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Inland Waterways Funding Mechanisms Synthesis

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Inland Waterways Funding Mechanisms Synthesis

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MULTIMODAL TRANSPORTATION
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Inland Waterways Funding Mechanisms Synthesis

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Table of Contents

Executive Summary 2

I. Introduction 3

II. Inland Waterways Trust Fund 4

III. Potential Funding/Inland Waterway Trust Fund Reforms 12

IV. Current State of the System 20

V. Conclusion 24

List of Tables and Figures

Table 1: List of Taxable Inland Waterways 8

Table 2: Congressional Budget Office (1992) Inland Waterway User Funding Options 15

Table 3: Cost Sharing Options Considered as Part of IMTS Capital Projects Business Model Report 19

Figure 1: Inland Waterways Fuel Tax 6

Figure 2: Taxable Inland Waterways 7

Figure 3: Inland Waterways Trust Fund Revenues 9

Figure 4: Inland Waterways Trust Fund Balances 10

Figure 5: Average Delay at Locks on Inland Waterway System (in hours) 22

Figure 6: Number of Scheduled and Unscheduled Unavailability on Inland Waterway System . 23

Figure 7: Scheduled and Unscheduled Unavailability on Inland Waterway System (in hours) ... 23

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Executive Summary

The inland waterway system is a vital part of the nation's multi-modal freight network. Although less visible than other modes, inland waterways allow shippers to transport bulk commodities in a relatively cheap and environmentally-friendly method. To ensure this transportation mode remains a feasible option and accommodates growth, it must continue to be safe, efficient, and functional. This synthesis provides comprehensive perspective on the financial prospects of the inland waterways system. It analyzes current funding levels, along with proposed funding changes and reforms.

Financial support for the inland waterways system comes from the Inland Waterways Trust Fund (IWTF). Historical data gathered provides evidence that the IWTF resources have rapidly declined in recent years, limiting the number of infrastructure projects that can be undertaken. Some of this is can be attributed to the lack of a fuel tax increase since 1995. The fuel tax serves as the primary revenue source for the IWTF. The purchasing power of each dollar is therefore eroded due to the increase of construction costs, coupled with the tax revenue not increasing. In order to reinforce the IWTF and deal with a mounting project backlog, several funding reforms have been proposed in addition to changes in project delivery and prioritization. Many reforms include raising the fuel tax and changing the current cost share structure. Other proposals lay out different options, such as tolling locks and dams or instituting license fees. In order to reverse the decline of the IWTF, it appears that substantive changes may be required.

The past and current state of the system also provides insight as to how previous investment levels have impacted reliability. Measures of lock performance, such as the number of outages (both scheduled and unscheduled) and the duration of lock outages, are used to assess system dependability. These reveal that in recent years there has been an increase in outages and outage durations. Possible factors include a reduction in funding for construction and maintenance projects, which compounds the increasing infrastructure age issue. Unexpected closures impact shippers by causing unplanned delays. These delays increase costs of inland waterway shipments by idling freight and reducing reliability. In turn, reduced system reliability may prompt modal shifts as freight shippers seek more consistent modes of transport.

This synthesis provides valuable information for stakeholders and policymakers regarding current funding levels and investments in the inland waterway system. The initial evidence in this report shows that declining funding levels, coupled with aging locks and dams, are likely contributing to increases in lock outages. If such issues are to be rectified, the reforms detailed here provide a starting point for changing the current funding regime.

I. Introduction

The 12,000 commercially navigable miles of the U.S. inland waterway system constitute a vital cog in the nation's transportation system, carrying over 800 million tons of domestic goods annually (U.S. Army Corps of Engineers, 2012). The inland waterway system provides a more fuel-efficient and environmentally-friendly way to transport freight compared to other modes of transportation. For each gallon of fuel, a barge can carry one ton of freight 530 miles, as compared to 420 via train and 70 via truck (U.S. Army Corps of Engineers, 2008). Barge cargo capacities are 15 times greater than rail transport, and 60 times greater than truck transport. With increasing fuel costs, environmental issues, and projected increases in freight shipments[1], the inland waterway system is likely to become increasingly utilized for the movement of bulk commodities such as coal and grain.[2]


Barge on the Ohio River, in Northern Kentucky

To adequately discuss the future of the inland waterway system and its ability to accommodate increased traffic, the current funding structure for maintaining and improving the system must be comprehensively examined. The adequacy of funding levels is likely to determine the extent to which the inland waterway system will be used in the future. This synthesis summarizes critical information related to the current status of inland waterway funding, funding reforms that could be implemented, and the present condition of the system.

[1] See the Federal Highway Administration's Freight Analysis Framework at http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/.

[2] Bray, Murphree, and Dager (2011) note the importance of the Ohio River system to coal shipments and the Mississippi River to grain shipments.

All of this information has been collected to inform decision makers and maximize the ability of the inland waterways to catalyze sustained economic growth. Although the project selection process and regulatory budgeting are integral to the funding process (each is discussed briefly in this report), the focus is primarily on funding mechanisms. Despite the importance of adequate funding for the inland waterway system, this is often neglected when infrastructure dollars are scarce. As noted by many researchers and government officials, the current transportation system infrastructure is aging and deteriorating. The average lock and dam facility is approaching 50 years old (U.S. Army Corps of Engineers, 2012). In an era of tight budgets for infrastructure investment, it is vital to evaluate how the inland waterway system is currently funded and whether this funding is sufficient for maintaining the system in the present, albeit tenuous, operational state.

Other funding issues arise from increased costs due to project delays, the increasing cost of new projects, and delayed maintenance. Insufficient funding causes inland waterway system performance to suffer, which decreases reliability and increases shipping times. This situation contributes to industry reticence regarding the maximization of transportation capabilities. Despite the cost advantage of shipping via the inland waterways, many shippers could opt to transport commodities using another method if inland waterway funding is inadequate. If this occurs, additional strain will be placed on highway and rail lines. As a result of limited funding and concerns about system reliability, there is a mounting interest in looking for flexible and innovative funding alternatives. This involves identifying proposals that reform or completely transform the current funding regime.

The information outlined in this synthesis provides a thorough overview of funding for the inland waterway system and recommends potential avenues of reform that will inform policymakers' and stakeholders' decisions moving forward. The paper then reviews the IWTF, proposed changes to the current funding system, and examines the inland waterway system with an emphasis on lock outages.

II. Inland Waterways Trust Fund

The Inland Waterways Trust Fund (IWTF) currently serves as the primary funding source for much of the construction and rehabilitation work on the inland waterways system. The fund is financed with a 20 cent per gallon fuel tax levied on barge and towing companies. Current construction and major rehabilitation projects[3] are funded on a 50/50 basis from the trust fund and the federal government.

[3] Defined in USACE Civil Works Direct Program based on following criteria: approval by Secretary of Army, minimum of two fiscal years for completion, capital costs are over $14.5 million for reliability improvement projects or over $1.8 million for efficiency improvements, and includes structural improvements that extend working life or increase operational efficiency.

However, operations and maintenance along the system are funded entirely by the federal government (Pointon, 2013). These costs have consistently exceeded construction and rehabilitation costs, averaging over $500 million annually (Stern, 2013). Interest is also earned on unspent balances in the fund. The IWTF was established as part of the Inland Waterways Revenue Act of 1978, which created a fuel tax at 4 cents per gallon and designated 26 waterways that would be subject to this levy. In 1986, the Water Resources Development Act (WRDA) established the Inland Waterways Users Board[4] and created the precedent for the 50/50 cost share. The Users Board's responsibility is to prioritize projects and make spending recommendations, and it consists of 11 members chosen by the Secretary of the Army. Membership on the board is designed to be representative of shipping interests, geographical areas served by the waterways, and tonnage shipped on individual waterways (Stern, 2013).

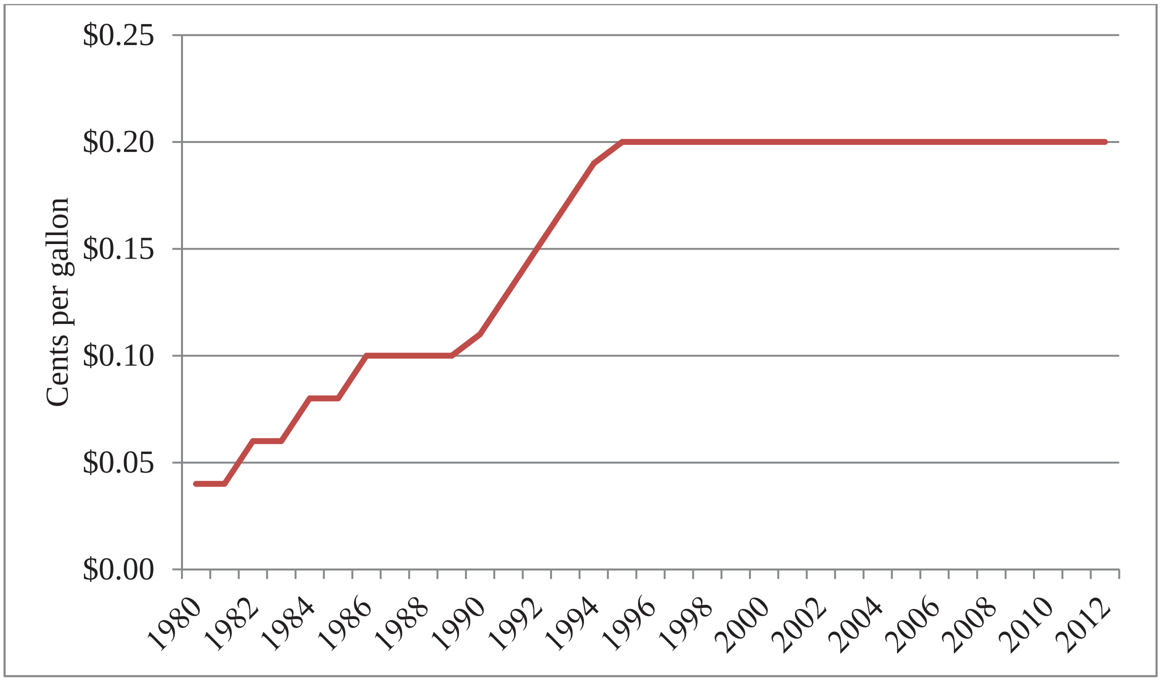
Additionally, the WRDA authorized a gradual increase in the fuel tax to 20 cents per gallon in 1995, and added the Tennessee-Tombigbee Waterway to the list of taxable waterways (Pointon, 2013). The law also mandated that Congress authorize construction projects and fund them using annual appropriations:

"Together, the acts of 1978 and 1986 established a fuel tax on commercial barges, cost-share requirements for inland waterway projects, and a trust fund to hold these revenues and fund investments in construction. The overall effect of these changes was a greater financial and decision-making responsibility for commercial operators on the inland waterway system." (Stern, 2013, p. 4)

Figure 1 illustrates price changes in the fuel tax (1980-2012). Congressional authorization is generally required to fund projects, but these authorizations do not include planning for future funding of multi-year projects. This often produces significant uncertainty over future funding levels. Such an approach leads to inefficiencies and needlessly prolonged construction timelines, which increases costs and diminishes the amount of funding available for other projects.

[4] Section 302 of the Water Resources Development Act 1986 specifies that the Users Board consist of up to 11 members appointed by the Secretary of the Army.

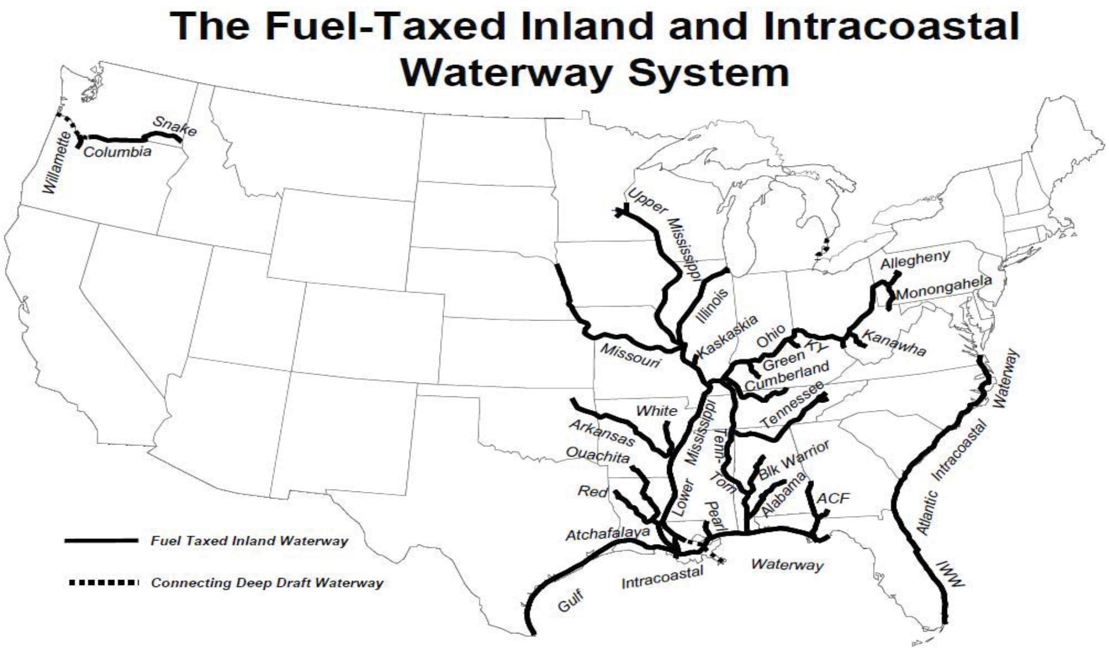
Figure 1: Inland Waterways Fuel Tax



It is important to note the tax has remained unchanged since 1995 and thus remains unadjusted to account for inflation. If the fuel tax were indexed to inflation—as measured by the Consumer Price Index—fuel would currently be taxed at 31 cents per gallon.

Figure 2 shows a map of the taxable waterways in the United States. The majority of activity centers on the Ohio and Mississippi Rivers and their tributaries.

Figure 2



Source: Inland Waterways Users Board Annual Report (2012)

The inland waterways depicted in Figure 2 are described in Table 1 on the following page. The U.S. Army Corps of Engineers (USACE) maintains responsibility for these waterways, which encompass 38 states and carry over 8 percent of all national freight traffic (Stern, 2013).

Table 1: List of Taxable Inland Waterways

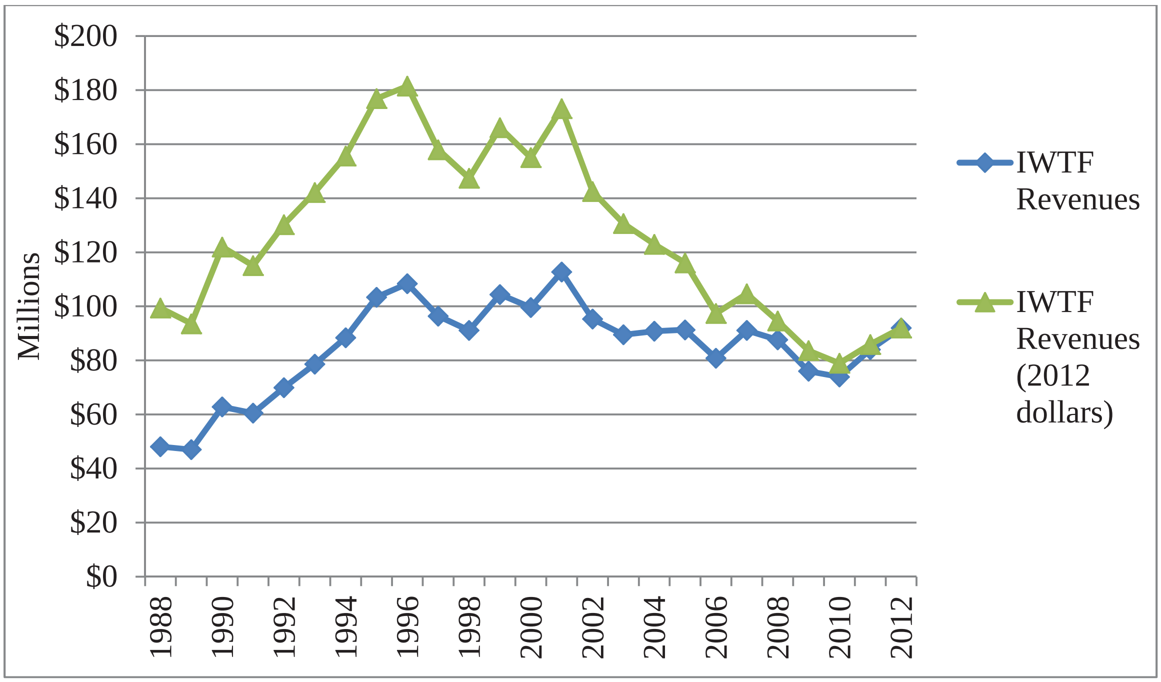
1. Alabama-Coosa Rivers: From junction with the Tombigbee River at river mile (hereinafter referred to as RM) 0 to junction with Coosa River at RM 314.
2. Allegheny River: From confluence with the Monongahela River to form the Ohio River at RM 0 to the head of the existing project at East Brady, Pennsylvania, RM 72.
3. Apalachicola-Chattahoochee and Flint Rivers (ACF): Apalachicola River from mouth at Apalachicola Bay (intersection with the Gulf Intracoastal Waterway) RM 0 to junction with Chattahoochee and Flint Rivers at RM 107.8. Chattahoochee River from junction with Apalachicola and Flint Rivers at RM 0 to Columbus, Georgia at RM 155 and Flint River, from junction with Apalachicola and Chattahoochee Rivers at RM 0 to Bainbridge, Georgia, at RM 28.
4. Arkansas River (McClellan-Kerr Arkansas River Navigation System): From junction with Mississippi River at RM 0 to Port of Catoosa, Oklahoma, at RM 448.2.
5. Atchafalaya River: From RM 0 at its intersection with the Gulf Intracoastal Waterway at Morgan City, Louisiana, upstream to junction with Red River at RM 116.8.
6. Atlantic Intracoastal Waterway: Two inland waterway routes approximately paralleling the Atlantic coast between Norfolk, Virginia, and Miami, Florida, for 1,192 miles via both the Albemarle and Chesapeake Canal and Great Dismal Swamp Canal routes.
7. Black Warrior-Tombigbee-Mobile Rivers: Black Warrior River System from RM 2.9, Mobile River (at Chickasaw Creek) to confluence with Tombigbee River at RM 45. Tombigbee River (to Demopolis at RM 215.4) to port of Birmingham, RM's 374-411 and upstream to head of navigation on Mulberry Fork (RM 429.6), Locust Fork (RM 407.8), and Sipsey Fork (RM 430.4).
8. Columbia River (Columbia-Snake Rivers Inland Waterways): From the Dalles at RM 191.5 to Pasco, Washington (McNary Pool), at RM 330, Snake River from RM 0 at the mouth to RM 231.5 at Johnson Bar Landing, Idaho.
9. Cumberland River: Junction with Ohio River at RM 0 to head of navigation, upstream to Carthage, Tennessee, at RM 313.5.
10. Green and Barren Rivers: Green River from junction with the Ohio River at RM 0 to head of navigation at RM 149.1.
11. Gulf Intracoastal Waterway: From St. Mark's River, Florida, to Brownsville, Texas, 1,134.5 miles.
12. Illinois Waterway (Calumet-Sag Channel): From the junction of the Illinois River with the Mississippi River RM 0 to Chicago Harbor at Lake Michigan, approximately RM 350.
13. Kanawha River: From junction with Ohio River at RM 0 to RM 90.6 at Deepwater, West Virginia.
14. Kaskaskia River: From junction with Mississippi River at RM 0 to RM 36.2 at Fayetteville, Illinois.
15. Kentucky River: From junction with Ohio River at RM 0 to confluence of Middle and North Forks at RM 258.6.
16. Lower Mississippi River: From Baton Rouge, Louisiana, RM 233.9 to Cairo, Illinois, RM 953.8.
17. Upper Mississippi River: From Cairo, Illinois, RM 953.8 to Minneapolis, Minnesota, RM 1,811.4.
18. Missouri River: From junction with Mississippi River at RM 0 to Sioux City, Iowa, at RM 734.8.
19. Monongahela River: From junction with Allegheny River to form the Ohio River at RM 0 to junction of the Tygart and West Fork Rivers, Fairmont, West Virginia, at RM 128.7.
20. Ohio River: From junction with the Mississippi River at RM 0 to junction of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania, at RM 981.
21. Ouachita-Black Rivers: From the mouth of the Black River at its junction with the Red River at RM 0 to RM 351 at Camden, Arkansas.
22. Pearl River: From junction of West Pearl River with the Rigolets at RM 0 to Bogalusa, Louisiana, RM 58.
23. Red River: From RM 0 to the mouth of Cypress Bayou at RM 236.
24. Tennessee River: From junction with Ohio River at RM 0 to confluence with Holstein and French Rivers at RM 652.
25. White River: From RM 9.8 to RM 255 at Newport, Arkansas.
26. Willamette River: From RM 21 upstream of Portland, Oregon, to Harrisburg, Oregon, at RM 194.
27. Tennessee-Tombigbee Waterway: From its confluence with the Tennessee River to the Warrior River at Demopolis, Tennessee.

Source: USACE

Outlays from the fund are based on monthly receipts (Pointon, 2013). Annual trust fund revenues (in millions of dollars) from 1988-2012 are shown in Figure 3. These figures have been adjusted to 2012 dollars which account for inflation. To make appropriate adjustments that reflect construction inflation on the inland waterway system, the USACE Civil Works Construction Cost Index System was used. This adjustment reveals the increases in construction costs from 2000 to 2010; during this period costs went up approximately 45 percent (Carter & Stern, 2010).

In nominal terms, revenues have flat lined since the late 1990s, yet in real terms there is a pronounced downward trend. Since 2001, real revenues have declined each year, with the exception of 2007 and 2011 when small increases occurred. Receipts in fiscal year 2012 were $89.3 million. Of that amount, $88.6 million was disbursed for projects (U.S. Army Corps of Engineers, 2012). This total pales in comparison to the American Society of Civil Engineer's 2013 Report Card, which estimated capital needs of $18 billion over the next twenty years.

Figure 3: Inland Waterways Trust Fund Revenues

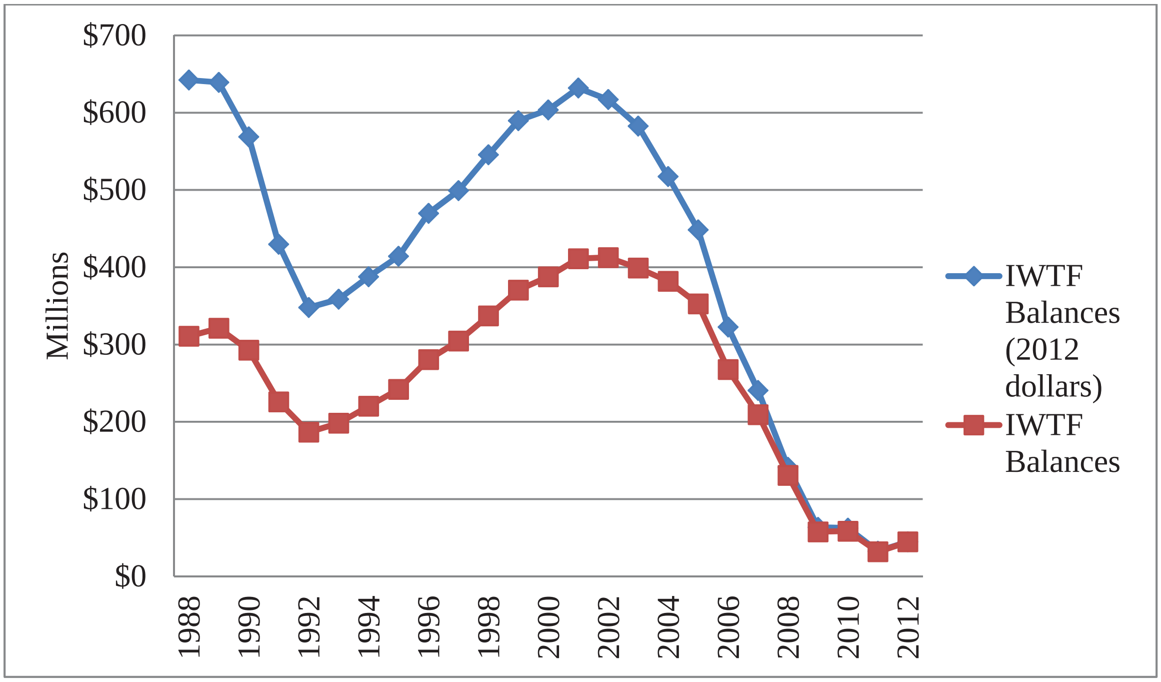


Source: U.S. Treasury Department and USACE

The most pressing issues facing the trust fund pertain to revenue shortfalls, which impede work on new construction and rehabilitation projects. According to the American Society of Civil Engineers' 2013 *Failure to Act Report*, only 50 percent of the inland waterway infrastructure and marine port needs will be sufficiently funded through 2040. Stern (2013) describes the situation as "limiting the number of new and ongoing inland waterway construction projects" (p. 1). Funding shortfalls have pushed increased costs onto households and businesses; current estimates place these costs at over $1.2 trillion. The report also cited other consequences that will result from insufficient funding, including export losses topping $2 trillion by 2040, and projected job losses in excess of 700,000. Inadequate funding will also reverberate in the price of goods and negatively affect disposable income for many Americans.

Figure 4 displays IWTF balances from 1988-2012 in both nominal and 2012 dollars. It is evident that balances have precipitously declined. Nominal balances have dropped nearly 90 percent (from a high of $412.6 million in 2002, to $44.8 million in 2012). In real dollars, the decline has been even greater. Using 2012 currency values as the baseline, trust fund balances have fallen over this period nearly $600 million dollars, although there has not been a smooth downward trend. Balance declines in the early 1990s were offset by a subsequent rebound; but the falls in recent years have been more sharply felt because the IWTF is nearing a zero balance.

Figure 4: Inland Waterways Trust Fund Balances



Source: U.S. Treasury Department

Sharp balance declines stem from increased project appropriations, declining receipts, and cost overruns (Stern, 2013). Due to a lack of funding and a viable cost sharing mechanism, new construction projects must be prioritized. Increases in appropriations began in 2005, as greater investments in IWTF projects were approved. This produced a situation where expenditures outpaced revenues, contributing to the abrupt decrease in balances in subsequent years (Stern, 2013). The decline in revenues has also contributed to project backlogs. When coupled with increasing costs and extended project times, these developments have placed the viability of the current business model in doubt (Hammond, 2013).

Congress has taken several steps to slow the rapid decline in the IWTF including:

1) *Exempting rehabilitation projects from cost sharing*

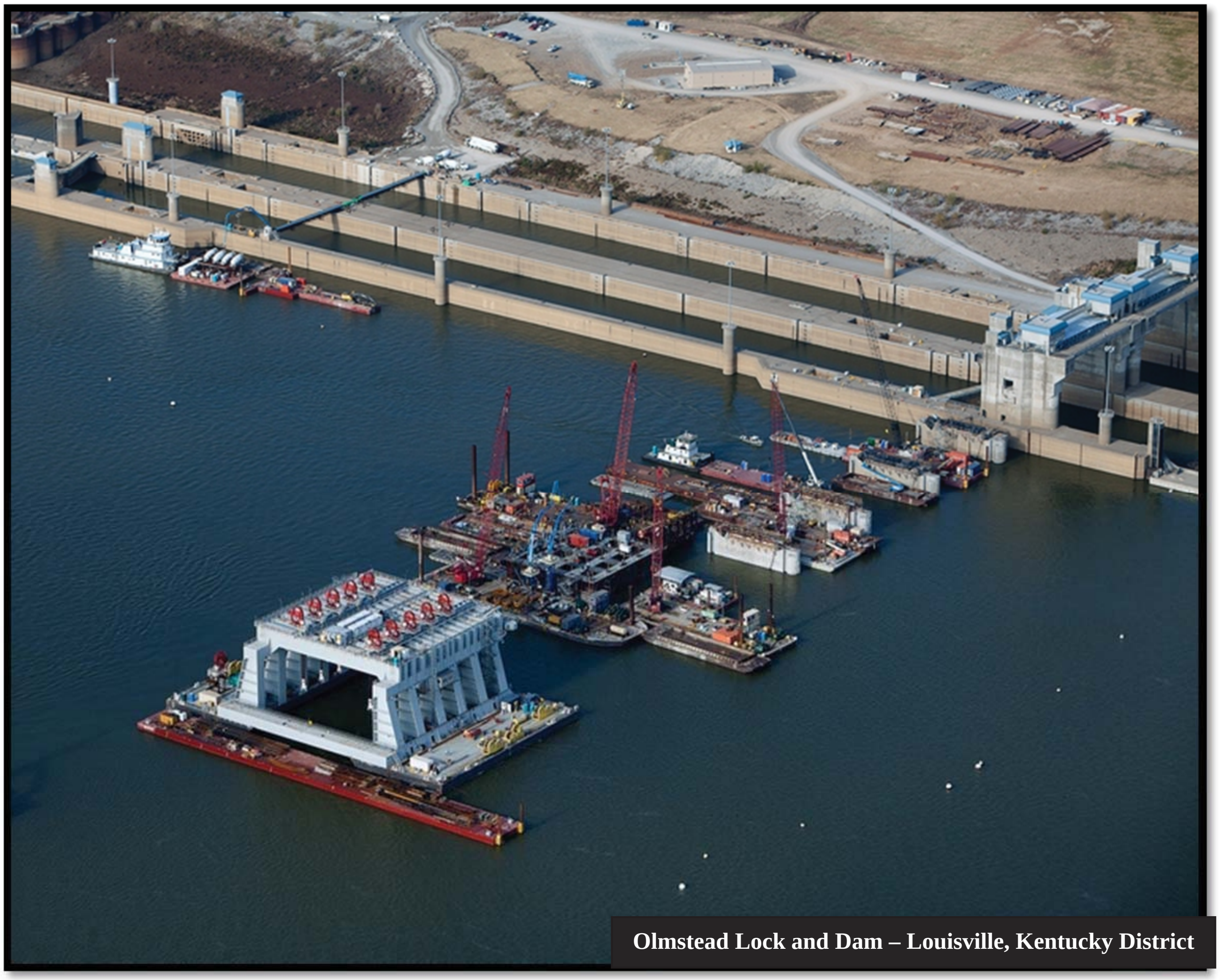
2) *Exempting cost share requirements for $400 million in construction funds appropriated via the American Recovery and Reinvestment Act*

3) *Prohibiting new construction contracts*

4) *Limiting appropriations so they match anticipated revenues.*

Additional funding concerns, outside of the IWTF, center on annual appropriations for operations and maintenance. While capital expenditures are an important component of inland waterway funding, maintaining the system in good working order is critical to preserve its reliability and efficiency. In FY 2010, $2.5 billion was requested for operations and maintenance. However, only $2.4 billion was appropriated (GAO, 2010).

Given that operations and maintenance appropriations are drawn from general federal revenues, uncertainty can arise if there is a lack of consensus between Congress and Presidential administrations over funding levels (Grier, 2002). Additional cost issues center around the Olmstead Lock and Dam on the Ohio River. Olmstead has received a significant proportion of funds due to cost overruns. Total project costs have shot up from an estimated $1 billion to over $3 billion as of 2012 (Stern, 2013). Cost overruns and lengthening construction timelines produce a cascade effect, which leaves other key projects underfunded or not funded at all.



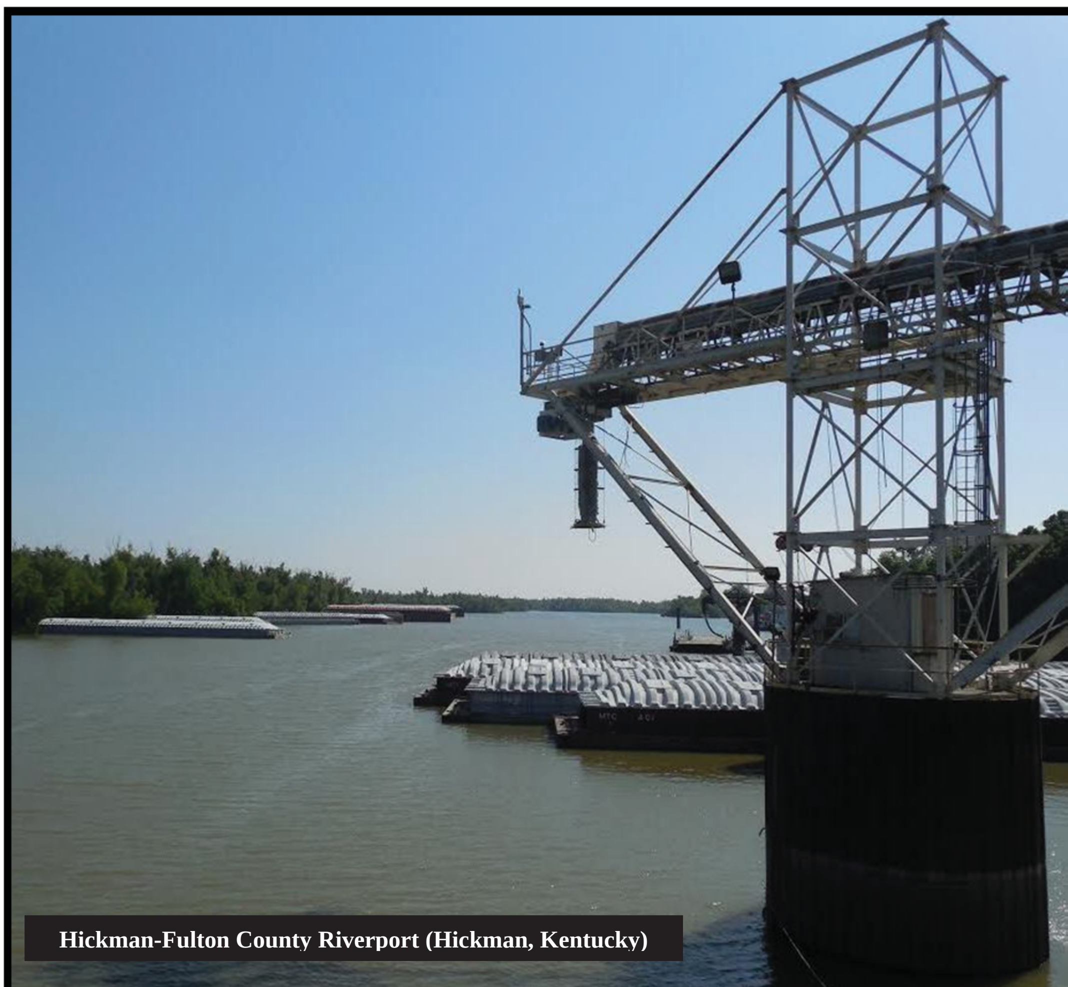
Olmstead Lock and Dam – Louisville, Kentucky District

III. Potential Funding/Inland Waterway Trust Fund Reforms

Although the current revenue structure of the IWTF, which is comprised of fuel taxes, appears to have been sufficient at one time, there are issues of great concern. The lack of inflation indexing, increasing project needs due to aging infrastructure, and the current state of the fund, all underline the importance of adopting policy changes to improve the IWTF's fiscal position, along with identifying new ways to increase operations and maintenance funding.

Given the IWTF's plummeting balance, there have been a number of proposals offered by various organizations and the federal government to alleviate revenue shortfalls. Although some reforms have been implemented, further policy shifts are necessary. Many of the proposed changes seek to improve the project identification and delivery process while raising additional funds, either by replacing the fuel tax outright or increasing it above the current rate. Based on the trajectory of past reform proposals, the impetus to alter the current funding structure or develop new revenue sources has been a source of conversation for some time.

When evaluating whether to change funding structures, Case and Lave (1977) note that several criteria that should be enhanced through user charges that include efficiency[5], equity, and administrative simplicity. They describe a number of user charge regimes including fuel taxes, annual license fees, segment tolls, lockage fees, and congestion tools, many of which remain salient given the current funding issues facing the inland waterways system. Increasing the fuel tax, an option many reform proposals contain today, is cited as beneficial due to administrative simplicity. However, it fails to meet the efficiency criterion as it would subsidize waterways with lower traffic volumes at the expense of higher traffic segments. Additionally, raising the fuel tax could reduce congestion by shifting freight to other modes if the cost differential of the tax increase was significant. Annual license fees could be levied on barges. This could be accomplished with costs determined by the annual operation and maintenance needs divided by total traffic, or by revenues needed to fund priority construction projects.



Hickman-Fulton County Riverport (Hickman, Kentucky)

[5] Defined by the Congressional Budget Office (1992) as “charging users a price equal to marginal social cost” (p.63).

In terms of administration, Case and Lave noted that this policy is similar to the fuel tax, yet the tax incidence does not necessarily fall on the waterway incurring the usage. This situation leaves the criteria of equity and efficiency unmet. Another possibility, segment tolling, would impose charges at certain points along the system. This would efficiently distribute the costs based on usage. The main benefit of this structure is the administrative simplicity. Like segment tolling, lockage fees are collected each time a vessel transits a lock. The efficiency and equity of such scenarios hinge on the pricing structure. If volume determines charges, then segments and locks with higher traffic flows would have lower rates than less travelled segments and locks. This could reduce individual costs in already-congested areas, leading to no impact on congestion, and potentially increase congestion. Distributing costs evenly across the system would not solve the problems of efficiency and equity in a fair manner.

Finally, congestion tolling is proposed with three different structures: auctioning queue spots, charging individual barges a per hour delay fee for each barge that is waiting (vessels would have the option to vacate their position), and a per hour delay fee with no option to vacate queue position. No one proposal meets all of the evaluation criteria. Balancing desired outcomes with needed funding levels will likely remain the overriding litmus test of any proposed reform. Case and Lave detailed which proposals are more likely to meet each criterion previously defined by stating "If efficiency is the prime concern, a segment toll plus locking fee and congestion toll- suitably average to attain administrative simplicity- are best. If equity and simplicity are the prime concerns, the segment toll might be set to bring total receipts up to the maintenance and investment cost associated with each segment." (Case and Love, p. 818)

The Congressional Budget Office's (1992) analysis of waterways funding featured a number of proposals, including some highlighted previously by Case and Lave (1977). The study presents criteria used to assess proposals with a variety of potential funding options. The first step in deciding what charges to extract is done by determining whether to levy a charge on the entire inland waterway system, or if the fee structure should be designed based on the characteristics of individual waterways. This approach would increase efficiency by reducing subsidization from low cost waterways to higher cost waterways. Secondly, the funding structure must be defined to distinguish between charging to recover operation and maintenance costs, or the recovery of project capital costs to determine which of funding alternative is most practical.

The individual funding arrangements identified by the Congressional Budget Office are listed below:

Table 2: Congressional Budget Office (1992) Inland Waterway User Funding Options

Recovery of Operation and Maintenance Costs	
Annual License Fees	Equal to operation and maintenance costs divided by number of barges using the waterway
Charge Equal to Operation and Maintenance Cost per Ton-Mile	Operation and maintenance costs divided by ton miles and charged to users on that basis
Per-Lockage Fee	Operation and maintenance costs divided by total lockages
Increase Fuel Tax	Increase fuel tax sufficient to cover operation and maintenance costs
Charge Based on Demand Factors	Charges vary based on availability of alternative routes; pricing sufficient to cover operation and maintenance costs
Combination Tolls	Utilize fuel tax and ton-mile charges by waterway
Lock and Dam Congestion Charge	Charges based on users willing to pay for first access at congested locks and dams
Recovery of Capital Costs	
Annual Fee	Annualized Capital Costs Divided by Users
Per-Use Charge	Capital Costs Divided by Number of Uses
Charge Based on Demand Factors	Charges vary based on availability of alternative routes; pricing sufficient to cover capital costs

The report concludes by observing that:

"Existing taxes imposed on users of inland waterways does not raise enough revenue to cover operation and maintenance costs, let alone costs of new construction" (p. 71).

Given that the main revenue source has remained unchanged since 1995, the funding difficulties and issues raised by this report are even more pertinent today than when the report was published in 1992. The Waterways Council, a national policy organization comprised of waterway users that advocates on behalf of the inland waterway system, has put forward a Capital Development Plan to improve infrastructure on the nation's inland waterways.

The Waterways Council lobbied to incorporate this plan into the Water Resources Development Act (WRDA), which is currently before the 113th Congress. The goal of the plan is to:

***1)** Prioritize projects over the system*

***2)** Improve USACE project management and abilities to deliver projects on time and budget*

***3)** Change funding mechanisms to ensure the system's future viability*

Source: (Colbert, 2013)

These changes would increase cost efficiencies on delayed projects and avoid cost increases associated with longer project times (Hammond, 2013). Underwriting these changes are the goals of funding projects efficiently, finishing projects in a timely manner, and using a system wide context when conducting project analysis. This plan argues for ranking projects based on condition, likelihood of declining performance, consequences of that decline, and return on investments affecting performance levels. Rankings would then be used to prioritize projects.

This type of change in prioritization reflects concerns Grier (2002) raises, which suggests looking at the threshold for project funding and the potential return on investments for lock and dam projects, rather than singularly focusing on benefit-cost ratios (National Academy of Public Administration, 2007). This plan would require the Users Board to collaborate with USACE to improve the current model and develop a long term funding strategy (Hammond, 2013). Outside of using simulations, such a coordinated approach seems applicable to the inland waterway system. The USACE is working within budgetary constraints to optimize the distribution of available funding across a spectrum of potential projects (Wang & Schonfeld, 2005).

The traditional cost sharing structure would also be overhauled. Construction and major rehabilitation projects over $100 million would still be shared 50/50 between the federal government and the IWTF. Rehabilitation projects less that $100 million would be completely funded by the federal government. Implementing these changes would require outlays of $270 million from the federal side and $110 million from the IWTF. This increase in expenditures would call for an increase in the fuel tax, or devising some other method of industry funding (Hammond, 2013). As previously noted, tax rate increases not indexed for future inflation will eventually erode purchasing power and impair the system by reducing the number funded projects. Revenue structures that account for such impacts, even if it is not explicitly linked to indexing, will shore up short and medium-term project funding for the inland waterway system.

Stern (2013) examines potential changes to the current financing system for inland waterways from two perspectives, the Users Board and the Executive Branch. Starting with an examination of policies implemented by the Bush Administration,[6] Stern details approaches to IWTF funding. Initial proposals focused on replacing the fuel tax with lockage fees. The fees would be tied to the balance in the IWTF, with fees rising when the balance fell below $25 million and decreasing when it surpassed $75 million. This change was touted as improving equity of inland waterway investments, as most capital projects involve locks. Congress rejected this proposal due to the increasing burdens it would place on lock users compared to the current fuel tax structure.

The Obama Administration has proposed replacing the fuel tax with user fees to boost revenues and increase efficiency. This proposal would also allow the USACE to increase fees at high-traffic locks. A more comprehensive option put forward would have maintained the fuel tax and levied annual fees to meet a revenue target (Stern, 2013). Expansion of the current system so that a larger number of waterways would be subject to user fees was another policy suggestion that was advanced. However, this plan was not anticipated to generate significant new revenues.

Although often at odds with administration attempts to change the current financing structure of the IWTF, the Users Board has offered several alternative proposals. These include raising the fuel tax and altering the current cost sharing structure. The Users Board has proposed increasing the fuel tax by 6-9 cents per gallon, while requiring the federal government to increase its cost share to 100 percent for dams, cost overruns, and projects between $8 and $99 million (Stern, 2013). The increase in the fuel tax would be indexed, and increased to compensate if revenues fall short of expected levels.

Appropriations would also be deferred to let the IWTF balance recover and stabilize. Outside of changes to the revenue and cost sharing structures, the Users Board offered a project priority list that recommended increasing involvement regarding IWTF projects. This could be done by requiring board approval and appointing representatives for each project team (Stern, 2013). This method would change the way projects are currently selected (by the USACE and the current Administration and Congress) while implementing a priority ranking system.

When determining an optimal investment strategy, it is imperative to account for average maintenance costs (Congressional Budget Office, 1992). Infrastructure projects that reduce the average maintenance cost (as well as transit times via reduced congestion, thus benefitting shippers as well) will often prove cost beneficial over the long-run. Including these measures as part of the decision-making process is likely to yield future benefits for the IWTF and system as a whole. Adding such considerations to the deliberation process will improve project selection and execution.

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[6] For a brief summary of additional administration proposals dating back to FY 1996, see Kruse, Ellis, Protopapas, and Norboge, 2013 p.13-23.

A study commissioned by the United Soybean Board (Kruse, Ellis, Protopapas, and Norboge, 2013)[7] developed a bonding alternative to fund waterway projects. This approach allows large capital intensive projects to be undertaken immediately, rather than facing interminable delays until sufficient revenues have been collected.[8] The authors cite several advantages of funding projects through bonds, including the cost reductions that result from beginning construction more quickly and the ability to use future revenues to deliver improvements to the current system. Three possible methods of applying this funding approach are also discussed: bond against IWFT revenue, raise the Inland Waterway Fuel Tax by 4 cents and bond against entire new revenue streams, raise the Inland Waterway Fuel Tax by 4 cents and bond only against the increase. Estimates suggest that the three bonding approaches could generate $1.3 billion (plan 1), $1.6 billion (plan 2), or $275 million (plan 3) in financing proceeds in their first year. Additional case studies in the report using non-domestic examples reveal that alternative financing mechanisms are often available and can provide necessary funding to assist in meeting more expedited project timelines.

The Inland Marine Transportation Systems (IMTS) Capital Projects Business Model (2010) argues for an annual funding level of $380 million (half of which is to come from the IWTF, and the other half from the federal government). This would require 50 cents per gallon increase in the fuel tax. IMTS recognizes a dramatic increase over the current 20 cents is unrealistic. However, the disparity reveals the pressing nature of needs facing the system and the inability of the current funding regime fulfill them. Given that such an increase is currently unfeasible, the report settles on a recommended increase in the fuel tax to at least 26 cents per gallon. The report also includes a table with different cost sharing options to consider as part of a more sweeping business model, with certain exemptions for high dollar projects such as Olmsted and Lower Mon. Those options are shown in Table 3.

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[7] The authors also conducted a stakeholder survey for various positions related to the inland waterways. The results can be found in Appendix A.

[8] The lack of project funding for completion is listed as a budgeting deficiency by the National Academy of Public Administration (2007).

Table 3: Cost Sharing Options Considered as Part of IMTS Capital Projects Business Model Report

Baseline Option – 50% Federal and 50% IWTF
50/50 for New Construction, 100% Federal for Major Rehabilitation
50/50 for New Construction and Major Rehabilitation above $50M, 100% Federal for Major Rehabilitation below $50M
50/50 for Locks, 100% Federal for Dams
50/50 for New Construction, and 75/25 for Major Rehabilitation
60% Federal, 40% IWTF
65% Federal, 35% IWTF
75% Federal, 25% IWTF
50% Federal, 50% IWTF on all projects except Lower Mon and Olmsted
50% Federal, 50% IWTF for New Construction and Major Rehabilitation above $50M (Locks); 75% Federal, 25% IWTF for New Construction and Major Rehabilitation above $50M (Dams); 100% Federal for Major Rehabilitation below $50M
50% Federal, 50% IWTF for Lock New Construction and Major Rehabilitation above $100M; 100% Federal for Dams and Lock Major Rehabilitation below $100M (with cap on Lower Mon)
50% Federal, 50% IWTF for Lock New Construction and Major Rehabilitation above $50M; 100% Federal for Dams and Lock Major Rehabilitation below $50M
50% Federal, 50% IWTF for Locks; 75/25 for Dams
50% Federal, 50% IWTF for Locks; 75/25 for Dams; 100% Federal for remaining Lower Mon
50% Federal ,50% IWTF for Locks; 80/20 for Dams

Source: IMTS Capital Projects Business Model Report (2010), p.69

The report suggests funding new lock constructions through a 50/50 cost share agreement between the IWTF and federal government, where any major rehabilitation over $100 million are funded at the same rate. For dam construction / rehabilitations, and lock rehabilitations costing under $100 million, the report endorses a 100 percent federal funding from general appropriations. Other proposals include establishing cost-share caps to cope with potential cost increases and overruns. While raising additional revenues for the IWTF is the focus of many proposals, the allocation and cost sharing issues dealing with current funding has come under scrutiny, as noted in the IMTS Capital Business Projects Model Report (2010). Faced with limited funds, the choice to allocate money can impact trends in system usage by altering its condition and efficiency. Grier (2002) critiques using ton-miles to make budget decisions because it is a measure that does not provide tributaries with enough credit for freight shipments. Without such tributaries, many trips would not be possible. Thus Grier proposes that funding allocations by waterways use system ton-miles.[9] Additional considerations may also center on shipper savings derived from waterways, including those with lower usage rates.

[9] "System ton-miles are computed by identifying every commercial cargo carrying vessel that has plied the inland waterway and summing the products of the tons times the total trip miles for each vessel trip. The total trip-miles represent the total distance from origin to destination" (p. 14).

Although the lack of funding has been highlighted as an obstacle to maintaining the inland waterway system in a functional state, the way in which current projects are undertaken may also impact funding levels. Kruse, Ellis, Protopapas, and Norboge (2013) developed a new approach to construction and maintenance on the inland waterway system that operates as an alternative to the current "build and expand" approach. The authors proposed a new strategy coined as "repair and sustain", which includes some elements of past strategies.[10] This new approach privileges maintenance designed to avoid critical failures, allows for major construction projects only when performance levels dips—permanently—below accepted thresholds, and staging necessary equipment to hasten repairs when they are needed. However, implementing this option seems unlikely given the current lack of funding.

The proposals reviewed here offer plans with different funding methods in an attempt to increase inland waterway expenditures and therefore preserve the system in a good state of repair. However, the level of desired expenditures and investment in the system has not been addressed. Is it acceptable to maintain the status quo? If not, what metrics should be used to identify a target level of performance? Also, what level of investment is required to meet and sustain the targets identified? These questions must be parsed within context with of the system's present state, and the residual impact of past funding levels on the system.

IV. Current State of the System

The rapid IWTF decline underscores the funding issues confronting the inland waterway system, while also raising questions about the current system's infrastructure resiliency. The USACE[11] runs 239 lock chambers at 193 sites along the waterway system (U.S. Army Corps of Engineers, 2012). The average age of these active locks is over fifty years, which calls into question their reliability. Aging infrastructure also requires additional investment to remain operational, yet project authorization currently exceeds available funds (Carter & Stern, 2010). Many older locks lack the size and capacity needed for today's barge tows. Older facilities typically have 600-foot chambers, half the size of today's 1,200 feet standard. Due to spatial constraints, many barge tows are separated and moved through these older locks piecemeal, and then reassembled on the other side.

This adds to transit times, increasing costs[12] and making inland waterways a less cost effective mode for freight transport. The Inland Waterways Users Board Annual Report (2012) described their concerns by stating: "The Board is increasingly concerned about the worsening condition of critically important locks and dams on our nation's waterways and about the growing inability of our current inland waterways modernization program to adequately address this

[10] The past strategies noted by the authors are: fix when it fails, advance maintenance, and rehabilitation.
[11] For more on the fiscal challenges facing the USACE as a whole including appropriations, project backlogs, authorizations and direction, and trust funds, see Carter and Stern (2010).
[12] See Kruse, Ellis, Protopapas, and Norboge, 2013 Tables 18, 19, and 20 for calculations on the additional costs of double cuts.

situation" (p.3). According to Carter and Stern (2010), the construction backlog facing the USACE would cost in excess of $62 billion to eliminate.

The 2013 Report Card for America's Infrastructure by the American Society of Civil Engineers described the dire condition of the inland waterway system and assigned a grade of D-[13] because:

"Barges are stopped for hours each day with unscheduled delays, preventing goods from getting to market and driving up costs. There is an average of 52 service interruptions a day throughout the system. Projects to repair and replace aging locks and dredge channels take decades to approve and complete, exacerbating the problem further." (p. 6)

Unscheduled delays impose higher costs on shippers because they are unable to plan around them appropriately. When barge tows are forced to separate to move through a lock, congestion and delays emerge. It also increases lockage times, particularly at high traffic locks or during periods of heavy traffic. Preventative maintenance designed to sustain locks and prevent breakdowns is not adequately funded, leading to a reactionary mentality when locks do fail (Grier, 2009). When outages on the system occur, disruptions to barge traffic can have significant economic repercussions. Grier (2009) observed that:

"An aging inland waterway infrastructure is not necessarily a concern as long as timely investments are made in maintenance and major rehabilitations, with some capacity and modernization improvements where needed." (p. 3)

Based on the status quo, many projects will remain incomplete for decades, some as far out as 2090 (Colbert, 2013), which aggravates the current situation–where important projects go unfunded (Hammond, 2013). The delays caused by limited funds perpetuate congestion issues and a decrease the long-term benefit of using the system while increasing construction costs. The mounting backlog of projects represents a trend that, if not addressed, will have significant ramifications for the inland waterway system in the years ahead as the effects of deferred construction and maintenance multiply and compound.

Examining trends in lock unavailability[14] illustrates the effects of limited funding on the inland waterway system. Grier (2002) gathered data on lock outages in the 1990s and found that aggregate outage duration has doubled in just a decade. Shipping itineraries can be modified if carriers know in advance about an outage, but those that are unscheduled can result in expensive modal shifts and delayed shipments. The American Society of Civil Engineers 2013 Report Card emphasizes unscheduled delays and some of the main drivers of these delays are cited:

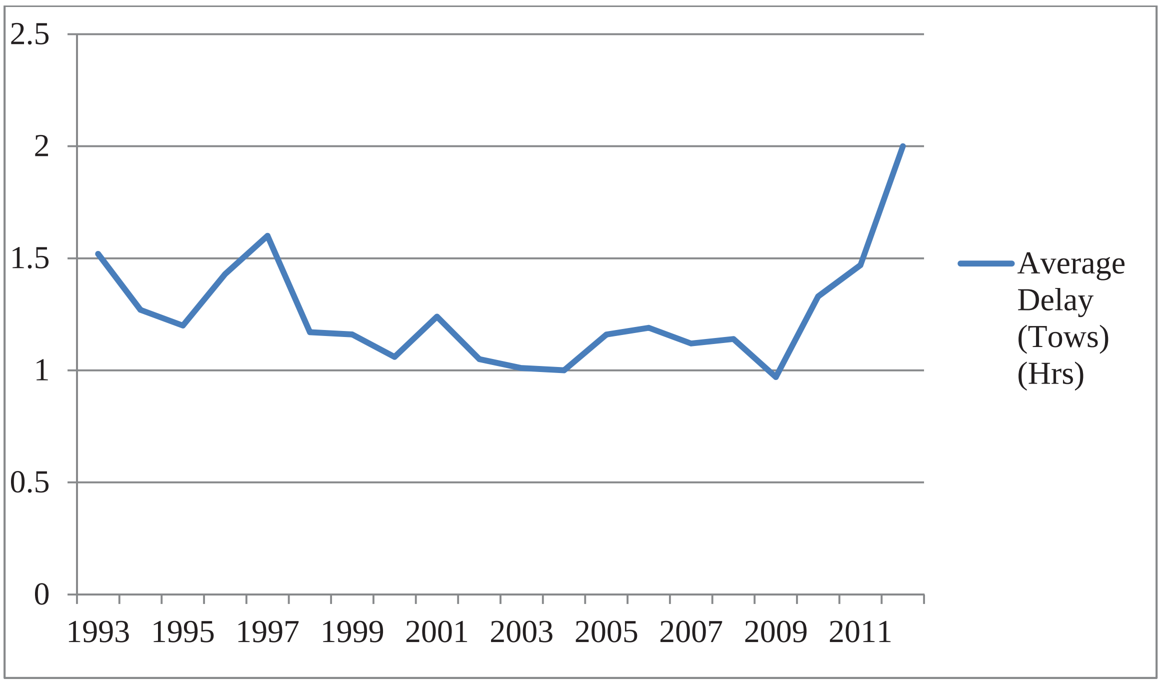
[13] A grade of D is defined as: poor, where the infrastructure "is in poor to fair condition and mostly below standards, with many elements approaching the end of their service life."

[14] Defined by Grier (2009) as time over a year in which the lock could not accommodate traffic due to a variety of reasons which may include weather, water levels, lock problems, etc.

"Unscheduled delay is most often the result of high volumes at transit points, as well as occasional failures in equipment, resulting in increased operating costs." (p.39)

In 2011, total lock outages accounted for 9 percent of operational time, of which 3 percent were unscheduled outages (U.S. Army Corps of Engineers, 2012). This may represent a small percentage of total operational time, but the impact of an unscheduled outage at a high-traffic lock for a long period of time can decrease system efficiency. Over a long period of time, this scenario will grow more problematic. Additionally, 90 percent of locks and dams experienced at least one unscheduled delay in 2009. Figure 5 shows the average delay vessels encountered at locks. The trend until 2009 appeared to be steady, if not slightly declining, but the most recent years reveal steep increase in average delays.

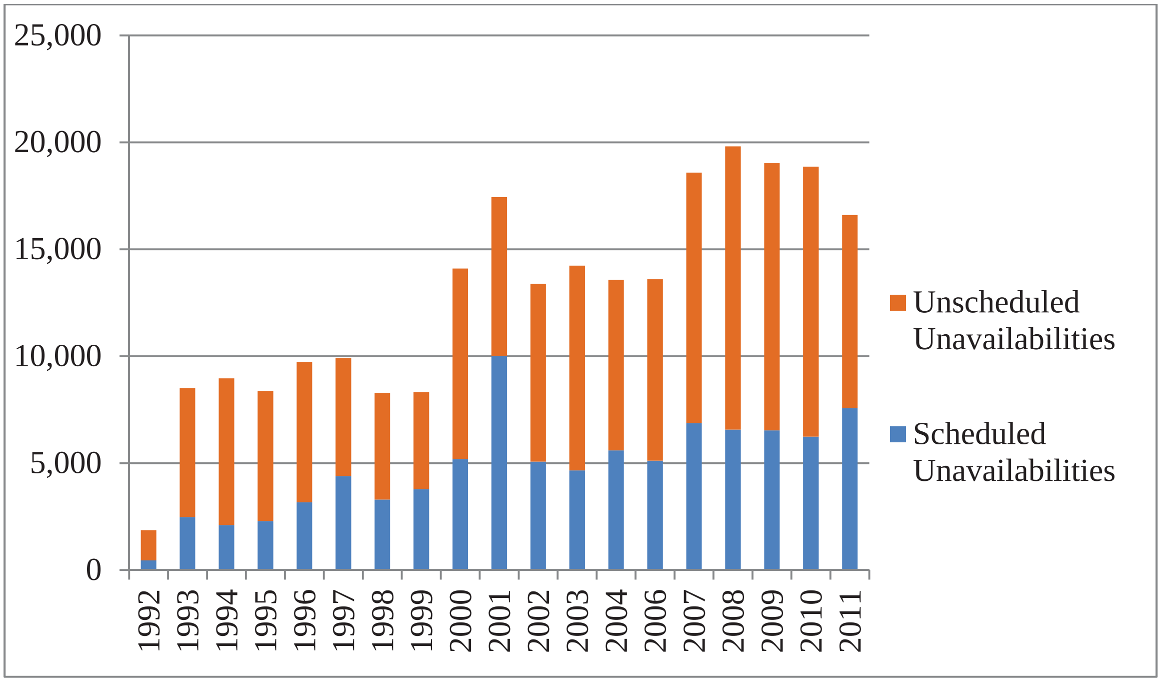
Figure 5: Average Delay at Locks on Inland Waterway System (in hours)



Source: USACE Lock Performance Monitoring System

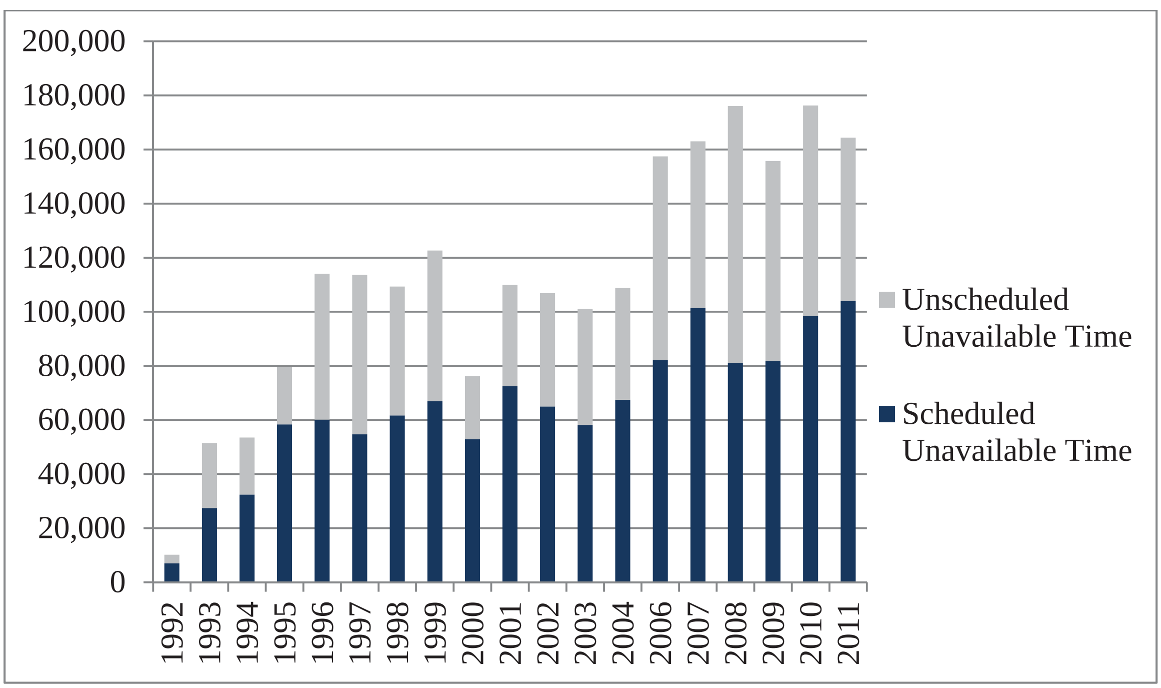
Figures 6 and 7 illustrate scheduled and unscheduled outages by number and duration for the US inland waterway system. Due to scheduled outages generally being more manageable, much of the attention is directed toward unscheduled outages that can disrupt shipping and create myriad issues for waterway users. The number and time of unscheduled outages has varied, but the general trend line is one of increasing unavailability.

Figure 6: Number of Scheduled and Unscheduled Unavailability on Inland Waterway System



Source: USACE Lock Performance Monitoring System

Figure 7: Scheduled and Unscheduled Unavailability on Inland Waterway System (in hours)



Source: USACE Lock Performance Monitoring System

Along the Ohio River from 2002 to 2011, unscheduled outages—measured in hours— increased nearly 98 percent, while the number of total unscheduled outages increased 145 percent.[15] Grier (2009) provides a possible explanation of increased outage times:

"Scheduled maintenance and repairs are occurring more often, at more locations, and are taking longer to complete; and unscheduled closures due to failures of a lock component, or some other incident, are occurring more often, at more locations, and are likewise taking longer to fix." (p. 4)

Longer and/or more frequent lock outages (especially unscheduled ones) can significantly impact system reliability. In turn, shippers may decrease their usage of the system by shifting freight to other more reliable modes.

V. Conclusion

The evidence compiled in this synthesis indicates several alarming trends, but also ample opportunities for reform. Problems with the sufficiency of current funding levels have eroded system condition and led to declining reliability. Some proposals argue for making changes to the USACE's budget process and the way projects are prioritized, which should merit attention. However, the most pressing issue appears to be securing a reliable and sufficient funding stream for the inland waterways system. Coordinated investments will be necessary in the coming years to maintain system performance through individual locks and dams that function interdependently as part of the larger system.

Waterways currently enjoy 100 percent federal funding for operations and maintenance, along with cost sharing on capital construction and major rehabilitation projects. The funding arrangements are ostensibly beneficial, yet uncertainty over the federal budget and concerns over deficit spending may negatively impact this less visible transportation mode. Aging locks and dams will need increased maintenance if system reliability is to be maintained at current levels, and other financial sources may have to be tapped to provide the required funding. Increases in lock outages disrupting freight shipments have economic impacts and can reduce the use of a mode that already has unused capacity and could accommodate increased traffic.

The IWTF serves as the key funding mechanism for capital construction and major rehabilitation projects. However, its balances have fallen close to zero in recent years and annual receipts cannot meet existing project needs. Because the fuel tax that has gone unadjusted since 1995, nominal revenues have remained stagnant while inflation has decreased purchasing power real dollars. As such, unfunded projects continue to grow in number, which increases competition for funding and a produces a significant project backlog. As needs go unmet, costs rises and infrastructure deterioration goes on unimpeded.

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[15] Data gathered from the U.S. Army Corps of Engineers Lock Performance Monitoring System (LPMS), available at: http://corpslocks.usace.army.mil/lpwb/f?p=121:1:1267106300118359.

However, there have been proposals to increase funding levels and secure a reliable stream of future revenues that will be sufficient to meet potential increases in demand. These should be carefully considered by policymakers to ensure that the inland waterways system remains a resilient mode of transportation able to keep pace with the nation's growing economy.

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