Highway Benefits of Relocating the Movable Span on the Vancouver Rail Bridge

Executive Summary

The U.S. Coast Guard is holding a public hearing on March 5, 2002 in Portland, Oregon to receive comments concerning the alteration of the Burlington Northern Santa Fe (BNSF) railroad bridge over the Columbia River between Vancouver, Washington and Portland, Oregon (Vancouver Rail Bridge). The Washington and Oregon Departments of Transportation (WSDOT and ODOT) are joint owners of the two Interstate 5 Highway Draw Bridges located less than one mile upriver from the Vancouver Rail Bridge. The rail and highway bridges are closely linked in terms of river navigation and operations.

Many other organizations will show the benefits of the change to river commerce and rail operations. This study is narrowly focused on economical benefits to the highway users.

WSDOT and ODOT strongly support the proposed improvements for several reasons. Highway congestion resulting from commercial barge bridge lifts on the Interstate 5 Highway Bridge would be virtually eliminated. The proposed improvement would also reduce the future safety risk of a collision between a commercial barge and the three bridges. The Vancouver Railroad Bridge is critical to both the high speed passenger rail and freight mobility interests of the states of Washington and Oregon. A collision that places the rail bridge out of service could have severe passenger rail and freight mobility impacts.

Purpose

Relocating the movable span of the Vancouver Railroad Bridge to more closely align with the highest clearance of the Interstate 5 Highway Bridge would eliminate the need for commercial barge bridge lifts under nearly all water conditions except for a limited number of barges requiring a high vertical clearance. The purpose of this study is to estimate the value of travel time savings to highway traffic by eliminating commercial barge bridge lifts on the Interstate 5 Highway Bridge.

The travel time savings for automobiles and trucks are the major highway benefit of reducing congestion resulting from bridge lifts. WSDOT and ODOT developed a simple spreadsheet model to estimate these benefits. The model is based in part on the congestion and traffic engineering methodology developed for WSDOT's benefit-cost methodology. Major inputs are the ten years of hourly bridge lift data, forecasts of future hourly traffic congestion on I-5, forecasts of future commercial barge traffic, and estimates of the hourly value of travel time savings.

Findings

The key findings of the study are:

- Highway traffic congestion on I-5 will spread into the mid-day period when there is currently no restriction on bridge lifts.

- Commercial barge traffic and the number of commercial bridge lifts will continue to increase from an average of about 275 per year today to about 400 per year in 2021.

- Bridge lifts during mid-day periods will significantly increase congestion by forming traffic queues that take a longer time to dissipate. These longer periods of traffic delay combined with a higher percentage of truck traffic in the mid-day period result in higher estimates of travel delay costs. In today's dollars, the benefits are estimated to increase from about $.8 million in 2002 to nearly $12 million in 2021.

- There are nearly $ 85 million in cumulative benefits in today's (real) dollars for the 20 year period from 2002 to 2021. The present value of these benefits using the federally specified discount rate of 7 percent is nearly $32 million.

- Given the increasing cost of congestion from bridge lifts, doing nothing could result in future pressure on elected officials to further restrict highway bridge lifts. Further restriction would add additional backup of commercial barge navigation and increase the safety risk by further limiting barge operations in daylight hours.

Introduction

The convergence of highway, rail, upriver barge and port facilities in the Portland/Vancouver I-5 Corridor makes it a gateway to national and international markets including Canada, Mexico and the Pacific Rim countries. Congress recognized Interstate 5's national significance and economic importance in Section 1105 of the Intermodal Surface Transportation Act (ISTEA) by designating it as a High Priority Corridor. Section 1010 of the same Act designated the existing rail line between Eugene, Oregon and Vancouver, British Columbia as a High Speed Rail Corridor. River commerce is vitally important to the economies of both Washington and Oregon. Over 40 percent of U.S. Wheat exports move on the Columbia River system. I-5 is an important crossroad for south-north and east-west freight movement. The Vancouver Railroad Bridge is critical to north-south and east-west freight shipments and to the high-speed passenger rail interests of the states of Washington and Oregon. The two Interstate 5 Bridges crossing the Columbia River between Vancouver Washington and Portland Oregon and the BNSF Vancouver Rail Bridge are key I-5 facilities connecting the Interstate and freight rail system with deep-water shipping and upriver barging. This is the most significant freight center along I-5 between California and Washington.

The Washington and Oregon Departments of Transportation (WSDOT and ODOT) are joint owners of the two Interstate 5 Highway draw bridges located less than one mile upriver from the Vancouver Rail Bridge. The rail and highway bridges are closely linked in terms of river navigation and operations. The proposed alteration would significantly reduce the future safety risk of a collision between a commercial barge and the Vancouver Rail Bridge. A collision that places the rail bridge out of service could have severe passenger rail, freight rail, barge navigation, and economic impacts. Converting the swing span of the Vancouver Railroad Bridge to a draw span and more closely aligning the span with the highest clearance of the Interstate 5 Highway Bridge would also eliminate the need for nearly all commercial barge bridge lifts. WSDOT and ODOT strongly support the proposed alteration because highway congestion resulting from commercial barge bridge lifts on the Interstate 5 Highway Bridge would be virtually eliminated. If the proposed railroad bridge alteration is not made and traffic congestion resulting from commercial barge lifts increase, WSDOT and ODOT anticipate that they would support future proposals to further restrict commercial barge lifts on the I-5 Interstate Bridges during daylight hours.

The purpose of this study is to estimate the highway benefits of eliminating commercial barge bridge lifts on the Interstate 5 Highway Bridge. The next section will provide an overview of the methodology and key input assumptions for the analysis. The remainder of this paper will present the results of the analysis.

Methodology, Key Inputs and Assumptions

This analysis uses a spreadsheet model to estimate travel savings benefits. Figure 1 provides an overview of the model.

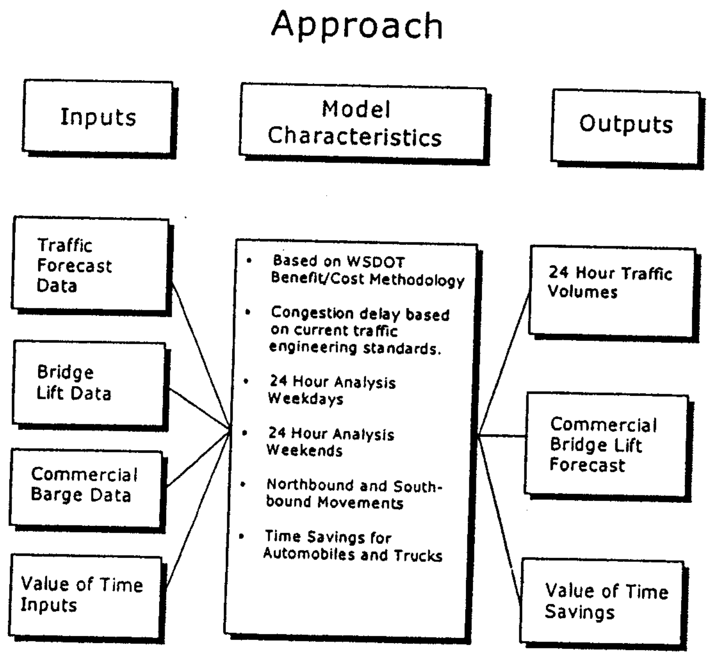

Figure 1
Model Process

Model Description

A spreadsheet model was developed for this analysis.[1] The traffic forecast methodology is based in part on methodology developed for WSDOT's statewide benefit-cost software that is used by WSDOT to screen and prioritize transportation projects.[2] A key element of the methodology distributes daily traffic volumes into each hour of the daily 24-hour period. The model has one calculation for each hour for an average weekday and another calculation for each hour of weekends and holidays. Hours during the weekday when the current bridge lift restriction is in place are not included in the benefits calculation. Traffic flows in the northbound and southbound directions are analyzed separately. When a bridge lift occurs, traffic backs up into traffic queues. A key element of the methodology is to estimate the length of time it will take after a bridge lift for the traffic queue to dissipate back to hourly traffic conditions that would have occurred without the bridge lift.

The base year for analysis is 2002 and the forecast period is from 2002 to 2021. The methodology uses a "constant dollar" approach in which all base year and forecast dollar values are in real 2002 dollars. This approach eliminates the need to forecast future rates of inflation and is consistent with the federal Office of Management and Budget (OMB) methodology. The model calculates a net present value of time savings benefits using the OMB specified real discount rate of seven percent.

Key Inputs and Assumptions

Traffic Forecasts

For this study, a traffic growth rate of 2.5% per year was used. This rate of growth for I-5 at the Interstate Bridge was developed by WSDOT's Transportation Data Office for travel analysis and forecasting. The growth rates are based on historical traffic counts and forecasts of future population growth.

Commercial Bridge Lift Inputs

The commercial bridge lift inputs are based on ten years of hourly bridge lift data collected on an hourly basis between July 1991 and June 2001. The number of bridge lifts vary from year to year, primarily as a function of water levels in the Columbia River and economic cycles. All bridge lift inputs for the model are based on ten year averages. The base year value of 275 commercial bridge lifts is the ten year average. Within the model, commercial bridge lifts are calculated separately for average weekdays and for average weekends, including holidays. The ten year weekday average is 185 commercial lifts. The ten year weekend and holiday average is 90 commercial lifts. The historic data was also used to develop an hourly average weekday and an hourly average weekend

[1] Because spreadsheet models are to a certain extent self documenting, WSDOT and ODOT will also provide a CD containing the spreadsheet model as background material supporting our comments.
[2] Mobility Programming Criteria and Evaluation Procedures. WSDOT. June 1998.

/holiday hourly profile. The profile is the probability of a bridge lift in each hour of an average weekday and in each hour of weekends and holidays. Figure 2 reports the hourly profile for average weekdays, excluding the morning and afternoon peak periods when bridge lifts are restricted.

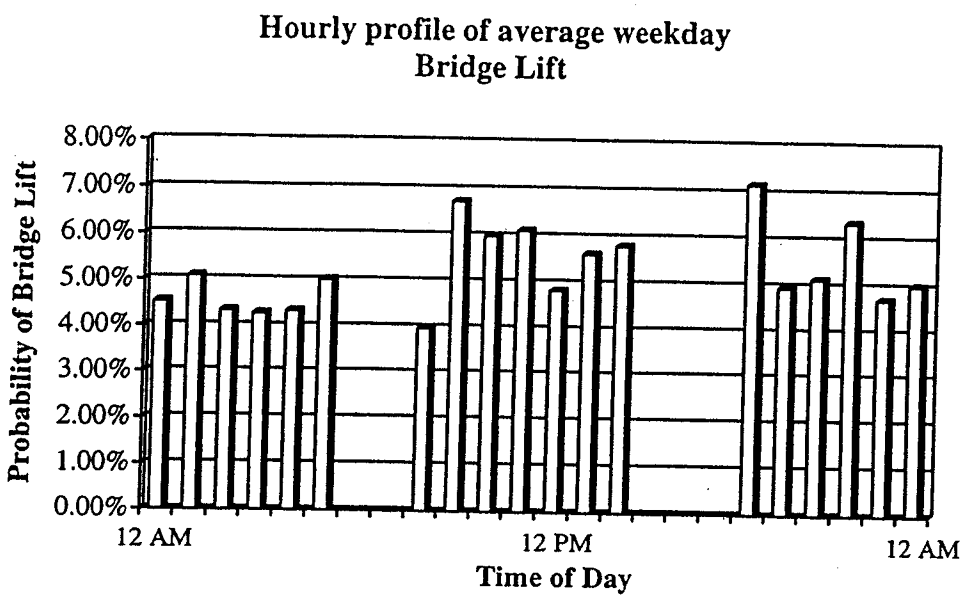

Figure 2

Bridge Lift Growth Rate Assumptions

A bridge lift forecast was developed by applying an annual growth rate to the number of commercial barge lifts in the base year. The study used a 3 percent annual rate of growth in barge container traffic for the twenty-year forecast horizon. The U.S. Army Corp of Engineers (USACE) estimated this rate of growth for its Columbia River Channel Deepening Environmental Impact Statement. Currently, approximately 10 percent of commercial barges are for containers. This 3 percent growth rate was applied to 10 percent of the commercial barge lifts in the base year. The majority of commercial barges transport grain. A growth rate of 1.8 percent was used for the remaining 90 percent of commercial barge lifts in the base year. This growth rate is based on the U.S. Department of Agriculture Baseline latest projections for U.S. Wheat Exports to 2010.[3]

Travel Time Savings

For this analysis, travel time savings are separated into three components, (1) The value of time saved per hour to the occupants of passenger vehicles and to trucking firms, (2) Vehicle operating costs per hour, and (3) the value of reliable travel.

[3] This data was reported in a memorandum dated October 23, 2001 to Mr. Bill Knutson of the US Coast Guard by Mr. Sorin Garber of HDR Engineering.

Value of time saved

The value of time saved used in this analysis is based on a study prepared by the Oregon Department of Transportation than was partly funded by the Federal Highway Administration.[4] A copy of the study is provided as an appendix to this analysis. The ODOT study uses a methodology developed for the Federal Highway Administration in the Highway Economic Requirements System (HERS)[5] and updated using Oregon data for the year 2000. The values are primarily based on weighted on-the-job and off-the-job costs, which in turn are a function of wage rates, including fringe benefits. Table 1 summarizes the value of time saved for automobiles and trucks from the ODOT study.

Table 1. Estimated Value of One Hour of Travel-Time by Vehicle Type, Oregon 2000

	Average Value
Automobiles	$13.95
Light Trucks	$15.21
Heavy Trucks	$19.40

For purposes of this analysis we have rounded these estimates to $14 per hour for automobiles and $19 per hour for trucks.[6]

Vehicle Operating Costs

Automobile operating costs are for gas, oil, maintenance, and tires. These costs will vary by type, age, and speed of vehicle. Other automobile ownership costs such as insurance, depreciation, and finance costs are treated as fixed costs and are not included in this analysis. This analysis uses the American Automobile Association's average operating cost estimate of 12.2 cents per mile for new 2000 automobiles.[7] This cost per mile value is multiplied by 42.3 (the average freeway speed in the Portland/Vancouver metropolitan area) to develop a rounded average operating cost per hour value of $5. [8]

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4 "The Value of Travel-Time: Estimates of the Hourly Value of Time for Vehicles in Oregon, 2000", Oregon Department of Transportation, November 2001.

5 "Highway Economic Requirements System, Technical Report" Federal Highway Administration, U.S. Department of Transportation, December 2000.

6 The truck value is an average of the light and heavy truck values in Table 1 weighted by vehicle miles traveled in Oregon. Since nearly 92% of vehicle miles traveled are heavy trucks, the weighted average is $19.29. For this analysis, this value is rounded down to $19.

7 "Your Driving Costs", American Automobile Association, 2000.

8 $.12.2 times 42.3 = $5.16. The average freeway speed for Portland/Vancouver is a 1999 value taken from Appendix B of the 2001 Annual Mobility Report, Texas Transportation Institute, 2001.

This analysis uses an average operating cost per mile for trucks of $1.10. This value was based on 1998 total cost per mile data of $1.74 reported by the American Trucking Association (ATA).[9] The ATA value was first reduced by fixed costs of 19.5 cents for taxes, insurance, and depreciation. The remaining costs were further reduced by 45 cents per mile for labor cost based on the time value for trucks calculated above ($19 divided by 42.3 miles).. This value is reasonably consistent with a Bureau of Transportation Statistics study of carriers that estimated that the average total expenses per mile (including fixed ownership costs) for all types of for-hire truck transportation was $1.78 in 2000.

Value of Travel Time Reliability

There is a growing body of research that recognizes that travel time reliability has a value than may be larger than travel time savings alone. For example, the World Bank's Transport Economics & Sector Policy group[10] recently published an economic analysis guidebook that stated:

Reductions in travel time variability, associated particularly with the reduction of congestion, may in practice be valued even more highly than reductions in the average or expected travel time. This is particularly important for movements of high valued freight, as poor reliability increases total logistics costs by requiring higher levels of buffer stockholding.

The Federal Highway Administration and State Departments of Transportation recognize the importance of improving travel time reliability and employ a variety of strategies to improve reliability such as ramp meters, managed lanes, improving travel time predictability for travelers by using Variable Message Signs, or dispatching service patrols to clear incident congestion more rapidly. Until recently, most analysis of the benefits of reducing travel time use estimates the value of time saved and vehicle operating costs saved similar to those estimated above but have not included a benefit for improving travel time reliability. This analysis includes a factor that estimates the benefits of improving travel time reliability by eliminating the need for bridge lifts on the Interstate 5 Bridge. The factor is based on a recent study that estimated sponsored by the National Cooperative Highway Research Program (NCHRP) of the National Academy of Science [11] that recommended:

...segmenting traffic forecasts by time of day and applying a "mark-up" factor to value of time assumptions that apply during periods of congestion. Based in the results reported in this study, the recommended mark-up factor is 2.5.[12]

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[9] American Trucking Trends 2000, American Trucking Association, 2000

[10] World Bank, Transport Economics and Sector Policy:Economic Appraisal, http://www.worldbank.org/html/fpd/transport/pol_econ/ea_docs/ea_2-3.htm

[11] Kenneth A. Small, Robert Noland, Xuehao Chu, and David Lewis, "Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User Cost", NCHRP Report 431. 1999.

[12] Ibid, p 5.

In this analysis, the 2.5 mark-up factor is multiplied by the $14 value of time estimate for automobiles and the $19 value of time estimate for trucks in each hour of the weekday or weekend during congested periods.

Results

Highway traffic congestion on I-5 will spread into the mid-day period when there is currently no restriction on bridge lifts.

Figures 3 and 4 show the current hourly southbound morning peak period and the northbound evening peak period traffic volumes in weekdays for 2002. Figures 5 and 6 indicate that by 2021 the morning and afternoon peak periods have spread into the mid-day period.

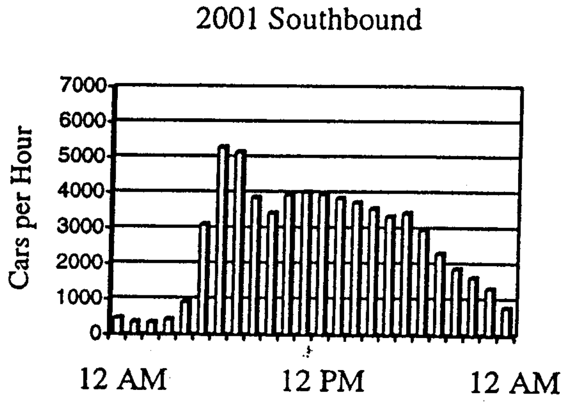

Figure 3

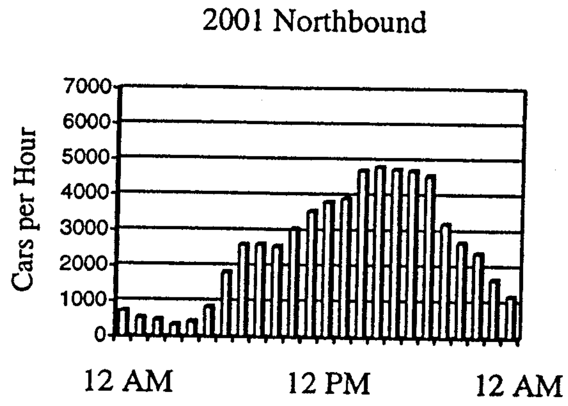

Figure 4

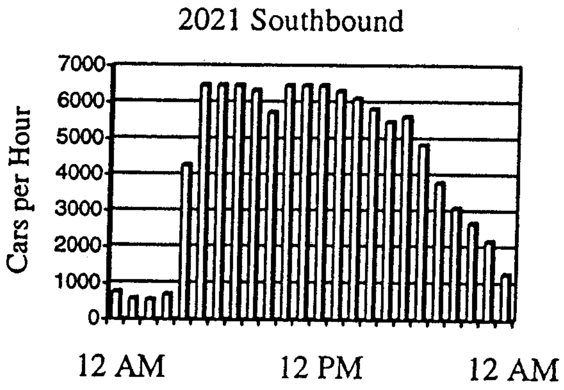

Figure 5

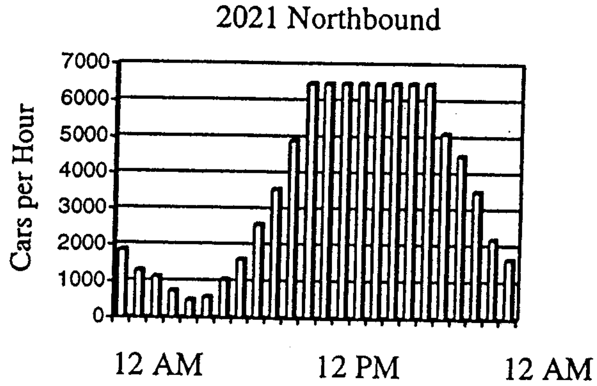

Figure 6

Commercial barge traffic and the number of commercial bridge lifts will continue to increase.

Overall, the number of bridge lifts are projected to grow by an annual rate of 2.1 percent. The number of barge lifts are forecast to increase from 275 in the 2002 base year to about 400 in 2021. Figure 7 presents the study estimate of the number of future bridge lifts

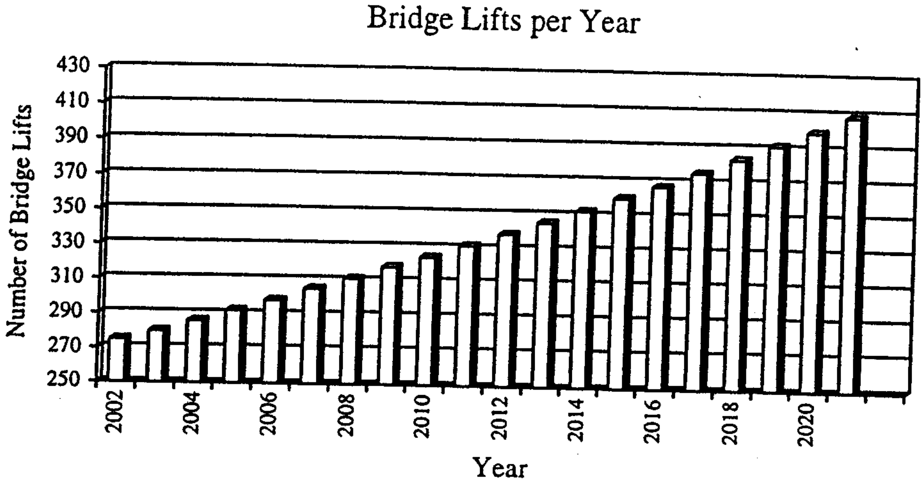

Figure 7

The time savings benefits for eliminating bridge lifts is significant.

The travel time savings highway benefits from changing the Vancouver Railroad Bridge span to eliminate commercial barge bridge lifts is significant. In Figure 8 presents savings estimates in today's (2002) dollars. Time savings increase from about $800,000 in 2002 to almost $12,000,000 in 2021. The cumulative total savings over the 20 year period is nearly $85 million. The 20 year present value of savings, using the OMB real discount rate of 7 percent, is nearly $32 million.

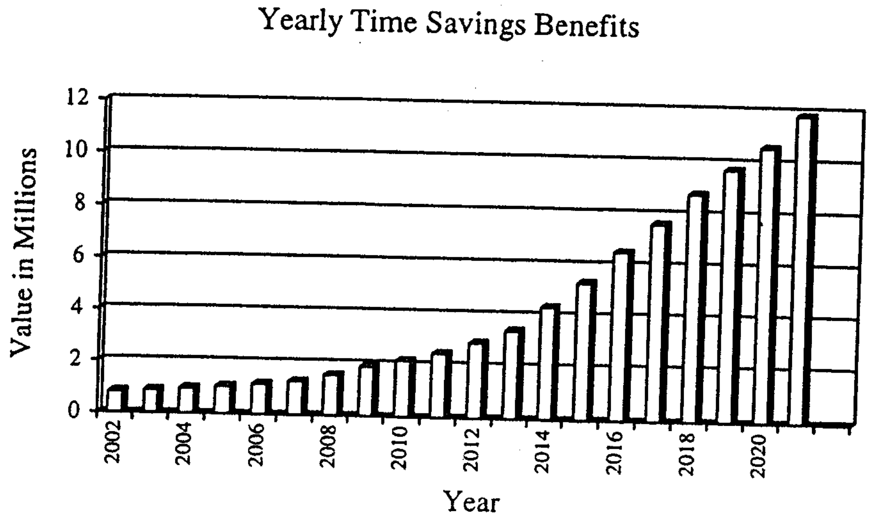

Figure 8

The cost savings per bridge lift is significantly higher than previous estimates.

Figure 9 presents estimates of the average cost savings per bridge lift. The cost savings increase from about $2,900 in 2002 to nearly $29,000 in 2021.

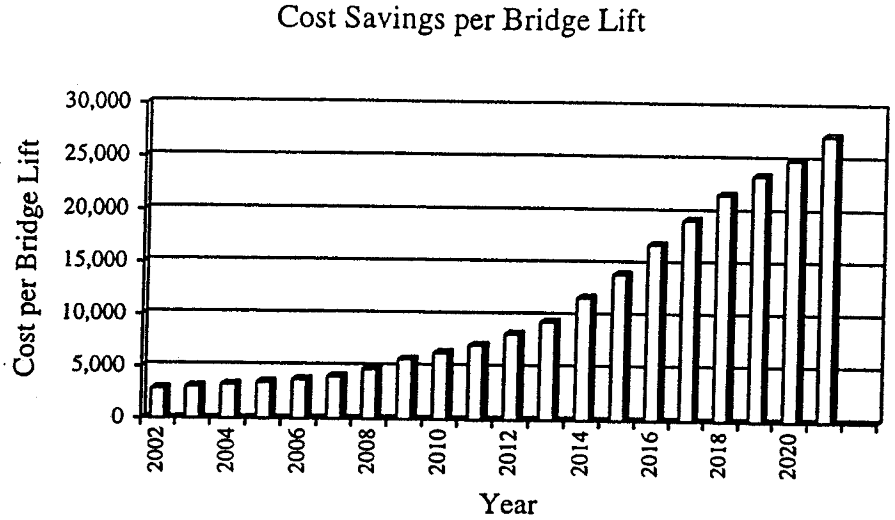

Figure 9

The values reported in Figure 9 are higher than earlier estimates of about $2,400 per bridge lift that were provided to the U.S. Coast Guard as information to be considered in their preliminary investigation. The estimates are higher in this study for several reasons. First, the earlier values were based on the analysis of a sample of the first three days of each month of the ten years of bridge lift data. This study uses the entire bridge lift database. The average bridge lift time was higher using the full data set. Second, the preliminary estimates assumed an average vehicle delay of 7.5 minutes and a maximum delay of 15 minutes. This study calculated the bridge lift delay based on traffic engineering formulas to calculate on an hourly basis how long it would take for traffic queues to dissipate. As Figure 8 above indicates, during the mid-day period as levels of congestion increase due to peak spreading, the time delay for the added congestion from a bridge lift also increases substantially. Finally, the preliminary estimates use an $8 per hour automobile delay cost and a $35 per hour delay cost for trucks to calculate time savings benefits. This study uses values consistent with FHWA methodologies and updated using current wage rates and vehicle operating costs. In addition, this study adds a separate value of travel time reliability factor that was not included in the previous estimate.

Numerical Results

Table 2 presents a summary of the numerical results in this study. In addition, WSDOT and ODOT are providing the U.S. Coast Guard a CD containing additional numerical detail including copy of spreadsheet model and of the ten years of bridge lift data.

Table 2
Summary of Numerical Results

Year	Projected Commercial Bridge Lifts	Value of Annual Time Savings (2002 Dollars)	Average Delay Costs Per Bridge Lift
2002	275	$801,779	$2,919
2003	280	$871,613	$3,108
2004	286	$950,686	$3,321
2005	292	$1,041,006	$3,561
2006	298	$1,145,281	$3,837
2007	305	$1,267,311	$4,159
2008	311	$1,533,669	$4,929
2009	318	$1,881,203	$5,922
2010	324	$2,142,425	$6,606
2011	331	$2,446,506	$7,388
2012	338	$2,891,881	$8,554
2013	345	$3,383,388	$9,801
2014	352	$4,321,901	$12,263
2015	360	$5,280,401	$14,674
2016	367	$6,494,270	$17,676
2017	375	$7,585,310	$20,221
2018	383	$8,742,625	$22,827
2019	391	$9,686,012	$24,770
2020	399	$10,548,438	$26,421
2021	408	$11,797,359	$28,941