



# River at Risk

An Economic Analysis of  
Expanding Ohio River Locks

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## An Economic Analysis of Expanding Ohio River Locks

### PREFACE

Since 1824, the U.S. Army Corps of Engineers (Corps) has been the primary force in changing the Ohio River from a free-flowing river with an average depth of 18 inches to a series of 20 lock and dammed pools with minimum depths of 13 to 25 feet. Other significant changes include:

- Freshwater mussel populations have dropped by 90 percent; 11 species are extinct, 34 are federally endangered,
- Seventy percent of riparian habitat has been destroyed, and
- Annually flooding has resulted in loss of life, and cost local communities and businesses millions of dollars in property damage and increased insurance costs.

These changes, and others, make the Ohio River a drastically altered version of its former self.

For 180 years, the Corps' building of locks and dams on the Ohio River has proceeded with little public review and scrutiny. This independent economic review, commissioned by The Ohio River Foundation, is the first publicly available independent review of any civil works project on the Ohio River. **The public will find the information in this report disturbing.** The findings call into question the reliability of economic justifications for billions of dollars of past, present, and future Corps projects. Serious questions are raised regarding the very foundation of the Corps' case for spending up to \$2 billion of taxpayer money to expand navigation locks.

In the 1800's, most commerce in the Ohio River watershed was transported on the Ohio River. Now, newer and faster modes of transportation (e.g., trains, trucks, pipelines) carry many of the goods once carried only by barge. Independent studies (see pp. 41-46) show that barge transport has lost market share to rail and trucks over the last 25 years, even though the Corps continues to promote expansion of the river navigation system as if it is the only viable transportation mode.

The Corps is conducting a \$51 million study, the Ohio River Mainstem System Study (ORMSS), of the Ohio River navigation system – 20 locks and dams on 981 miles of the Ohio from Pittsburgh, Pennsylvania to Cairo, Illinois. Currently, barges go through 1200 foot locks that have auxiliary chambers in case of a breakdown of a main lock or to ease congestions. The Corps' new study will propose expanding the current system, including lengthening auxiliary locks from 600 to 1200 feet.

The public should not underestimate the magnitude of what the Corps is proposing. Three existing dams have 1,200-foot auxiliary locks and all others have a smaller auxiliary chamber that can be used in case of main chamber outages. More than 60 percent of the river tonnage moves locally, and virtually all shipments are low-value bulk commodities, such as coal, with a long "shelf-life." Expanding the auxiliary lock chambers from 600-feet to 1,200-feet would force taxpayers to pay for 100 percent system redundancy and availability – an unnecessary level for

low value, non-time sensitive commodities. The Corps is attempting to justify lock expansions that could ultimately cost \$2 billion. Under the best set of assumptions, this would only reduce travel time for an entire Ohio River trip by less than 24 hours.

For decades, the major tool utilized by the Corps in recommending expansion of the Ohio River navigation system has been forecasting future traffic patterns. Preceding the release of the ORMSS, the Corps has presented preliminary economic forecasts of future traffic on the river at meetings attended by Ohio River Foundation, federal and state government officials, scientists, and other non-governmental representatives. The same forecasts were presented at each of the meetings and showed forecasts of increasing traffic on the Ohio River, despite the absence of evidence to support such a position.

It is possible that the Corps may revise their forecasts. However, the data presented to date, against the backdrop of questionable Ohio River and other U.S. waterway studies (see pp. 41-46), the lack of independent review of these data and the Corps' recommendations all combine to create major concerns for those people who are interested in improving and maintaining river health. Acting in the public interest, the Ohio River Foundation had **no choice but to seek an expert review** of Corps project justification and traffic forecasting on the Ohio River. To obtain a rigorous economic review, a well-respected academic in the field of transportation economics was retained to author this report.

The Corps has remained steadfast in its support for continued expansion of the system. Its most recent activity has been to receive congressional authority to lengthen certain lock chambers. However, the Bush Administration has held the line against any new large-scale Ohio River construction measures. Instead, the Administration suggests in its budget recommendations that the Corps should first use non-structural measures (such as scheduling) to improve efficiency, similar to the measures recommended in this report. In this time of large national budget deficits and a need for fiscal restraint, a clear, compelling economic benefit should be required before spending billions of taxpayers' money.

An additional concern for the public is that the Corps' appointed technical reviewers of their J.T. Myers and Greenup proposals did not mention the concerns detailed in the following pages of the attached report. This raises serious questions about the Corps' review protocol.

The attached independent expert report, commissioned in the public interest by the Ohio River Foundation, is intended to encourage a rigorous discussion and evaluation of the economic methods and data used by the Corps. Expanding auxiliary locks at an expense of billions of U.S. tax dollars will continue the trend of habitat loss and destruction for the benefit of navigation industry profits. As this report shows, the Corps has failed to demonstrate that this expenditure is worth the investment or the continued degradation of the river.

Richard Cogen  
Executive Director  
Ohio River Foundation

# River at Risk

## An Economic Analysis of Expanding Ohio River Locks

### *An Economic Analysis of the U.S. Army Corps of Engineers' Proposals for Extending 600-foot Auxiliary Locks and/or Constructing New 1,200-foot Auxiliary Locks on the Ohio River*

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*Report commissioned by The Ohio River Foundation*

#### Executive Summary

This paper compares the U.S. Army Corps of Engineers (Corps) total traffic and coal traffic forecasts with actual traffic levels on the Ohio River Mainstem (ORMS) and through the J. T. Myers Locks and Dam located near Evansville, Indiana. The analysis finds that the Corps greatly overestimated actual total traffic and coal traffic levels on the ORMS and through the J. T. Myers Locks and Dam.

Methodologies and data used in the Corps estimates of the benefits of lock improvements at the J.T Myers Locks and Dam were reviewed and found to be inconsistent with industry practices and economic theory. **These inconsistencies and the greatly overestimated traffic forecasts are fundamental flaws in the analysis. These flaws make the Corps' analysis an unreliable tool in guiding public investment decisions in Ohio River navigation improvements.**

This report suggests needed changes in the Corps' analyses to make them reliable tools in public investment decisions on proposed navigation improvements. Two National Research Council reports made similar recommendations for the Corps of Engineers' benefit cost analyses of lock improvements on the Upper Mississippi River.

Where lock extensions, such as those at JT Myers and Greenup, cost hundreds of millions of dollars per extension, public benefits must be clear and distinguished from those benefits that accrue to the barge industry. It is clear that the Corps' analyses must be revised and corrected before any rational funding decisions can be made on proposals to extend or replace locks on the Ohio River. Fortunately, the absence of any evidence indicating increasing coal traffic on the Ohio River provides adequate time for the Corps to correct and revise all of the mistakes in the previous Corps' analyses before critical funding decisions must be made.

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<sup>1</sup> See Page 39 for full biography.

## Introduction

Since 1954, the U.S. Army Corps of Engineers (Corps) has made major public investments in lock infrastructure at Ohio River dams including construction of 1,200-foot main and 600-foot auxiliary locks at 17 dams. More recent public investments include:

- Construction of the new Olmsted Dam and twin 1,200-foot locks near Cairo, Illinois to replace Locks and Dams 52 and 53,
- Construction of new 1,200-foot main and 600-foot auxiliary locks at the Robert C. Byrd Lock and Dam near Huntington, West Virginia (formerly called the Gallipolis Locks and Dam),
- Replacement of the 600-foot auxiliary lock with a new twin 1,200-foot lock at the McAlpine Locks and Dam near Louisville, Kentucky, and
- Major investments in locks and dams on tributaries to the Ohio River.

The Corps has received congressional authorization to extend the 600-foot auxiliary locks to twin 1,200-foot locks at the J.T. Myers Locks and Dam near Evansville, Indiana and the Greenup Locks and Dam near Portsmouth, Ohio. The basic argument behind these lock extensions is that shifting barge traffic to the 600-foot auxiliary locks when the 1,200-foot main locks are closed for repairs, results in sharp increases in congestion and transportation costs. The Corps further argues that transportation cost savings from lock extensions will exceed the costs of extending the auxiliary locks to 1,200 feet.

In its interim feasibility report on the J.T. Myers and Greenup Locks Improvements study,<sup>2</sup> the Corps states “[T]ransportation savings are estimated as the difference between the least costly mode (usually rail or truck) and the existing waterway routing. Using this method, annual waterway system benefits are equal to the product of traffic moving on the waterway and the transportation savings for each ton of that traffic.”

The Corps also states<sup>3</sup> “the primary benefit from Federal investment in commercially navigable waterways is in the collective transportation cost savings for barge shipments over the least costly alternative routing. The benefit, generally referred to as movement rate savings, also accounts for any differences in transportation costs arising from loading, unloading, transloading, demurrage, and other activities involved in the point-to-point transportation of goods. Estimating waterway investment benefits requires an analysis of 1) waterway demands, and 2) transportation costs for the waterway routing and the least costly alternative routing.”

The J.T. Myers and Greenup report specifies waterway demand as: “At the individual movement level, a given consumer has some level of demand for transporting commodity  $n$  from region  $x$ . The slope and location of this demand curve is determined by an array of factors—commodity supply prices, rail rates, barge rates, commodity input requirements, alternative supply region prices and so on.”<sup>4</sup>

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<sup>2</sup> Department of the Army. "Interim Feasibility Report: J.T. Myers and Greenup Locks Improvements: Indiana, Kentucky and Ohio, Economics Appendix." U.S. Army Engineer District-Louisville, Louisville, Kentucky 40201-0059, April 2000, pp. 1-2, 1-4 and 1-5.

<sup>3</sup> Ibid., pp. 1-4.

<sup>4</sup> Ibid. 1-5.

## Objectives

This evaluation examines whether the Corps' J.T. Myers and Greenup report accurately estimated consumer demand for waterway transportation and the benefits from investments in waterway navigation infrastructure. In addition, this evaluation examines the soundness of the methodologies, models, data and results of the Corps' analyses of Ohio River navigation investment feasibilities. The specific objectives are to:

- Evaluate the general methodologies and models used in the Corps' Ohio River feasibility studies,
- Compare the Corps' coal and total traffic forecasts with actual traffic levels of these commodities. These comparisons are important because forecasted traffic is a major determinant of the Corps' estimated congestion costs and the estimated benefits of the recommended investments,
- Evaluate the Corps' methodology and data used to estimate congestion levels and costs. This evaluation will examine whether the Corps' analysis identified and used the least-cost non-barge transportation alternatives and other alternative ways of shipping or receiving products during periods of normal traffic and out-of-service period maintenance periods, and
- Make specific recommendations of needed improvements in the analyses of Ohio River navigation investment proposals.

## I. TRAFFIC FORECASTS

A major part of the Corps' procedure for estimating future benefits from lock improvements is forecasting the level of barge traffic in future years. These forecasts are used as the future traffic levels in the Corps' feasibility studies that analyze lock congestion, congestion costs and the benefits of investments in the waterway navigation infrastructure. If the Corps underestimates future barge tonnages, their estimated benefits for waterway navigation investments will be understated. If the Corps overestimates commodity tonnage, their estimated benefits will be overstated. Thus, the accuracy of the forecasts is crucial to the integrity of their analyses.

This section compares actual Ohio River traffic for individual years with the Corps "most likely traffic forecasts" published in the June 1995 "Forecasts of Future Ohio River Basin Waterway Traffic 1990-2050, Part II" report listed below, and in the J.T. Myers and Greenup feasibility report with actual Ohio River traffic for individual years. The data for these comparisons were taken from the following Corps reports:

1. U.S. Army Corps of Engineers. "Waterborne Commerce of the United States, Part 2," Institute for Water Research, Department of the Army, New Orleans, LA, 1998, 1999, 2000, 2001, 2002 and 2003,
2. Jack Fawcett Associates. "Forecasts of Ohio River System Coal Exports, Final Report," Bethesda, Maryland, May 9, 1997,

3. U.S. Army Corps of Engineers. "Ohio River Navigation System Reports, Commerce on the Ohio River and Its Tributaries," Great Lakes and Ohio River Division, Huntington Division, 1994, 1997, 1999, 2000, 2002 and 2004,
4. U.S. Army Corps of Engineers. "Final Report Forecast of Future Ohio River Basin Waterway Traffic 1990-2050, Part II: Commodity Traffic Demand Forecasts," Huntington District Navigation Planning Center, June 1995,
5. U.S. Army Corps of Engineers. "Gallipolis Lock and Dam Replacement, Ohio River, Phase 1, Advanced Engineering and Design Study General Design Memorandum, Main Report and Environmental Impact Statement," Huntington District, Huntington, West Virginia, February 1981,
6. Department of the Army, "Interim Feasibility Report: J.T. Myers and Greenup Locks Improvements: Indiana, Kentucky and Ohio, Economics Appendix," U.S. Army Engineer District, Louisville, Kentucky, 40201-0059, April 2000,
7. U.S. Army Corps of Engineers. "Unpublished Preliminary 2004 Ohio River Barge Traffic Data," Lock Performance Monitoring System, October, 2005.

The June 1995 commodity forecast report presents traffic forecasts only for 10-year intervals starting in 1990. The J.T. Myers and Greenup Locks Improvement revised forecasts beginning in 1996 were followed by 10-year interval forecasts from 2010 to 2060. A comparison of the actual annual traffic tonnages with Corps forecasts between 1990 and 2010 required converting the 1990-2010 and 1996-2010 forecast intervals to annual forecasts. The following equations—necessitated by the absence of annual forecast data in these two reports—were used to develop annual forecasts between the 1990 and 2010 total and coal forecasts:

$$\text{Tons}_i = (\text{Tons}_t) (1+\text{GR})^i \quad (1)$$

where

$\text{Tons}_i$  = tons of coal shipped in year  $i$ ,

$\text{Tons}_t$  = tons of coal shipped in beginning year  $t$ ,

$\text{GR}$  = annual rate of growth for shipments over the time period beginning in year  $t$  and ending in year  $T$ ,

$i$  = year in the time period between  $t$  and  $T$ ,  $t < i \leq T$ .

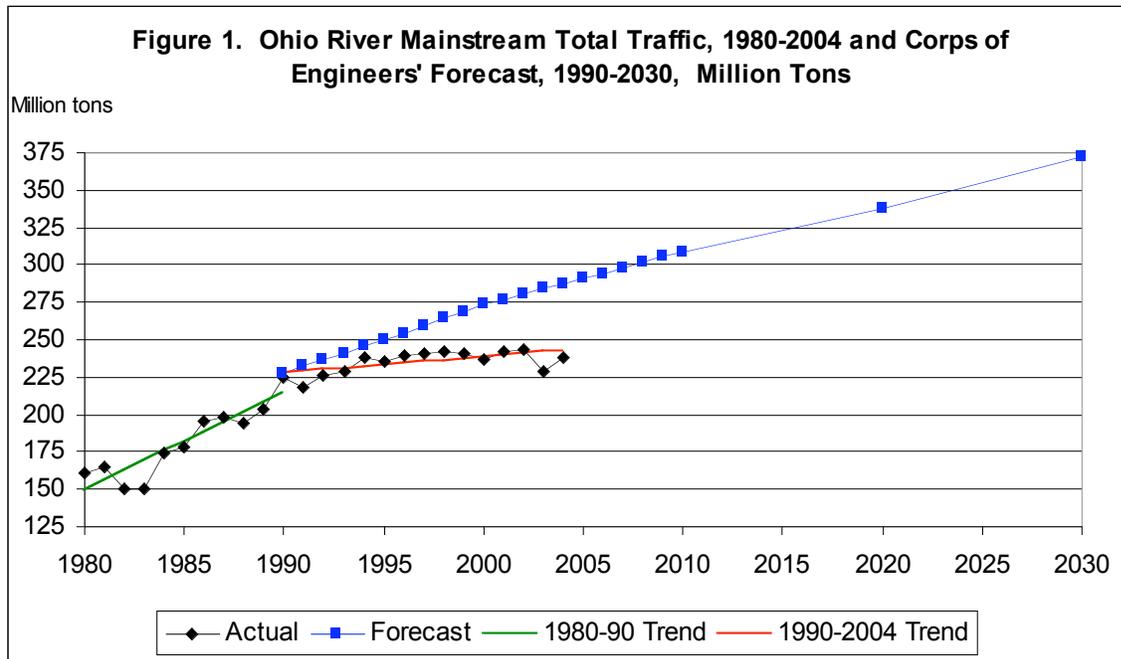
$\text{GR}$  was defined as,

$$\text{GR} = \left[ \frac{\text{Tons}_T}{\text{Tons}_t} \right]^{\frac{1}{T-t}} - 1 \quad (2)$$

### Ohio River Mainstem (ORMS) and J.T. Myers Barge Traffic Forecasts

Figure 1 shows the trends in ORMS total traffic. Actual ORMS total barge traffic increased from 160.7 million tons in 1980 to 225.6 million tons in 1990, an average annual increase of 6.5 million tons per year. Between 1990 and 2004, total tonnage increased only 13.2 million tons, an

average annual increase of only 0.94 million tons per year. Thus, the rate of increase in actual total traffic declined sharply during the last 12-year period of available data. In fact, total ORMS traffic declined 5.2 million tons from 2002 through 2004.



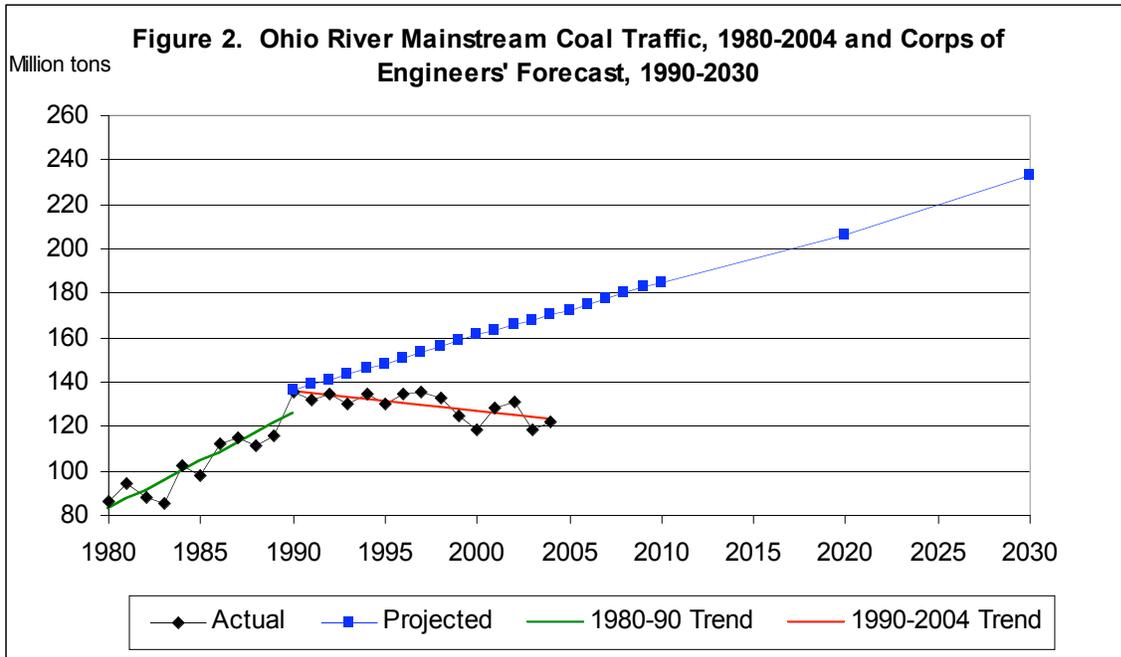
Source: See pages 6 and 7 of this report, documents (1), (3), (4), (6) and (7)..

However, the Corps' forecasted total traffic increased almost 60 million tons from 228 million tons in 1990 to 287.4 million tons in 2004. Summing up the annual differences between actual and forecasted traffic, the Corps overestimated total ORMS traffic by a total of 360.2 million tons from 1990 through 2004.

The important points from Figure 1 are:

- The trend in total actual ORMS tonnage indicates a major slowdown in the rate of growth of total ORMS traffic beginning in 1990. For example, total ORMS traffic declined 5.2 million tons from 2002 through 2004.
- Beginning in 1990, the Corps forecasted rapid growth in ORMS total tonnage, resulting in increasingly large forecasting errors.
- The overestimation of ORMS total traffic by the 1990 traffic forecasts is likely to increase in the years ahead.

Figure 2 shows total coal tonnage on the ORMS. Total ORMS coal tonnage increased rapidly from 86 million tons in 1980 to 135 million tons in 1990, an average annual increase of 4.9 million tons. However, from 1990 through 2004, actual total coal tonnage declined 13 million tons, an average annual decrease of 0.93 million tons per year. During the same time period, the Corps forecasts coal traffic to increase 33.8 million tons from 136.7 million tons in 1990 to 170.5 million tons in 2004.

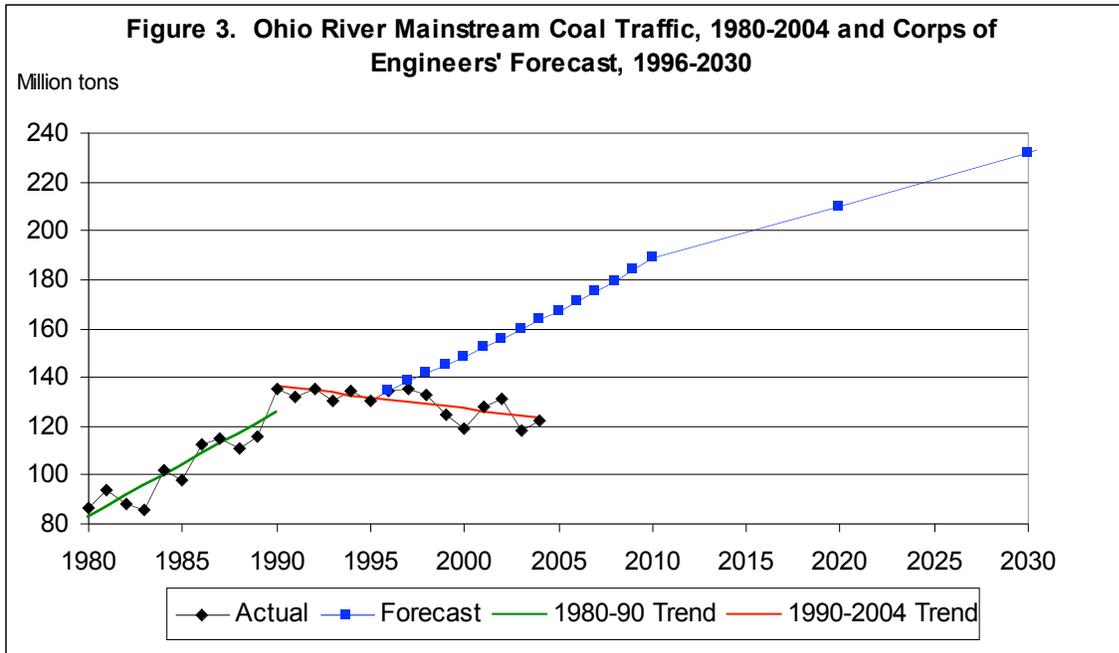


Source: See pages 6 and 7 of this report, documents (1), (3), (4), (6) and (7).

Summing up the differences between annual actual ORMS coal traffic and annual forecasted coal traffic shows that the Corps overestimated ORMS tonnage by a total of 361.8 million tons from 1990 through 2004, an average annual overestimation of 25.8 million tons per year. More importantly, the amount of overestimation increased rapidly over time, from 1.6 million tons in 1990 to 48.7 million tons in 2004. If these trends continue, the degree of overestimation will increase over time.

The Corps revised its coal traffic forecasts in the J.T. Myers and Greenup Feasibility report, presumably because of the poor performance of the above 1990-2050 forecasts. The revised coal traffic forecasts were developed under four alternative scenarios. Three of the scenarios had coal traffic growth rates of 1.1 to 1.3 percent per year. The fourth scenario had a zero growth rate; however, the Corps rejected the zero rate growth option. Instead, they selected a 1.3 percent annual growth rate scenario as the most likely coal traffic projections. The Corps did not revise the projections for the other commodities.

Figure 3 shows the revised 1996 to 2030 ORMS coal traffic forecasts. It also compares the

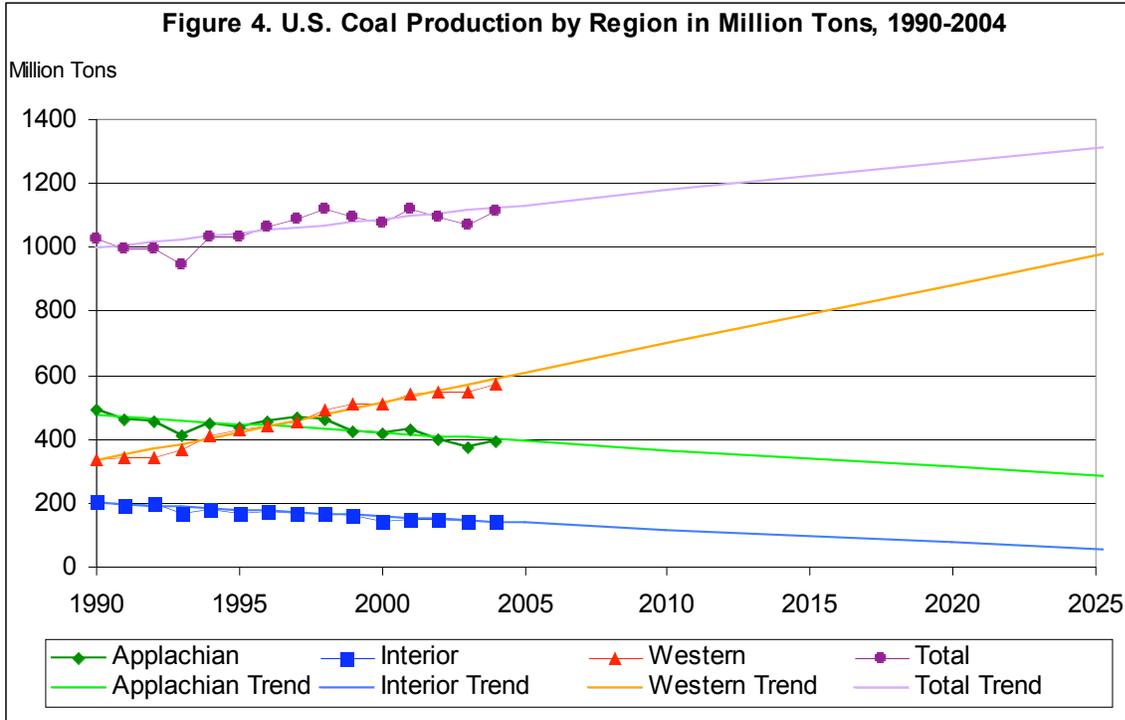


Source: See pages 6 and 7 of this report, documents (1), (3), (4), (6) and (7).

forecasts with actual ORMS coal traffic from 1996 to 2004. Forecasted coal traffic increased from 134.8 million tons in 1996 to 163.3 million tons in 2004, an increase of 28.5 million tons or 3.6 million tons per year. Actual coal traffic declined from 134.8 million tons in 1996 to 122.1 million tons in 2004, a decline of 12.7 million tons or 1.6 million tons per year.

In the revised coal estimates in the J.T. Myers and Greenup report, the Corps overestimated ORMS coal traffic by a total of 191.1 million tons in the eight-year period from 1996 through 2004 or 24 million tons per year. Even this revised Corps forecast was not close to actual traffic levels. Given the continuously increasing ORMS coal tonnage forecasts through 2060, and the downward trend in actual coal traffic, it is reasonable to conclude that the size of the Corps' coal forecasting errors is likely to become increasingly larger over time. This conclusion is reinforced by the trends illustrated in Figure 4.

Figure 4 shows the trends in coal production in the three major U.S. coal producing regions. Between 1990 and 2004, total U.S. coal production increased by 82.5 million tons. Yet, coal production in the two major coal producing regions served by the ORMS—Appalachia and Interior—declined by 159.9 million tons during the same period.



Source: Department of Energy, Energy Information Administration, “Coal Home Page,” [eia.doe.gov/fuelcoal.html](http://eia.doe.gov/fuelcoal.html).

Table 1 shows that coal production in the five states served by the ORMS declined 25 percent during 1990-2004. The largest percentage declines in coal production were in Illinois, Ohio and Kentucky (Appalachian and Interior regions). Yet, over the same time period, coal production in the Western region—primarily Wyoming—increased 72 percent. In 2004, Wyoming alone produced more coal than the entire Appalachian region. This dramatic shift from higher sulfur Interior and Appalachian coals to low sulfur Western coals suggests that the decade-long downward trend in ORMS coal barge traffic is likely to continue. This, combined with the rapidly increasing ORMS coal traffic forecasts, suggests a continuation of the increasing overestimation of ORMS coal traffic.

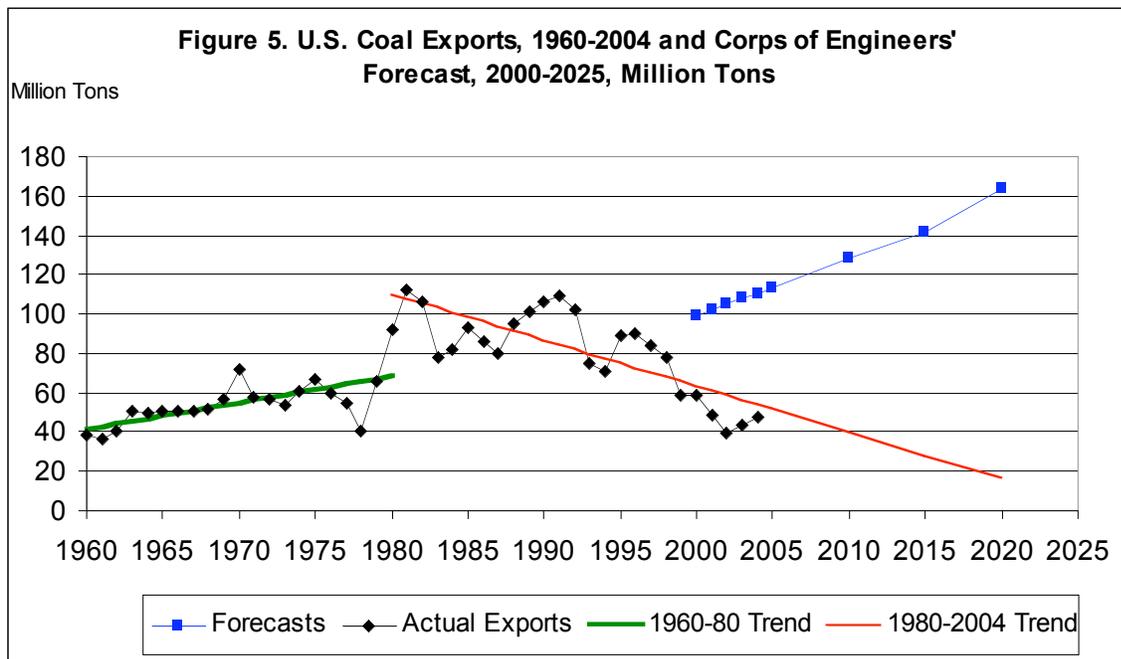
One might argue that the declines in Appalachia and Interior coal production are not important. Rather, it doesn’t matter where the coal is produced as long as it moves on the ORMS. However, assuming that ORMS shippers and receivers are selling more electricity and other products, and therefore buying more coal, the fact that ORMS coal traffic has been declining suggests that Ohio River coal users are receiving their coal by other modes, such as rail and from other sources, such as Western coal or purchasing more electricity from the national electricity transmission grid during supply emergencies.

Table 1. Coal Production by Ohio River States in Millions of Tons, 1990 and 2003

<u>State</u>	<u>1990</u>	<u>2004</u>	<u>Percent Change</u>
Illinois	60.4	35.1	-41.9
Indiana	35.9	35.4	-1.4
Kentucky	173.3	113.8	-34.3
Ohio	35.2	23.2	-34.1
West Virginia	169.2	147.9	-12.6
Total	474.0	355.4	-25

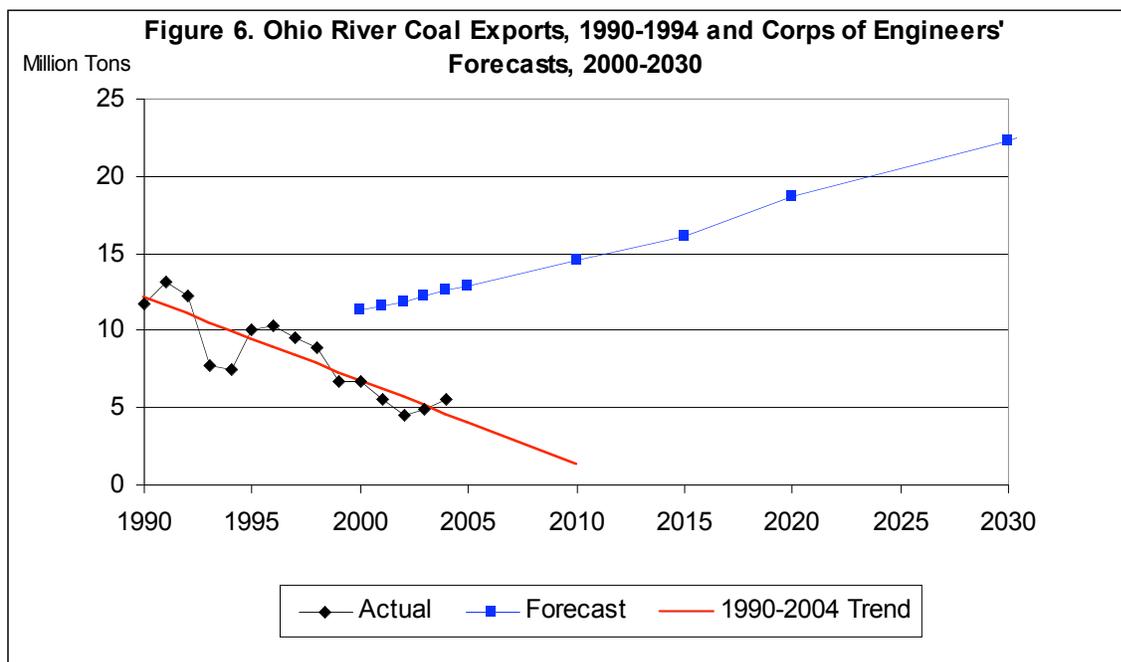
Source: Department of Energy, Energy Information Administration, “Coal Home Page,” [eia.doe.gov/fuelcoal.html](http://eia.doe.gov/fuelcoal.html).

The trend in U.S. coal exports, shown in Figure 5, also supports the conclusion that the size of the Corps’ coal forecasting errors is likely to become increasingly larger over time. In their 1995 traffic forecast report, the Corps assumed that the ORMS would carry 3.5 percent of total U.S. coal exports. Later, the Corps contracted with Jack Fawcett Associates to forecast Ohio River System (ORS) coal exports from 1994 to 2050. Figure 5 compares the Fawcett Associates U.S. coal export forecasts with actual U.S. coal export traffic.



Source: See page 3 of this report, document (2); Department of Energy, Energy Information Administration, “Coal Home Page,” [www.eia.doe.gov/fuelcoal.html](http://www.eia.doe.gov/fuelcoal.html).

Actual U.S. coal exports increased rapidly from 38 million tons in 1960 and peaked at 112.5 million tons in 1981. The 1981 level was the highest U.S. coal exports in history. Since 1981, U.S. coal exports declined 57.3 percent to 48 million tons in 2004. Figure 5 also shows the Corps' forecast of U.S. coal exports beginning in 2000. For the five years from 2000 through 2004, the Corps overestimated U.S. coal exports by a total of 286.2 million tons, or 57.2 million tons per year. Total U.S. coal exports are important because the Corps' ORMS annual coal export forecasts were obtained by multiplying the U.S. annual coal export forecasts by 11.38 percent, the average ORS share of U.S. coal exports for the years 1990 through 1994. Therefore, the huge overestimation of U.S. coal exports guarantees that ORS coal export forecasts will be greatly overestimated. The trends depicted in Figure 6 show that this is indeed the case.



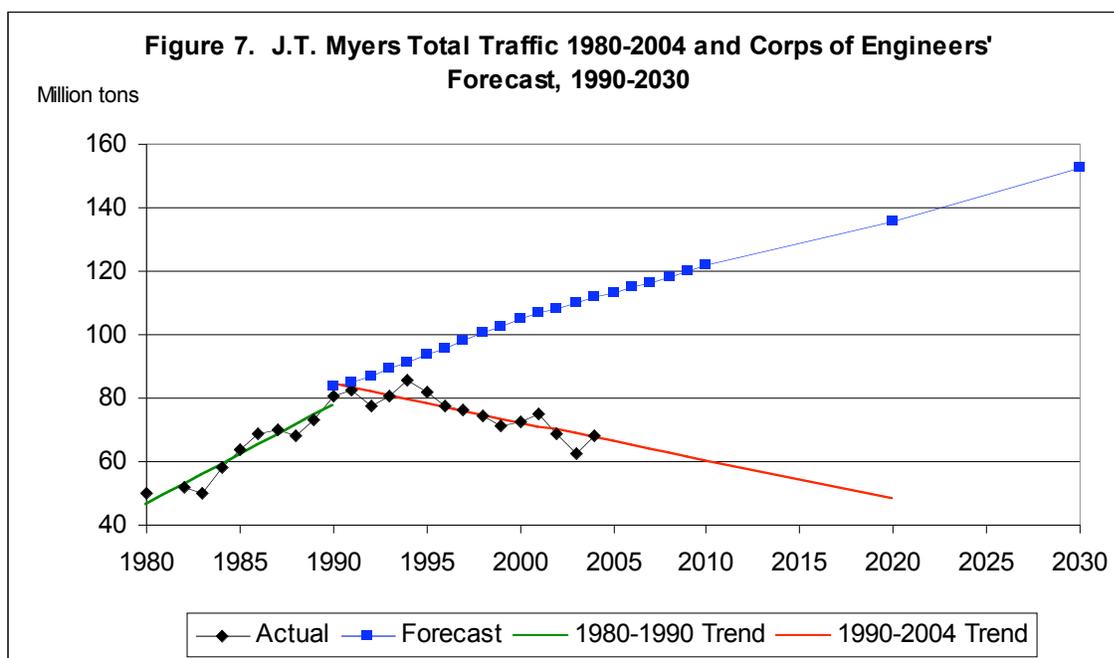
Source: See page 6 of this report, document (2).

Figure 6 shows the 1990-2003 Ohio River System (ORS) coal exports as estimated by the Jack Fawcett Associates method. Fawcett Associates developed these estimates from 1990-1994 coal shipment data provided by the Corps. The estimated average ORS share of 1990-1994 U.S. coal exports was 11.4 percent. The Fawcett report states "ORS coal exports increase and decrease proportionally with the total U.S. coal exports forecast under each scenario." Therefore, the actual coal exports in Figure 6 for the years 1995 through 2004 were obtained by multiplying actual U.S. coal exports for those years by 11.4 percent. Since total U.S. coal exports declined sharply during these years, ORS coal exports declined 53 percent from 1990-2004. Figure 6 also shows the Corps' ORS coal export forecasts from 2000-2030. The Corps overestimated ORS coal exports by a total of 32.4 million tons for an average of 6.5 million tons per year from 2000 to 2004. While this overestimation is important, it explains only a small portion of the overestimated average annual ORMS coal traffic of 25.8 million per year from the 1990 ORMS coal forecasts in Figure 2 and of 24 million tons per year from the revised coal traffic estimates

shown in Figure 3. This suggests that other forces are contributing to the decline of ORMS coal traffic in the face of rapidly increasing coal traffic forecasts. More important, current trends suggest that the Corps' ORS coal export forecasts are likely to overestimate actual exports by increasing amounts over time.

### J.T. Myers Locks and Dam Traffic Forecasts

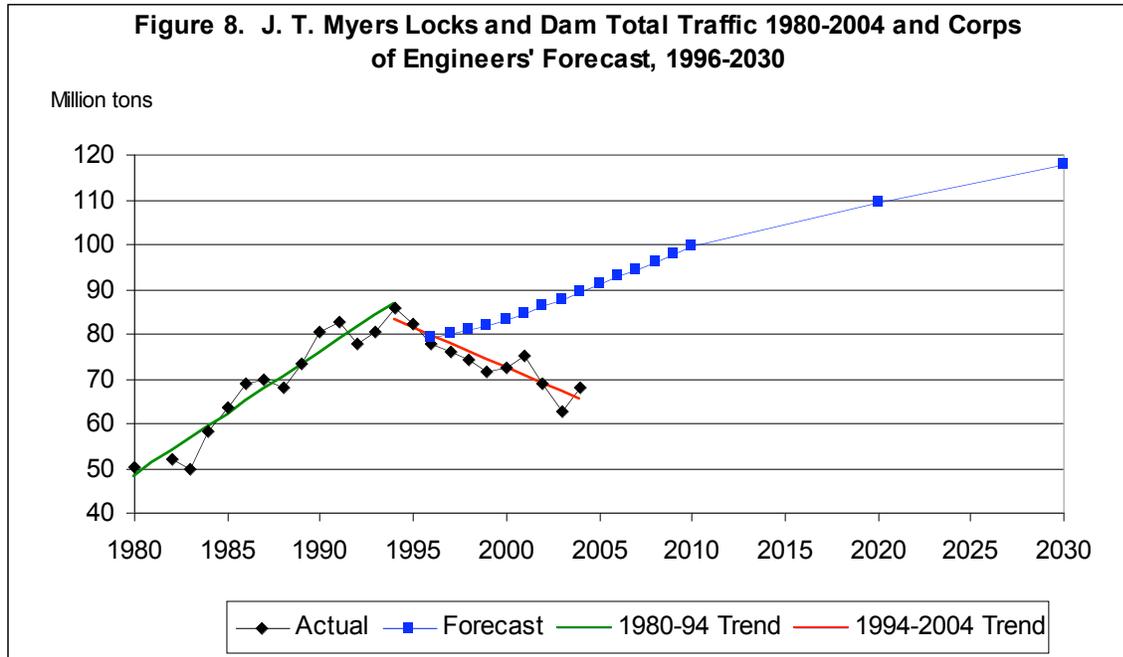
The most important traffic forecasts in the Corps' analysis are those for individual locks and dams because these forecasts are a major input into the Corps' procedure for estimating lock congestion levels and costs. Figure 7 shows the actual total tons and the 1990 to 2030 forecast of total tons of commodities moving through the J.T. Myers Locks and Dam (L&D) located near Evansville, Indiana. Total actual barge traffic was 80.4 million tons in 1990. By 2004, J.T. Myers L&D total traffic had declined to 67.9 million tons. However, the Corps forecast total tons transiting the J.T. Myers L&D to grow from 83.5 million tons in 1990 to 111.6 million tons in 2004. Summing up the annual differences between their forecast and actual traffic tons from 1990 through 2004, the Corps overestimated total J.T. Myers L&D traffic by a total of 330.6 million tons or 22 million tons per year. This huge overestimation creates a major upward bias in the estimated benefits from extending the J.T. Myers auxiliary lock.



Source: See pages 6 and 7 of this report, documents (3), (4), (6) and (7).

The Corps also revised the J.T. Myers L&D total traffic forecast beginning in 1996. Figure 8 shows the new forecast along with actual total J.T. Myers L&D traffic. The new total traffic forecast began at 78.9 million tons in 1996 and increased to 89.3 million tons in 2004, an increase of 10.4 million tons. Yet, during the same period, actual total traffic declined 9.7 million tons from 77.6 million tons in 1996 to 67.9 million tons in 2004. Summing up the annual

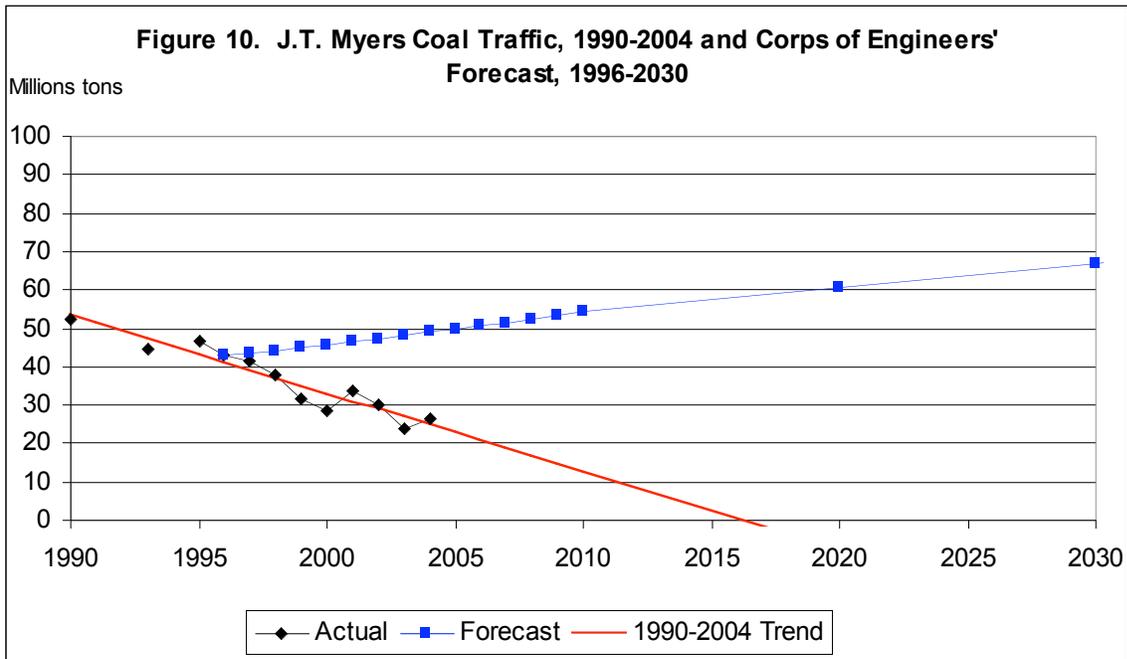
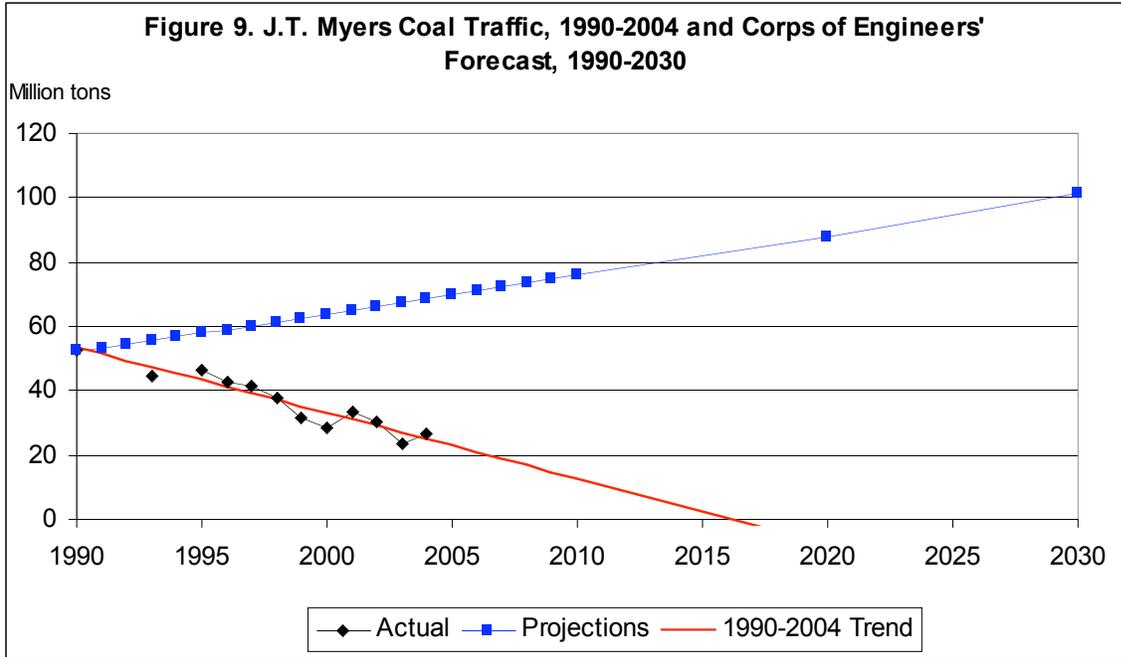
differences between the actual and the revised total traffic forecasts, the new Corps forecasts overestimated total J.T. Myers L&D traffic from 1996 through 2004 by a total of 104.5 million tons or 14.9 million tons per year.



Source: See pages 6 and 7 of this report, documents (3), (4), (6) and (7).

The major reason for the huge overestimation of J.T. Myers L&D traffic was the rapid decline in coal traffic. Figure 9 shows the Corps' original J.T. Myers L&D 1990 to 2030 coal traffic forecasts. Actual coal traffic transiting J.T. Myers L&D declined sharply from 52.3 million tons in 1990 to 26.3 million tons in 2004, a decline of 26 million tons decline over 14 years. The Corps forecast J.T. Myers L&D coal traffic to increase from 52.3 million tons in 1990 to 68.6 million tons in 2004. Summing up the annual differences between the actual and forecast coal tons for the years 1995 to 2004 – these years were chosen because of missing data for some earlier years – the Corps overestimated J.T. Myers L&D coal traffic by a total of 290.3 million tons or by 32.3 million tons per year.

The Corps also revised the 1990 J.T Myers L&D coal traffic forecasts. Figure 10 shows the revised Corps' J.T. Myers L&D coal traffic forecasts from 1996 to 2004 in comparison with the actual 1996 through 2004 traffic. Actual coal traffic declined from 42.8 million tons in 1996 to 26.3 million tons in 2004, a decline of 16.5 million tons or 2.1 million tons per year.



Figures 9 & 10 sources: See page 6 and 7 of this report, documents (3), (4), (6) and (7).

During the same time period, the revised coal traffic forecast increased from 42.8 million tons to 49 million tons. Summing up the differences between the actual and the revised traffic forecasts, the Corps overestimated J. T Myers L&D coal traffic by 116.7 million tons or 14.6 million tons per year. Again, on the second try, the Corps continued to forecast rapidly increasing coal traffic through J.T. Myers L&D in the face of declining actual coal traffic.

Reasons for the downturn in coal traffic include:

- Coal production east of the Mississippi River peaked in 1990 and declined since then. Western coal production increased rapidly, suggesting a shift from high sulfur Eastern coal to low sulfur Western coal.
- U.S. coal exports peaked in 1981 and have been declining since then.
- Electricity transactions on the national transmission grid have increased rapidly in recent years.

These trends suggest that coal traffic on the Ohio River is likely to remain stagnant or continue to decline until these trends are reversed.

One might argue that the time frames in the two J.T. Myers L&D forecasts are too short to draw valid conclusions and that coal use, in particular, could very well increase in the future. Indeed, an article in the November 16, 2004 issue of the Wall Street Journal stated that rapidly increasing oil costs are resulting in increased global demand for coal.<sup>5</sup> However, three issues cast doubt on the validity of the argument that increased global coal demand would increase ORMS coal traffic to the level of the Corps' forecasts. First, U.S. coal production and domestic consumption increased during the period from 1990 through 2004. Yet, ORMS coal traffic declined sharply during that period. So the issue for lock extensions is not demand but rather the sources of the coal used for electricity generation and how the coal is delivered to the Ohio River Basin utilities.

Secondly, the Wall Street Journal article states that worldwide coal production is increasing rapidly, particularly in China, Columbia, Australia and Indonesia. This suggests that there are several alternative global sources of coal to meet the increased global coal demand.

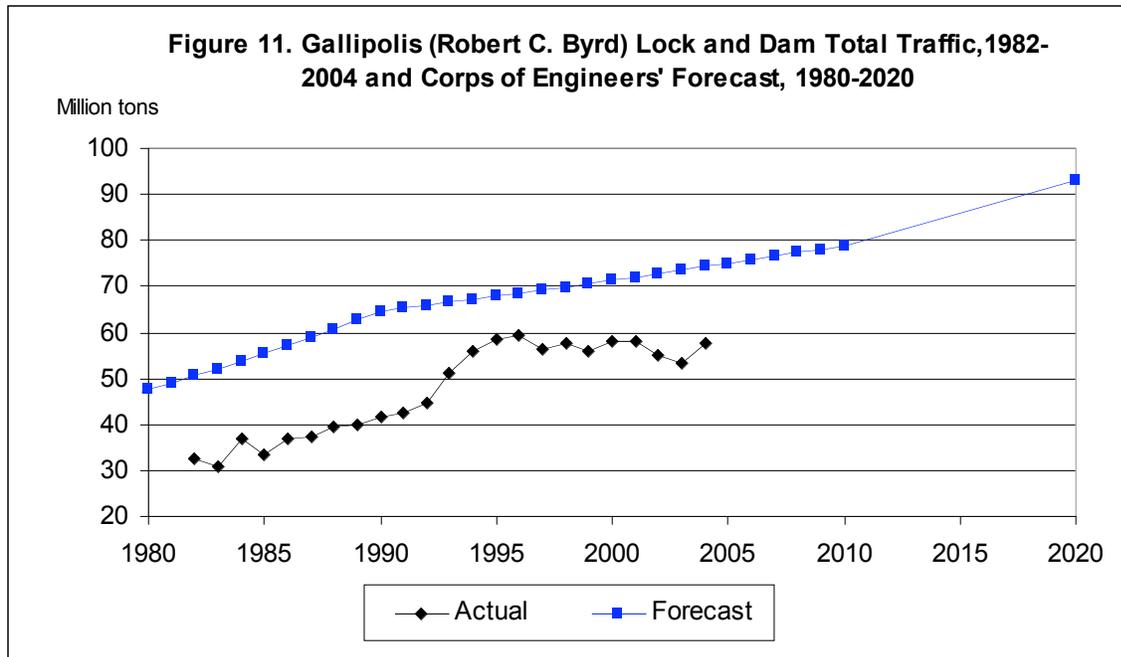
Third, Figure 11 shows the forecast total traffic through the Gallipolis L&D (now called Robert C. Byrd Locks and Dam) for over a quarter century from 1976 through 2010. The Corps consistently overestimated total traffic through the Gallipolis L&D for each of the 23 years from 1982 through 2004. Summing up the differences between the actual tons and the forecast, the Corps overestimated total tons through the Gallipolis L&D by a total of 395 million tons from 1982 through 2004. The total overestimation would likely be higher if the actual ton data from 1976 through 1981 were available. These overestimated traffic data through the Gallipolis L&D include the years when U.S. coal exports were at all time record levels.

The huge forecasting error for the Gallipolis L&D raises three serious questions. First, why does the Corps continue to overestimate tons through Ohio River locks? Second, was the construction of the Gallipolis L&D an economically sound decision? The huge overestimation of future Gallipolis L&D traffic resulted in greatly upward biased estimated benefits from the new locks at

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<sup>5</sup> Wall Street Journal. "Global Surge in Use of Coal Alters Energy Equation," Vol. CCXLIV, No. 97, November 16, 2004, p. A1.

that location. The Gallipolis L&D was designed and constructed for a 95 million ton annual capacity. Yet, the maximum tonnage that has so far moved through the facility is 59 million tons in 1996 and has trended downward to 57.8 million tons in 2004. The long-term-trend in the forecasting errors in Gallipolis study suggests that the forecasting errors in the J.T. Myers-Greenup report may continue well into the future. Third, how could the Corps justify constructing the new 1,200 main and 600 feet auxiliary locks at the Gallipolis L&D, now called the Robert C. Byrd Locks and Dam, when the maximum actual traffic through the new locks was only 62 percent of the Gallipolis L&D stated capacity?



Source: See pages 6 and 7 of this report, documents (3), (5) and (7).

The Corps also forecasts sharp increases in total and coal traffic for the Greenup Lock and Dam. Yet, actual traffic through Greenup L&D declined similar to those transiting J.T. Myers L&D. For example, in their revised traffic forecasts, the Corps forecast total Greenup L&D traffic to increase from 70.8 million tons in 1996 to 90.5 million tons in 2010, an increase of 2.8 million tons per year. Yet, total traffic transiting Greenup L&D declined from 67.3 million tons in 1996 to 64.5 million tons in 2004, a decline of 0.4 million tons per year. Likewise, the Corps' revised coal traffic forecast projected coal traffic through Greenup L&D to increase from 44.4 million tons in 1996 to 60.9 million tons in 2010, an increase of 2.4 million tons per year. During the same time period, actual coal traffic transiting Greenup L&D declined from 40.9 million tons in 1996 to 35.9 million tons in 2004, a decline of 0.7 million tons per year. Thus the Corps consistently overestimated total and coal traffic, which result in greatly overestimated benefits from lock extensions.

## Conclusions from the ORMS and J.T. Myers and Greenup Traffic Forecasts

The Corps twice forecast increasing total and coal traffic for the ORMS and J.T. Myers and Greenup locks and dams. Actual total traffic increased on the ORMS through 2002, but at a much slower rate than the forecast. However, for 2003 and 2004 actual total ORMS traffic declined 5.2 million tons. Actual coal traffic declined on the ORMS and both total and coal traffic declined at the J.T. Myers and Greenup locks and dams. Current trends, combined with two sets of rapidly increasing traffic forecasts through 2050 and 2060, imply that the level of overestimation of traffic will increase over time. This suggests that the estimated congestion costs and benefits from lock improvements at both locks are greatly exaggerated by these overly optimistic forecasts.

No one can precisely forecast future traffic. However, recent declines in coal traffic on the ORMS and at the J.T Myers and Greenup locks and dams suggest that declining or stable barge traffic are likely possibilities. The Corps rejected the stable possibility in its recently revised traffic forecasts. The result is a set of forecasts that raise serious credibility questions about the Corps' feasibility studies.

## DATA USED TO ESTIMATE TRANSPORTATION COST SAVINGS

The Corps defines transportation cost savings as the difference between the existing waterway movement and the least costly alternative mode (usually rail or truck). In the real world, these differences vary widely over time for individual shippers and among shippers. In addition, these differences depend on the locations of the shipping and receiving facilities, as well as the prices at and the number and locations of alternative markets, transport rates to these markets and the number of transport options available to each shipper and receiver. An accurate analysis would account for these differences over time, space, shippers and receivers. Acknowledging these differences in individual shipper demands, the Corps states "[I]n practical terms, collecting the information necessary to estimate willingness-to-pay along individual demand curves is problematic. Individual movements from the ultimate off-river origins and destinations are not available in the Waterborne Commerce Statistics Center data, only waterside origin and destination data are reported."<sup>6</sup> The Corps also states "Nevertheless, willingness-to-pay information for individual movements, like those conceptually discussed above is constructed (see Section 7.3.4 Transportation Rate Analysis). The problem is made manageable by gathering ultimate origin and destination rate data for each waterside movement and reporting its transportation rate data as weighted averages based on ultimate origin tons." The Corps further states, "[T]ransportation rate specialists at the Tennessee Valley Authority (TVA) measured transportation rates and supplemental costs for the sample of commodity movements using a combination of shipper surveys, costing models and Waybill data."<sup>7</sup>

Table 2 shows the 1999 TVA transportation cost data used in the J.T. Myers-Greenup feasibility study. The cost data are reported as linehaul, accessorial and leg transport costs. The linehaul portion is the direct barge and rail costs. The accessorial costs are the loading/unloading/transloading costs and the legs represent the cost of hauling the commodities from their origins to the river and from the river to their ultimate destinations. The Corps estimates that barge transportation saves ORMS shippers and receivers, on average, \$7.96 for each ton hauled on the ORMS compared to the alternative rail haul. However, there are several major problems with these data:

1. The barge cost data appropriately contain linehaul, accessorial and leg costs. Most products delivered by barge must be hauled to the river by truck or rail, and unloaded and transferred into barges. At the destination, most products must be unloaded from the barges and transloaded on to trucks or rail cars to be delivered to the final destination.

However, in the Corps' analysis, all products delivered by rail must be hauled by truck or rail to a river origin, transloaded into another rail car, delivered to a river destination, unloaded from the rail car, and reloaded into another rail car or truck for delivery to the final destination.

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<sup>6</sup> Ibid. 1-6.

<sup>7</sup> Ibid. 7-9.

Table 2. Summary of Corps Transportation Cost Statistics, 1999

<u>Commodity</u>	<u>Savings per ton</u>	<u>Water rater per ton</u>			<u>Land rate per ton</u>		
		<u>Barge line haul</u>	<u>Accessorial</u>	<u>Legs</u>	<u>Rail rate</u>	<u>Accessorial</u>	<u>Legs</u>
Coal	\$ 7.20	\$ 3.34	\$ 3.53	\$ 3.68	\$13.24	\$ 3.09	\$ 1.52
Petroleum products	7.93	5.55	1.52	0.07	12.59	2.31	0.12
Aggregates	6.98	2.79	2.34	1.46	7.68	3.48	2.40
Grain	5.66	6.65	4.23	1.97	13.78	3.90	0.85
Chemicals	27.98	13.28	2.66	0.65	40.99	2.99	0.58
Ores and minerals	22.64	8.45	3.78	0.88	30.59	4.51	0.66
Iron and steel	13.01	7.66	5.42	4.17	23.18	5.67	1.88
All other	9.44	4.86	3.46	0.64	13.12	3.80	1.48
All commodities	\$ 7.96	\$ 3.31	\$ 3.31	.\$ 3.00	\$13.38	\$ 3.22	\$ 1.54

Source: J.T. Myers-Greenup Feasibility Study, pp. 7-11.

In the real world, coal delivered by rail is almost always loaded into rail cars at the origin and delivered directly in the same cars to the final destination. An executive of a coal mining company that ships both Appalachian and Interior coals by barge and rail direct to users stated that he knows of no coal ever delivered by rail or truck to a river location, then transferred into rail cars, delivered to another river destination, unloaded from the rail cars into trucks or other rail cars and delivered to the final destination. This is also true for most other products. Thus, in the Corps' analysis, rail delivered transport costs for most products are overstated by the leg costs. The Corps estimated that the leg cost for coal—the dominant product moving on the ORMS—is \$1.52 per ton, and that the average leg cost for all products is \$1.54. This \$1.52 or \$1.54 multiplied by all tons on the ORMS is an overstatement of benefits of lock improvements and should be eliminated from the analysis.

The transloading costs for the land movement also overstate transport costs. Most products delivered directly to their final destinations never move to the river. Therefore, transloading costs into and out of rail cars or trucks for direct delivery by rail or truck are phantom costs and should be excluded. The amount of transloading cost is not identified, so the magnitude of this overstatement is unknown. The Corps should provide this information.

2. The rail linehaul cost data in Table 2 represent the Corps' estimates of the weighted average cost of hauling each product group from one river location to another. It is not possible to evaluate the quality of these estimates by comparing them to railroad rate data because the origins and destinations are unspecified. However, it is possible to compare the Corps' 1999 average rail linehaul cost for coal—\$13.24 per ton—with average rail coal rate data published by the U.S. Department of Energy (DOE). Table 3 shows the DOE average 1999 railroad rates for contracted coal shipments by regions.

The data in Table 3 show that the average 1999 DOE railroad linehaul coal rate out of the Northern Appalachia coal producing region was \$9.33 or \$3.91 per ton lower than the Corps' estimate of \$13.24 per ton. The average 1999 DOE railroad linehaul coal rate out of the Central Appalachia region was \$10.16 or \$3.08 per ton lower than the Corps' estimate. The average 1999 DOE railroad linehaul coal rate out of the Illinois Basin coal producing region was only \$3.75 per ton or \$9.49 per ton lower than the Corps' estimate. Only the Uinta Basin had a higher average rail rate than the Corps' estimate. That average rate was \$13.29 per ton or \$0.05 per ton higher than the Corps' estimate. However, the average length of haul out of the Uinta Basin region was 1,135 miles, about three times more than the 378-432 mile hauls out of the two Appalachia regions and almost eight times longer than the average 148 mile haul out of the Illinois Basin coal producing region. The average 1999 DOE coal rate for the U.S. was \$10.25 or \$2.90 lower than the Corps' estimate; yet, the average length of haul for national coal movements was 713 miles, about 1.7 times longer than the average coal movement out of the Appalachia regions and 4.8 times longer than the average Illinois Basin length of haul.

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Table 3. Comparison of the Corps' Rail Linehaul Coal Costs with the Department of Energy Average Rail Coal Rates to Electric Utility Plants and Average Miles Hauled, by Selected Coal Producing Regions, 1999.

<u>Source of Data</u>	<u>Region</u>	<u>Rail Rate per Short Ton</u>	<u>Corps Cost Minus DOE Average Rates</u>	<u>Average Miles Delivered</u>
Corps Cost Estimate	--	\$13.24	--	--
DOE Rates	Northern Appalachia <sup>a</sup>	9.33	\$3.91	378.3
	Central Appalachia <sup>b</sup>	10.16	3.08	432.4
	Illinois Basin <sup>c</sup>	3.75	9.49	147.9
	Powder River Basin	12.32	0.92	1,096.9
	Unita Basin <sup>d</sup>	13.29	-0.05	1135.3
	National	\$10.25	\$2.99	712.9

Source: Corps of Engineers' J.T. Myers and Greenup Feasibility Studies and Department of Energy and Energy Information Administration: Coal Transportation Rates and Trends in the United States, 1979-2001, Online Report, [eia.doe.gov/cnef/coal/page/trans/ratesntrends.html](http://eia.doe.gov/cnef/coal/page/trans/ratesntrends.html).

<sup>a</sup> Includes Ohio and Northern West Virginia

<sup>b</sup> Includes Eastern Kentucky and Southern West Virginia

<sup>c</sup> Includes Illinois, Indiana and Western Kentucky

<sup>d</sup> Includes Colorado and Utah

The major conclusions from Table 3 are:

- In comparison with the rail rates reported by the DOE, the Corps greatly overestimated railroad coal linehaul costs. The Corps' rail linehaul costs were estimated by TVA personnel, using a combination of survey data from river shippers, unidentified cost models and Waybill data. Rail shippers pay rail rates, not estimated costs from rail cost models. Most rail cost models use historical railroad cost data. These historical costs are based on old, high-cost technology. With the current rapid railroad adoption of cost-reducing technology, cost estimates from railroad cost models are highly likely to overestimate railroad costs.
- The Corps' basic transportation costs were estimated for 1997. Railroad cost savings technology—lighter and higher capacity rail cars and heavier rail lines—combined with new, high fuel efficient, alternating current locomotives, longer trains and mergers enable railroads to reduce costs and rates. Recognizing that these technologies are cost saving, the Corps re-estimated their 1997 costs based on 1999 technology. Overall, the Corps reduced all rail costs by an average of 2.3 percent. Railroad coal transport costs were reduced 1.6 percent. DOE presents data on annual average railroad coal rates. Average U.S. railroad coal rates declined from \$11.06 in 1997 to \$10.25 in 1999, a reduction of 7.3 percent. Therefore, railroad rates declined by almost four times more than the Corps' estimated technology cost reductions. This suggests that the Corps' estimated railroad cost data greatly underestimate the impact of technology on U.S. coal rates.

The Corps' estimated railroad costs exceed the average railroad rates reported by the DOE for all regions including the Powder River Basin with one exception. The average rate out of the Uinta Basin exceeded the Corps cost estimate by only five cents per ton. Yet the average lengths of haul of railroad coal movements out of the Appalachia and Illinois Basin coal producing regions are among the lowest in the U.S. This suggests that the Corps estimated rail costs are about \$3.00 higher than the average U. S. coal rail rate, \$3.00 to \$4.00 higher than the average rail coal rates out of the Appalachian areas and \$9.00 above the average coal rail rate out of the Illinois Basin.

- There is great variability in railroad coal rates among the sub-regions of the Appalachia and Interior coal producing regions. This suggests that coal rail rates among shippers within these regions also vary greatly. The Corps' weighted average point estimate of \$13.24 per ton not only greatly overestimates the DOE reported coal rates; it also masks all of the analytical value of the variability of the railroad rates of coal and other products.

- The Corps also estimates the cost of moving products by barge, and uses a single weighted average cost for moving all products in a given group. Yet, shippers/receivers pay barge rates, not estimated barge costs. Except for barges under long term shipment contracts to shippers/receivers, actual spot barge rates vary widely within years, and even radically in some years. For example, grain barge rates have varied from 80 to 400 percent of tariff within one year. These large swings in barge rates have a large impact on the benefits of lock extensions. Yet, the Corps' data ignore within-year barge rate variability.

### Conclusions on the Corps' Estimated Transportation Costs

The Corps correctly states that the Waterborne Commerce Statistics Center does not provide off-river origin and destination data. So instead of collecting their own off-river origin-destination and rate data, the Corps forces all products moving by rail or truck to move to a river location, transload to another rail car, move to another river location, transload to another rail car or truck and move to the final destination. This procedure is fundamentally flawed, because almost all products not moving by water move directly by rail or truck from the origin to the destination. Moreover, the Corps uses rail costs estimated by cost models using historical railroad cost data. Railroads have been able to rapidly reduce their costs by the adoption of high capacity lightweight aluminum cars, highly fuel efficient alternating current locomotives, 115- to 150-car shuttle trains, reduced size train crews and rapid consolidation of the industry. The cost models, using historical data, are unlikely to be able to capture these cost savings. Therefore, the Corps' transportation costs appear to be overstated. This further suggests that the benefits from Ohio River lock extensions are exaggerated and cannot be used to credibly estimate the benefits of lock improvements. Interestingly, many railroad rates that shippers/receivers actually pay, including specific origins and destinations, are available on the Internet. Moreover, some government agencies maintain time series of some rail rates and barge rate data on major rivers.

### TC AND EQ MODELS

The Corps uses two models to estimate the increased costs from waterway congestion and to estimate the level of waterway traffic with positive rate savings that will approximate the maximum system tonnage. The Tow Cost (TC) Model estimates the individual costs of moving a given set of shipments through a waterway system under a hypothesized set of conditions. It basically compares the modeled time required to complete a movement to an existing known average time to complete the same movement. It then proportionally increases or decreases the existing cost by the proportional increase or decrease in the time to complete the movement under the hypothesized condition. Note that the TC Model only evaluates water movements by barge. It is incapable of incorporating and evaluating rail or truck transport options and alternative market options.

The Equilibrium (EQ) Model is used to attempt to determine which set of movements should be removed from the system—i.e., diverted to rail at one waterside location, then moved to a different water location where it would again be transferred to a different railroad or truck to be delivered to its final destination. The EQ Model removes some movements so that the next (iterative) run of the TC Model will consider a set of movements that are closer to the equilibrium set—that is, the set of movements with positive benefits that maximizes system tonnage. Thus, the EQ Model is not an optimizing model and is not guaranteed to converge to equilibrium.

There are major problems with these models. The first problem is that neither model is capable of evaluating the impact of alternative transportation and marketing options that industries use on a daily basis to adjust to changing rail, truck and water transportation rates. Shippers and receivers make these adjustments whether the changes in transportation rates and or commodity prices are the result of lock congestion, changes in supplies and demands or any other changes that affect the profitability of shipping/receiving products by water. Some of these options vary with the type of product being shipped on the river. Most of these options require little or no federal investment in waterway infrastructure to implement. Because coal is the dominant product moving on the Ohio River, this section identifies some adjustment options available to coal shippers/receivers to reduce or avoid waterway congestion. Some options are:

1. The most obvious option for coal shippers to avoid waterway congestion is to load the coal on a train and ship it directly to its destination. This option would likely reduce the total distance hauled and eliminate the leg and accessorial costs charged to rail shipments in the TC and EQ models. Waterway interests might argue that contracts between coal miners and coal users specify the mode of transport. The Corps did not present any evidence on the types of contract clauses that specify the modes of shipment. Neither did they specify whether a typical contract can or cannot be modified to meet temporary transportation needs.

Another argument used by the Corps against incorporating this direct rail shipment option in the model is the large number of origins and destinations for the products moving on the ORMS. The Corps did not present any evidence on the number and locations of the origins and destinations of coal shipments. Academic transportation and economic journals contain a vast body of literature describing generalized price spatial equilibrium models that have been used to solve transportation problems similar to those of inland waterway lock congestion. This literature describes several alternative methods of constructing price spatial equilibrium models that incorporate numerous origins and destinations. It also describes how and where to collect the data necessary to solve these models.

A third possible objection to the use of direct mine-to-user rail movements is that some users are not capable of receiving coal by rail. A published newspaper article<sup>8</sup> discussing a two-week shutdown at the McAlpine Lock at Louisville, Kentucky, stated, "[T]ransporting coal by railroad is not possible since the power plants are configured to

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<sup>8</sup> Fenton, Justin. "Lock users hope repairs go smoothly." Cincinnati Enquirer, August 8, 2004.

receive coal by water." Table 4 shows the number of coal burning electrical plants located on the Ohio River and the modes of transport used by these utilities.

Of the 25 coal burning Ohio River electrical plants reporting to the DOE, 11, or 44 percent, receive coal by rail. It is not necessary that all electrical plants be able to receive coal by rail. For modeling purposes, all that is needed is that enough coal be delivered directly by rail to reduce congestion. In fact, the Corps' option of shipping coal to river locations by rail or truck to be transferred into rail or truck, carried to another river location to be transferred into another rail car or truck to be delivered to an electric plant, is not only unrealistic; it is impossible for the 14 of the 25 Ohio River plants that do not receive coal by rail or truck. Thus, the cumbersome, costly, and unrealistic alternative option used in the Corps' TC and EQ models could not be used by 56 percent of the Ohio River electric plants identified by the DOE.

2. Shipments that originate in the pools on either side of the lock under construction could be delivered to a barge loading or unloading facility located on the side of the dam that would not require passing through the congested locks. For example, depending on which side of a lock the coal user is located, coal could be delivered from the mine to a barge loading facility on the side on the lock that the receiver is located. This procedure would avoid the closed or congested locks and still deliver the coal by barge. It would be an economically viable option if the additional rail or truck costs to the barge loading facility that avoids the congested lock were less than the costs of barging to and locking through the congested lock. This procedure would allow the coal to be delivered to the barge-only electrical utility plants and still avoid the congestion at the auxiliary lock at the dam under maintenance closure. Incorporating this option in the analysis would require the model to accommodate origin and destination locations. The TC Model and the Waterborne Commerce Statistics data do not accommodate this or most other realistic options to barge shipments.
3. Incorporate a coal storage activity in the model so that additional coal could be received prior to the maintenance closure. This higher quantity of stored coal would then be drawn down during the temporary shutdown of the main lock under repair. If implemented at all electrical users on the river, this option would reduce congestion at the auxiliary lock by the sum of the coal storage capacities. Undoubtedly, many coal users already utilize this option to hedge against reduced coal deliveries or higher coal costs during planned lock closings. However, the Corps does not account for cost savings from this option in its TC and EQ models. The additional data on individual plant storage capacity could be obtained easily by a survey form or telephone surveys.

Table 4. Number of Coal Consuming Electric Utility Plants in Ohio River Valley States by Mode of Coal Transport.

State	Total Number of Reporting Coal Consuming Plants	Located on Ohio River			Did Not Report Transport Options	
		Total on Ohio River Reporting Transport Options	Reported Only Ohio River Barge Transport	Also Reported Rail and/or Truck Options	Total in Five States	Number Located on Ohio River
Illinois	16	1	0	1	4	0
Indiana	23	3	2	1	4	3
Kentucky	16	4	2	2 <sup>a</sup>	4	1
Ohio	24	11	8	3	5	0
<u>West Virginia</u>	<u>13</u>	<u>6</u>	<u>2</u>	<u>4</u>	<u>0</u>	<u>0</u>
Total	92	25	14	11	17	4
Percent	--	--	56	44	100	23.5

Source: Bonskowski, Richard F., Energy Information Agency, Department of Energy, Washington, D.C., rbonskow@eia.doe.gov, August 12, 2004.

<sup>a</sup>One plant located on Ohio River dismantled its barge receiving facilities and receives only western coal by rail.

4. Electricity demand is typically higher for summer air conditioning and for winter heating and lower in the spring and fall months. Incorporating seasonality in the model would enable the Corps to evaluate the cost saving from scheduling maintenance closures during low electricity demand times.
5. Allow electric utility plants to trade barges of coal during maintenance closure times. Most locks transit both upstream and downstream coal shipments. Recognizing that each plant requires coal of specific characteristics, plants located south of a lock under maintenance closure could be allowed to purchase or trade for coal of the required characteristics that does not need to transit a congested lock. Alternatively, they could purchase or trade for coal that could be blended into the required characteristics. Plants located north of the closed or congested main lock could trade or make similar purchases of coal that does not need to transit a congested lock. These purchases or trades would reduce the quantity of coal moving through the auxiliary lock during the main lock maintenance closure. Trading barge loads has been a common daily practice in the grain industry for many years. Yet, the Corps does not incorporate this option into its current models.
6. Incorporate the possibility of purchasing electricity over the "grid – our nation's electric superhighway" during supply emergency periods. In its 2003 annual report, Cinergy Corporation, a combination of Cincinnati Gas and Electric Company and PSI Energy, the largest electric utility in Indiana, states:

"In the contiguous 48 states, electricity moves from giant power plants to local distribution stations over 160,000 miles of high-voltage transmission lines. Originally designed to meet the needs of customers in clearly defined service territories, the transmission grid now also serves as a superhighway for thousands of hourly power transactions."<sup>9</sup>

The grid serves as a wholesale market for thousands of hourly electrical transactions among the nation's wholesale electric producers and distributors. Thus, the grid is an alternative source of electricity that the Corps feasibility studies ignore. This option, including prices of wholesale electricity, should be incorporated into a model to credibly evaluate this option that electric users have to adjust to lock maintenance closures and lock congestion. If included in the models and if the cost of electricity purchased from the grid is lower than the cost of generating electricity from coal that must transit a congested auxiliary lock, the purchasing utility, other coal users, and barge companies would benefit from the reduced congestion as a result of purchasing electricity from the grid.

7. The Corps states "Economic analysis of service degradation focuses on the evaluation of alternative measures to:

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<sup>9</sup> Cinergy Corporation. "Choosing Our Futures. Issue #4, The Future of the Grid - Our Nation's Superhighway." 2003 Annual Report, Cincinnati, Ohio.

- increase capacity or
- replace or rehabilitate aging structures."<sup>10</sup>

In other words, it focuses almost exclusively on improving the physical lock infrastructure. Little emphasis is placed on evaluating non-structural opportunities to improve the management of the flow of barges through the locks. The Corps has long had a "first come-first serve" policy of locking barges through locks. The random arrivals at locks and the lack of Corps coordination of arrivals and locking schedules, force waterway operators to treat lock congestion as an uncontrollable event. In its first review of the Upper Mississippi-Illinois Waterway Feasibility Study, the National Research Council (NRC) identified several non-structural options to reduce congestion.<sup>11</sup>

These options included:

- scheduling barge arrival times,
- charging a congestion fee,
- rationing the number of users at specific congested times.

The NRC report states "There are also concerns about the Corps' focus on lock extensions with little consideration of nonstructural alternatives. The full range of nonstructural alternatives should be evaluated before lock extensions are considered. A comprehensive assessment of the benefits and costs of these nonstructural options for improving waterway traffic management should be considered. Congestion management could improve waterway traffic management almost immediately while reducing congestion by extending locks on the UMW-IWW would take a decade or more"<sup>12</sup>

The Corps estimated the benefits and costs of congestion fees at J.T. Myers L&D. The estimated B/C ratio was 6.0, the highest of any alternative evaluated. However, the Corps stated "While fees help in reducing delays, significant delays are still experienced during these closures. This plan is eliminated from further consideration due to serious problems associated with implementing a fee program and its inability to fully address the needs at J.T. Myers." Thus, the Corps ignored the benefits of this and other non-structural options in its feasibility study.<sup>13</sup> These nonstructural options plus the options identified earlier, combined with eliminating the forecasting errors and overestimation of transport costs, and eliminating the major problems of the TC and EQ models could greatly reduce the estimated costs of congestion. Moreover, they could help reduce the need for multi-billion dollar investments in lock infrastructure.

The only way the Corps can develop credible analyses of comparing the "least cost mode," with the option of lock extension is to include the real options available to shippers/receivers. The alternative options vary among shippers, receivers and commodities. Grain, for example, typically has many origins, destinations, market prices, alternative modes and rates. Moreover, quantities shipped vary among seasons. Price spatial equilibrium models have been successfully

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<sup>10</sup> J.T. Myers and Greenup Lock Improvements Feasibility Studies, pp. 1-3.

<sup>11</sup> National Research Council. "Inland Navigation System Planning: The Upper Mississippi River-Illinois Waterway." National Academy Press, Washington, DC, February 28, 2001.

<sup>12</sup> National Research Council, 2001, p. 87.

<sup>13</sup> J. T. Myer and Greenup Feasibility Study, p. A10-5.

applied to the grain transportation and distribution systems. The Corps needs to develop similar coal and other product models that incorporate actual origins and destinations, alternative markets and their prices, seasonal shipments, prices, and alternative modes and actual rates for these modes. These modal rates can be obtained from published railroad tariffs, barge tariffs and percents of tariffs and from data generated by the DOE and industry sources. The Corps' Upper Mississippi River Study Group attempted to develop such a model. However, it was unsuccessful, in part, because it was forced to rely on data that do not have off river origins, destinations and their transport costs. These data are not useful in a realistic price spatial equilibrium model.

The TC and EQ models are designed to compare barge costs with the "least cost alternative mode." This cost comparison is relevant if the product in the analysis consistently moves from the same origin to the same destination over long periods of time. The Corps' feasibility studies generally cover a 50-year time period. The data in Table 1, showing the declining coal production in several Appalachian states suggest that fixed origins and destinations are not the case for coal. Fixed origins and destinations are certainly not the case for grains. The most profitable grain markets for individual shippers shift daily and even hourly. As a result, most grain companies have a merchandiser who searches for the highest net profit (measured as price minus transport costs) markets on a daily basis. They frequently shift quantities of product and modes of transport with the changes in the highest net bid for their grain. Therefore, evaluating the value of lock extensions on the basis of fixed origins and destination over a long (fifty year) period is not a relevant procedure. Shippers of grains, and other products (e.g., agricultural chemicals) make their shipment decisions based on the highest profits, which is usually measured as price net of transportation costs. Therefore a credible model must maximize net profit --price minus transport costs-- to correctly estimate the net benefits of lock extensions. The proper measure to evaluate the benefits from lock extension is the difference in shipper net profits with the lock extension and the net profits from the next best on-river or off-river market without the lock extension. The TC and EQ models are incapable of evaluating alternative off-river markets and prices.

In conclusion, the TC and EQ models have fundamental flaws that prohibit their use as credible tools in waterway investment decisions. There is a vast literature in transportation and economics journals that identify price spatial equilibrium models as an appropriate method of evaluating problems similar to waterway investment options.

Two NRC Reports strongly recommend price spatial equilibrium models as the appropriate tool in evaluating waterway investment options.<sup>14</sup> Moreover, the Corps attempted to develop a price spatial equilibrium model (the Essence Model) in evaluating investments on the Upper Mississippi-Illinois Waterway. However, the NRC report concluded that the Essence Model was not a spatial equilibrium because it did not link production areas with alternative markets. A major reason for the Essence Model's lack of spatial characteristics was that the data used by the Corps do not include origin and destination locations, prices at alternative markets and transport rates from each origin to each destination. The TC and EQ models have these same omissions.

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<sup>14</sup> National Research Council, February 28, 2001, and National Research Council. "Review of the U.S. Army Corps of Engineers "Restructuring Upper Mississippi-Illinois Waterway Feasibility Study." The National Academies Press, Washington, DC, 2004.

## CONCLUSIONS

The basic conclusion from the evaluation of the J.T. Myers and Greenup Lock Improvement Feasibility Study is that the study has fundamental flaws. These flaws stem from the failure to accurately incorporate into the models the economic criteria and market conditions that the Corps acknowledges drive the shipment decisions in the marketplace today. Any subsequent study that uses the same methods, models, and data used in the J.T. Myers and Greenup Study will be unreliable in guiding public investment decisions.

The fundamental flaws include:

- Corps' traffic forecasts project large increases in total and coal traffic on the Ohio River. Actual total traffic on the ORMS has had only small increases since 1990 and actually declined 5.2 million tons from 2002 through 2004. The Corps overestimated Ohio River Mainstem total traffic by 360 million tons over a 14-year period from 1990-2004. In a revised forecast, the Corps overestimated total traffic by 191 million tons over a seven year period from 1996-2004.
- Corps' traffic forecasts project large increases in total and coal traffic through J.T. Myers and Greenup Locks and Dams. Total traffic through J.T. Myers L&D has declined since 1990 and coal traffic has declined over 50 percent since 1990. Total and coal traffic through Greenup Locks and Dam have also declined in the face of rapidly increasing Corps traffic forecasts. The Corps overestimated J.T. Myers total traffic by 330 million tons over a 14-year period from 1990-2004 and in a revised forecast, by 104 million tons over a seven year period from 1996-2004. These overestimations of future traffic result in an upward bias in the estimated benefits from extensions of J.T. Myer and Greenup locks.
- The Corps has a long history of errors in forecasting large increases in future barge traffic that have never materialized. Examples of large forecasting errors include:
  - Coal and total traffic forecasting errors cited above on the ORMS and J.T. Myers and Greenup Lock Improvement Feasibility studies,
  - Grain and total traffic forecasting errors in two studies of the Upper Mississippi – Illinois Waterway and the Lock and Dam 26 study,
  - Grain and total forecasting errors in two studies of the Missouri River,
  - Total and coal traffic forecasting errors in the Tennessee-Tombigbee River study, and
  - At least 23 years of large traffic overestimation for the Gallipolis L&D on the Ohio River.
- A major reason for the Corps' consistent overestimation of waterway traffic is that the Corps assumes that waterway traffic is independent of relative model freight rates and of relative product prices at alternative markets. A recent paper by TVA personnel

essentially agrees with this reason for the failed waterway traffic forecasts.<sup>15</sup> The TVA study tried to relate short run commodity flows to observed barge rates (TVA estimated barge costs). The authors state, “[T]he effort yielded no reportable results.” The authors concluded “[I]n terms of developing a viable approach to estimating long-run demand relationships, the study team recommends the construction of pooled cross sectional data sets describing transportation prices, factor prices, commodity prices, firm entry and exit decisions and firm location decisions.”

- No one can correctly forecast the future. However, the Corps’ consistent large overestimation of future barge traffic on the above rivers strongly suggests major changes are needed in the Corps’ analytical procedure. Two options are possible: One is to forecast barge traffic levels under alternative scenarios (including stable and even declining traffic scenarios). Then run the models and report benefit cost analyses for these scenarios rather than discarding the stable forecast as the Corps did in the Myers-Greenup study. A second, and better alternative, is to develop and implement real price spatial equilibrium models that connect origins, destinations and product prices at all relevant markets and real rates from origins to destinations for all relevant transport options. Given origin supplies or demands at individual destinations, price spatial equilibrium models can internally generate traffic projections. These internally generated forecasts will be based on the factors that determine individual shipper/receiver demand for waterborne inland transportation as acknowledged by the Corps in the J.T. Myers-Greenup Feasibility study. Moreover, a theoretically sound price spatial equilibrium model, combined with the appropriate data, will provide the necessary price-quantity relationships needed to estimate elasticities of demand for barge transportation at varying distances from the river under study.
- The transport costs used in the TC and EQ models are based on rail-truck routings that are rarely, if ever, used. This cumbersome, unrealistic routing results in costs that are virtually certain to overestimate the costs of realistic alternative transport options and therefore, overestimate the benefits of lock extensions.
- The coal transport rates used in the TC and EQ models are derived from cost models and shipper surveys. These costs sharply exceed average railroad coal rates for the same region that are published by the Department of Energy. This overestimation of railroad rates compared to the DOE rates probably result in overestimated benefits from lock extensions.
- The TC and EQ models are incapable of evaluating several alternative transport and marketing options, some of which are routinely used by industry in adjusting to waterway congestion and to changes in supply and demand. This omission almost certainly results in overestimated benefits from lock extensions.

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<sup>15</sup> Bray, Larry, Chrisman Dager and Mark Bruton. “Willingness to Pay for Water Transportation in the Ohio River Basin,” paper presented at the 2004 Transportation Research Board Annual Meeting, Washington, D C, January 2004.

- The Corps fails to consider the benefits of non-structural traffic management alternatives to help reduce waterway congestion and congestion costs.
- The Corps models assume that the forecasted quantities of products move from fixed origins to fixed destination over a fifty-year period. A price spatial equilibrium model would correct this major problem.

## RECOMMENDATIONS

The Corps' J.T. Myers-Greenup Lock Improvement Feasibility Study has fundamental flaws that need to be reviewed and corrected before further funds are appropriated for these civil work projects. Importantly, any subsequent study that uses the same methods, models, and data used in the J.T. Myers and Greenup Study should be considered unreliable in guiding public investment decisions. Fortunately, the decade-long decline in ORMS coal traffic takes enough pressure off the congestion issue to enable the Corps to delay the lock extension questions until these analytical problems are solved. In the meantime, the Corps should:

- Develop, analyze, and implement a set of realistic non-structural options with positive benefit/cost ratios to reduce congestion. The NRC report strongly recommends that this should be done before attempting to re-estimate the benefits and costs of lock extensions,
- Attempt to incorporate actual economic criteria and market conditions by starting the following process of constructing a realistic price spatial equilibrium model by the following:
  - develop a set of realistic transport and marketing options that mimic industry practices in adjusting to waterway congestion and changes in supply and demand,
  - identify origin and destination locations that will allow the spatial equilibrium model to function properly,
  - collect railroad rate data from railroad tariffs that are published on the Internet and from other sources and substitute them for the unrealistic estimated costs used in the current feasibility studies,
  - identify alternative market locations and prices at these markets for products moving on the ORMS,
  - collect actual barge rates for barge loading and receiving facilities on the Ohio River including spot rates that can vary widely over time and space and contract rates that are fixed over specified times quantities, origins and destination, and
  - develop realistic price spatial equilibrium models for the major commodities moving on the ORMS to evaluate the benefits and costs of federal investments in Ohio River waterway improvements. These models can be structured to maximize

shipper profits (defined as price minus transport costs) for products that shift among alternative markets in response to changing market prices. The price spatial equilibrium model should also solve the Corps' forecasting error problem by internally generating ORMS traffic forecasts based on the market prices and actual transportation rates built into the model.

- In view of the low growth and recent decline in total Ohio River traffic and the long and sharp decline in Ohio River coal traffic, the federal government should delay decisions on Ohio River lock improvements until the Corps develops and implements realistic price spatial equilibrium models and several nonstructural options. The Corps should then re-estimate the benefits and costs of lock extensions using the newly developed price spatial equilibrium models.
- This evaluation focused on the economics of the J.T Myers-Greenup Interim Feasibility Report. A similar analysis should be made of the engineering analyses in the study.

## ABOUT THE AUTHOR

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Baumel has published over 390 articles in refereed journals, research and extension bulletins and trade journals. His research has focused on improving the efficiency of the transportation of bulk products including grains, chemicals and coal. He has had a major impact on the restructuring of the railroad, rural road, and the grain and fertilizer distribution systems in the midwest United States.

He was appointed to the Advisory Committee to the Joint Economic Committee of the U.S. Congress National Infrastructure Study (1983), the Rural Transportation Advisory Task Force (1979-1980), and the National Research Council Committee to Review the Upper Mississippi River-Illinois Waterway Navigation System Feasibility Study (2000-2001). He was a reviewer of the National Research Council Review of the U.S. Army Corps of Engineers Restructured Upper Mississippi- Illinois River Waterway Feasibility Study (2003).

Baumel has been recognized by 30 international, national, regional, state and university awards, including the highest awards given by the American Agricultural Economics Association, the Transportation Research Forum and Iowa State University. Baumel grew up in West Chester, Ohio and graduated from Union Township High School in West Chester. He received B.S. and M.S. degrees from The Ohio State University and the Ph.D. degree in Economics from Iowa State University.

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