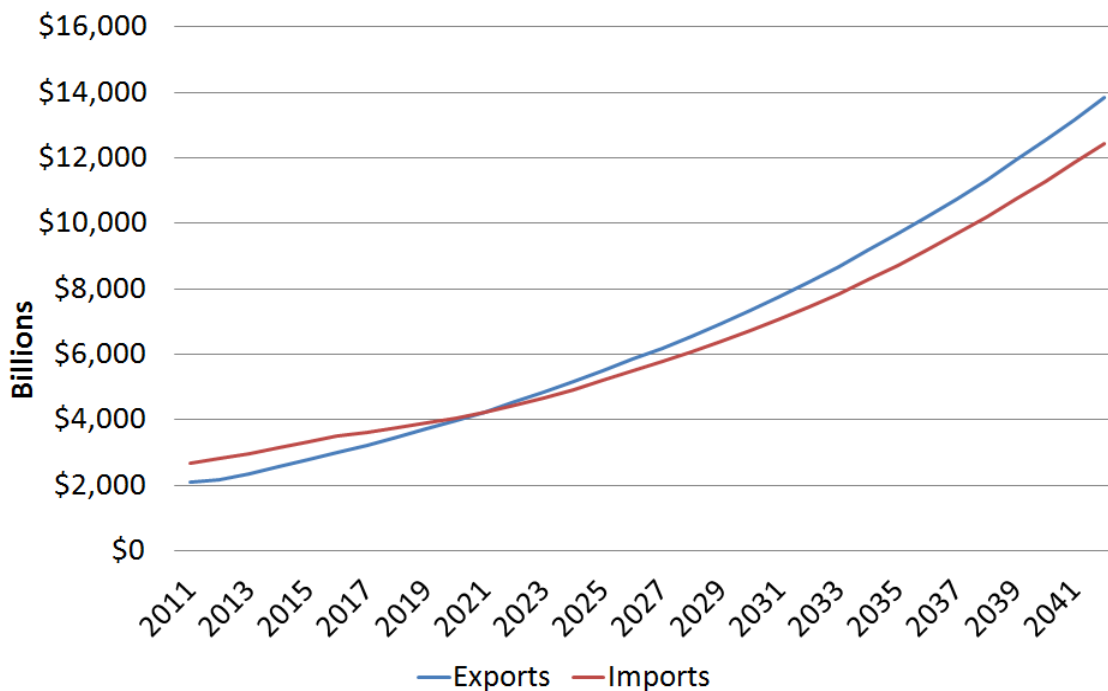
This East Coast container fleet forecast shows the number of container vessels (by TEU range) being deployed on trade routes that include the U.S. East Coast ports. Vessels above 52k TEU are considered *post-Panamax* vessels.



replaces expectation. Even in the face of this uncertainty, individual ports are actively engaged in port expansions and studies to deepen and widen Federal access channels. We can predict that in the absence of transshipment centers *post-Panamax* vessels will call in large numbers, they will call at most major ports and their sailing drafts will become known. Our challenge is to invest in capacity expansion in the right places at the right time consistent with industry needs.

Port capacity depends upon channel depths, channel widths, turning basin size, sufficient bridge heights, and port support structures such as dock and crane capacity to offload and onload goods. The deepest channel requirements are likely to be driven by “weight trade” services. Vessels can be filled to their weight capacity or their volume capacity. Vessels loaded to their weight capacity sail at their maximum design draft; they sit deeper in the water. For volume trade routes, channel width and turning basin size may be of greater importance than additional channel depth at some ports, as vessels loaded to their volume capacity often sail at significantly less than their design draft. The Asian export trade is considered a “cube trade” (i.e. volume trade). Careful consideration is needed when determining channel depth requirements at U.S. ports for this trade route.

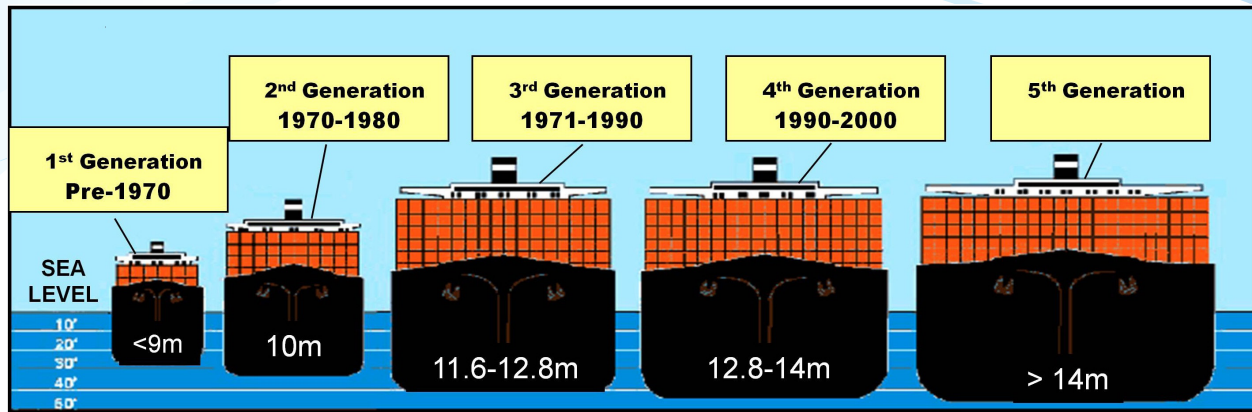
Figure 2: Forecast of U.S. Exports and Imports 2011-2042



Source: IHS Global Insight, *The U.S. Economy, The 30-year Focus, First Quarter 2012*



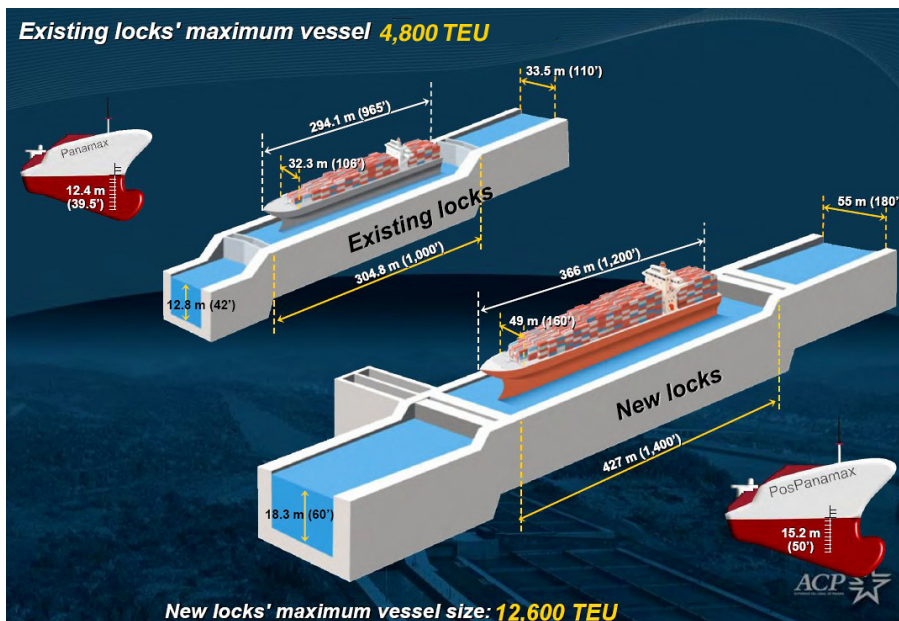
Figure 3: Evolution of Container Ships



Post-Panamax Ready

For this report, a port is considered “*post-Panamax ready*” if it has a channel depth of about 50 feet with allowances for tide, as well as sufficient channel width, turning basin size, dock and crane capacity. U.S. West Coast ports at Seattle, Oakland, Los Angeles and Long Beach all have 50-foot channels. Northeastern U.S. ports at Baltimore and New York have or will soon have 50-foot channels. In the Southeast, Norfolk has 50-foot channels. South of Norfolk along the Southeast and Gulf Coasts there are no ports with 50-foot channel depths, although Charleston with a 45 foot channel depth and nearly 5 feet of tide can accommodate most *post-Panamax* vessels. This is also the region with the greatest forecast population and trade growth.

Figure 4: Panama Canal Dimensions
Vessels 40% Longer, 64% Wider and 50 Ft Draft



Source: Panama Canal Authority, February 2011

Cascade Effect

A system vision should extend beyond the major ports to include lower tier ports. New, large vessels are typically deployed on the longest and largest trade service – Asia to Northern Europe. The “smaller” vessels on that service re-deploy to the next most efficient service for that vessel size. Cascading typically increases average vessel size for each trade service. A navigation system vision should address this cascade effect and its impact on infrastructure for shallower ports. Analysis of individual ports will determine whether the port will need to accommodate *post-Panamax* vessels or the cascade effect.



Remaining Globally Competitive

To remain competitive in a changing global trade market, the U.S. would need to continue making the justified investments necessary to maintain and improve its navigation transportation infrastructure where it is appropriate and efficient to do so. Understanding the current funding challenges and making long-term plans for operations and maintenance (O&M) and justified investments are critical to developing an effective vision for a competitive navigation system.

USACE Civil Works appropriations to address waterside infrastructure have averaged about \$1.5 to \$2 billion per year for the last decade. These expenditures have been used to maintain, construct and improve the most highly justified inland and coastal navigation infrastructure projects, and reflect the nation's most efficient navigation investment strategy. To accommodate expected increase in agricultural exports through the Gulf, the current inland waterways must be adequately maintained through maintenance dredging and justified major rehabilitation.

To accommodate expected increase in agricultural exports through the Gulf, the current inland waterways must be adequately maintained through maintenance dredging and justified major rehabilitation.

USACE currently has 17 active studies investigating possible port improvements, most associated with the desire to be *post-Panamax* ready. One such study at the Port of Savannah is nearing completion and indicates an economically justified project that will cost about \$652 million. It is likely that other studies will also show economically justified projects, either to become "*post-Panamax* ready" or "*cascade* ready." The preliminary estimate to expand some ports along these two coasts was about \$3-\$5 billion. Specific investments in ports must be individually evaluated for their timing and economic and environmental merits.



Financing Options

Addressing “the critical need for additional port and inland waterway modernization to accommodate post-Panamax vessels” necessitates an examination of the current delivery mechanisms, the identification of issues and the offering of options for the future. Among the issues identified, securing funding sources to take advantage of modernization opportunities in a timely manner, given the constrained fiscal environment, was judged the most critical. A notional list of financing options is presented to initiate discussion of possible paths to meet this challenge—it is anticipated that a variety of options may be desirable, and in all cases individual project characteristics, including its economic merits, would need to be considered in selecting the optimal financing mechanisms. These options are illustrative only and do not necessarily represent any Administration, USACE or IWR position.

Some options include:

Coastal ports

- Increase Federal appropriations in the USACE budget for harbor maintenance and improvements while maintaining current cost share responsibilities.
- Increase Harbor Maintenance Trust Fund (HMTF) user fees and allocate increased revenues to harbor improvements.
- Maintain or increase Federal appropriations and also increase local cost share requirements.
- Encourage individual port initiatives by phasing out the HMTF, expecting individual ports to collect their own fees and make their own investment and maintenance decisions.

Inland waterways

- To support waterway improvements, increase the fuel tax and provide increases in Federal appropriations to track with the increased revenues flowing into the IWTF; depending upon the revenues from the fuel tax, reduce the share of total costs that is paid from general appropriations.
- Replace the fuel tax with a vessel user fee and/or combine the fuel tax with a vessel user fee and increase revenues and appropriations for improvements at least by the amount of the increased revenues.²
- Implement public-private partnerships with the responsibility for improving, operating and maintaining the inland waterway navigation infrastructure along specified segments of the system. Financing for these actions would be secured in private capital markets with revenues to repay the financed activities earned from a combination of vessel user fees (segment fees or lockage fees) and appropriations.

Regardless of the Federal government’s role in funding future navigation improvements, maintenance and operations, USACE will continue to have an environmental regulatory oversight responsibility. Under most options USACE will continue its responsibility for performing environmental assessments and developing environmental protection and mitigation plans. However, if individual ports choose to proceed on their own with harbor deepening projects then USACE would need to provide permits for any proposed action.



Environmental Impacts

Since the 1970s, compliance with the National Environmental Policy Act (NEPA), Clean Water Act, Endangered Species Act (ESA) and other regulatory law has greatly reduced the adverse environmental impacts of many previous practices and positively transformed social attitudes toward the environment. Due to these changes in national commitments,



Zebra mussel cluster, Detroit River (Credit: Center for Great Lakes and Aquatic Sciences)

future modernization actions that would have significant adverse impacts will be mitigated, often at great expense, and will play an important role in modernization decisions. In this section, the “environmental footprint” caused by the transportation system is first described to help identify the potential for future environmental impact and mitigation needs. Then indicators of potential impact sources and vulnerabilities are compared to determine which regions may require the most impact mitigation as a consequence of modernization.³



The Environmental Footprint

The national footprint of adverse environmental impacts has accumulated over many decades and is not indicative of the present rate of adverse impact, which is much improved. Measured in geographical terms, the environmental footprint directly impacted by development of transportation system infrastructure is a small fraction of the conterminous United States. But the degree of adverse impact on natural systems and wild species of public interest has been particularly intense and the offsite impacts on air, water and habitat quality from systems operations have been far reaching. The sources of past environmental effects indicate the type of future modernization impacts that are likely to occur from expansion of harbor, port and intermodal infrastructure and from transportation systems operations. Modernization will need to be accompanied by justified mitigation to avoid further 1) degraded air and water quality that threatens human health and safety, especially of low income and minority groups; 2) loss of important natural and cultural heritage found in parks, refuges, wetlands and scarce species; or 3) loss of recreational, commercial and other economically important resources.

Potential infrastructural development along coasts and waterways is a concern because coastal ports and inland waterway infrastructure is closely associated with two of the scarcest types of ecosystems—free flowing rivers and estuarine wetlands. Lock and dam impoundments have contributed substantially to the imperilment of numerous freshwater



species by reducing free-flowing river habitat. In general, dredging of nontoxic bottoms impacts coastal and riverine benthic organisms temporarily and bottoms typically recolonize quickly following disturbance. In the past, about 10 percent of bottom sediments were contaminated with toxic materials and resistant to colonization by some bottom species. Sediment toxicity directly affects bottom species and indirectly affects the fish and other species that feed on them and humans at the end of the food chain. Contaminated sediments are now disposed of in isolated containment areas. In 1992, USACE was authorized to beneficially use dredge material for environmental improvement. Today about 20 to 30 percent of port and waterway dredged material is used for habitat creation and other beneficial use. But dredging also has had some persistent effects, including some unavoidable take of imperiled species (e.g., sea turtle take is about 35 per year) and damage to shallow-water estuarine ecosystems. Deepening coastal navigation channels can also favor destructive saltwater intrusion into freshwater ecosystems and domestic water supplies.

With respect to operations, future emissions of potentially harmful materials into air and water, including green house gasses, also are a significant environmental concern. Because harbors concentrate transportation system operations in densely populated areas, they remain a significant source of air quality degradation and inequitable impact on low income and minority groups (which is inconsistent with Federal policies pertaining to environmental justice). Trucks contribute much more than any other mode to atmospheric emissions. In general, relying more on oceanic shipment by large vessel and inland shipment by train and waterway in place of truck transport is preferred because trucks are so much less fuel and emissions efficient. Ports have made improvements to reduce emissions and are planning more, consistent with social concerns. As freight transport operations increase, accidents may increase. Accidental collision of whales and other marine mammals with vessels approaching and leaving ports has been a significant mortality source, but may moderate with recent speed restrictions. Potential oil and other contaminants spills are associated with all modes.

"Factoring in environmental and public health costs needs to be part of the decision making process at every step in order to ensure future sustainability of our ports, our coastline, and our population."

— Environmental Defense Fund



Potential Regional Impact Differences

Past vulnerabilities and adverse impacts revealed in the transportation system footprint of ports and harbors informed selection of 11 indicators of potential impact, which was assessed regionally. These indicators reveal the potential for somewhat greater environmental impact in the Southeast Atlantic Region and, to less extent, in the Pacific Region. Freight transport is expected to grow most rapidly in those regions because of high regional population growth rate. In the Southeast, more harbor expansion is needed to accommodate the largest vessel sizes. In addition, in the Southeast Atlantic Region environmental impact mitigation may be more costly because of greater wetland and endangered species vulnerability. In the Pacific Region mitigation may be more costly due to greater vulnerability of economically important water resource use and low income and minority communities. The Northeast Atlantic Region was ranked lowest because it has the slowest population growth, the greatest amount of unused port capacity, and the least vulnerability to loss of wetlands, parks and other preserves, and threatened and endangered species. The Gulf Region was not ranked quite so low because of its high regional population growth rate, less unused port capacity and greater vulnerability to wetland and endangered species losses.

The effects of Panama Canal expansion have the potential to redistribute some freight transport growth from Pacific Coast ports to Southeastern ports, raising their impact level as increased impact at Pacific ports fall somewhat. The canal expansion may also favor more transport of grains and soybeans on the Upper Mississippi and Illinois Rivers, increasing the need for lock maintenance. Adverse impacts from possible lock rehabilitation are expected to be minor except for the potential need to mitigate unavoidable loss of riparian wetlands. Some positive effects on air emissions are expected because of less time needed in lock transit.

Adaptive management is a wise strategy to use for future modernization, given the uncertainties held in future modernization actions and mitigation costs, which depend on specific locations, types of actions taken and other unknowns.



Non-Financial Considerations



There are many non-financial factors to be considered when modernizing the Nation's navigation infrastructure:

- A modernization strategy should be part of a national transportation strategy that considers multi-modal connectivity and capacity of the intermodal freight transportation corridors. This would necessitate consistency with other Federal programs such as DOT Tiger Grants.
- Navigation infrastructure modernization will have environmental impacts that will most likely require impact avoidance or replacement of lost environmental quality. Total avoidance of impact may be indicated where the effects are of such national significance that development of transportation infrastructure at the proposed site should not be supported at the Federal level.
- Opportunities to contribute to the Administration's initiative to increase exports, energy independence and enhance national security should be considered.
- Local sponsor commitment in terms of cost sharing and community support should be taken into consideration.
- Consideration should be given to ports that facilitate traffic to multiple regions of the country as opposed to serving only a local catchment area.
- When infrastructure projects are planned, designed and implemented, they should explicitly include the concept of adaptive management (i.e., the identification of sequential decisions and implementation based on new knowledge and thresholds) within a risk management framework.

Who Benefits?

Who benefits from deep water port and inland waterways maintenance and enhancement? The use of larger ships will provide economies of scale to the ocean carriers. These cost savings might be shared with the shippers, the producers and, ultimately, with consumers. However, it should be noted that the portion of traffic transiting the Panama Canal will also benefit the Panama Canal Authority (ACP). In fact it may be possible for the ACP, through its toll structure, to extract a majority of the benefits on routes that use the canal, limiting the cost savings associated with the use of larger vessels through the canal that will be available to carriers, shippers, producers or consumers. A careful understanding of this is required when choosing which ports to deepen and how to finance the project.

Ports could benefit from increased freight moving through them. As noted, reduced costs for an all-water route from Asia to the East Coast could cause a shift of some market share from the West Coast ports to the East Coast. However, given the expected overall increase in trade, it is not a zero sum game and it is possible that even if West Coast ports were to lose some market share, they will still see an increase in cargo moving through their ports. Moreover, West Coast ports and their rail partners are investing heavily to increase the capacity and efficiency of the intermodal land bridge to ensure it remains competitive and retains market share.

Transshipment might offer some cost savings to cargo headed for ports that are not *post-Panamax* ready. However, transshipment hubs add time and extra handling, costs that may exceed the benefits of using a larger vessel.

The opportunities for reduced costs available to U.S. agricultural exporters through the use of larger bulk carriers are also available to their competitors in international markets.

What seems certain is that some mix of these impacts will be realized gradually over time as market participants gain better certainty of the options they face.



Additional Thoughts

A modernization strategy should be part of an overall national intermodal freight transportation strategy. While the three dominant freight carrier modes – water, rail and truck – compete for market share, there is a growing recognition of the need for multi-modal linkages and for infrastructure investments to be coordinated across the modes to ensure that they complement each other and ensure the best overall use of the available funds for the Nation. This can be supported by prioritizing navigation investment according to their multi-modal connectivity. On March 1, 2012 USACE signed a Memorandum of Understanding with the Department of Transportation on collaboration with a purpose to identify and capitalize on opportunities to improve the Nation’s transportation infrastructure investments where shared equities exist.⁴

A national intermodal freight transportation strategy could also consider local sponsor commitment in terms of cost sharing and community support. Opportunities to contribute to the Administration’s initiative to increase exports, energy independence and enhance national security must be considered.

**Figure 5: The Inland Waterway Connection
Linking the Heartland to the Coasts**



Source: U.S. Maritime Administration, February 2011



Report Observations and Findings

The main observations and findings of the report are as follows:

- World trade and U.S. trade is expected to continue to grow.
- *Post-Panamax* size vessels currently call at U.S. ports and will dominate the world fleet in the future.
- These vessels will call in increasing numbers at U.S. ports that can accommodate them.
- Along the Southeast and Gulf coast there may be opportunities for economically justified port expansion projects to accommodate *post-Panamax* vessels.
 - This is indicated by an evaluation of population growth trends, trade forecasts and an examination of the current port capacities.
 - Investment opportunities at specific ports will need to be individually studied.
- The potential transportation cost saving of using *post-Panamax* size vessels to ship agricultural products to Asia, through the Panama Canal may lead to an increase in grain traffic on the Mississippi River for export at Gulf ports.
 - An analysis indicated the current Mississippi River capacity is adequate to meet potential demand if the waterways serving the agricultural export market are maintained.
 - A need for lock capacity expansion is not indicated.
- Despite the uncertainty in market responses to the deployment of *post-Panamax* vessels and the expansion of the Panama Canal, individual investment opportunities for port expansion can be identified using established decision making under uncertainty techniques. Adaptive management techniques can also be used to address uncertainty issues. Preliminary estimates indicate the total investment opportunities may be in the \$3-\$5 billion range.
- Environmental mitigation costs associated with port expansion can be significant and will play an important role in investment decisions.
- The primary challenge with the current process to deliver navigation improvements is to ensure adequate and timely funding to take advantage of potential opportunities.
 - A notional list of financing options is presented to initiate discussion of possible paths to meet this challenge—it is anticipated that a variety of options may be desirable, and in all cases individual project characteristics, including its economic merits, would need to be considered in selecting the optimal financing mechanisms.



What Is Navigation Infrastructure?

For this report, the term navigation infrastructure refers to the basic facilities required for safe and efficient vessel movement and handling. This infrastructure includes:

For coastal ports

- channels (including harbor entrance channels, port channels, ocean-route canals and connecting channels)
- turning basins
- navigation jetties
- dredge material placement facilities
- berthing facilities (docks, dredged berths and anchorage areas)
- aids to navigation (channel buoys, global GPS, AIS and updated charts)

For inland waterways

- channels
- locks and dams
- channel training structures
- dredged material placement facilities
- tow marshalling areas
- berthing facilities (docks, dredged berths and anchorage areas)
- aids to navigation (channel buoys, global GPS, AIS and updated charts)

These lists are not exhaustive but are generally representative of the facilities included in navigation infrastructure. Other infrastructure, such as cranes, storage yard space and intermodal transfer connections are critical to the efficient movement of cargo, but are not considered navigation infrastructure.

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References

- 1) Complete Statement of the Honorable Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works) before the Committee on Transportation and Infrastructure, Subcommittee on Water Resources and Environment, United States House of Representatives, on the Economic Importance of Seaports: Is the United States Prepared for 21st Century Trade Realities – October 26, 2011.
- 2) The Administration transmitted a legislative proposal to the Congress to reform the laws governing the Inland Waterways Trust Fund as part of the Jobs Bill proposal in September 2011.
- 3) Please see the main report for U.S. Port and Inland Waterways Modernization: Preparing for *Post-Panamax* Vessels, Chapter 4: Environmental Impacts of Capacity Expansion, for references.
- 4) See appendix C of the main report for a copy of this MOU.

Photos are from USACE digital libraries unless otherwise noted.

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