



New Hampshire Port Authority Main Wharf Expansion Benefit-Cost Analysis

Portsmouth, New Hampshire

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for the New Hampshire Department of Transportation

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1. INTRODUCTION

1.1 Background and Purpose

The New Hampshire Port Authority Main Wharf is a commercial port that handles nearly 300,000 tons of freight annually. Located within a mile of Interstate-95, the port is also rail accessible and has recently begun to receive freight by rail within the past few months. Salt, sand, and scrap metal are the primary commodities received and shipped at this port, but the port also provides specialty services on-demand to businesses located upstream and other customers.

Significant growth in the handling of the port's primary commodities, as well as the expansion of the types of commodities received, is currently limited by the main wharf's size and structural integrity. Despite that the port has been approached by industries not currently served at the terminal, offering the opportunity for economic growth, the existing main wharf cannot accommodate these potential customers.

The current length of the port's longest wharf is 582 feet and is insufficient for providing full service for all cargo hatches of bulk carriers, creating inefficient operations. In addition, new businesses that require the ability to transfer certain heavy cargo off marine vessels and into trucks cannot currently be served, due to the physical condition of the wharf. The U.S. Army Corps of Engineers' Piscataqua River Federal Navigation Channel was constructed to accommodate 750 foot long vessels, but the smaller size of the existing wharf means that the terminal is underutilized. The NH Port Authority Main Wharf Expansion project would lengthen the existing main wharf at the port by 125 feet, providing the opportunity to better serve existing customers and potentially expand the customer base. In turn, this would improve and increase ocean commerce and safety, as well as provide environmental benefits.

The New Hampshire Department of Transportation (NHDOT) is requesting \$11.2 million through the United States Department of Transportation's National Infrastructure Investments discretionary grants program (referred to as TIGER II). The \$11.2 million grant would be combined with a \$2.8 million match provided by the State of New Hampshire. The combined \$14 million in funds would be used to improve the NH Port Authority Main Wharf in Portsmouth, New Hampshire.

The Benefit-Cost Analysis described in the following sections estimates the benefits and costs associated with the proposed infrastructure improvement. The project is evaluated as compared to the current system, which is considered the baseline, and a future scenario without major capital improvements. It is anticipated that if no major improvement is made to the main wharf of the NH Port Authority, the port's operations will be significantly reduced.

1.2 Summary of Benefit-Cost Results

Using the TIGER guidance recommended discount rate of 7 percent, the expansion of the main wharf will result in a strong return on investment:

- Total benefits of \$41.2 million in present value terms;
- Total costs of \$11.8 million in present value terms;
- Total net present value (NPV) of \$29.4 million, with a benefit-cost ratio of 3.5 at a 7 percent discount rate.

A benefit-cost ratio (BCR) of 3.5 at a 7 percent discount rate indicates that the benefits of the project outweigh the costs considerably, suggesting that the project is economically justifiable. For comparison purposes, the BCR was also calculated at a 3 percent discount rate, resulting in a BCR of 6.2 for the main wharf expansion project.

1.3 Organization of the Report

This report provides the framework of the benefit-cost analysis in Section 2. Information related to the port activity assumptions utilized in the analysis is provided in Section 3. Benefits and costs are detailed in Sections 4, as is a discussion of the economic theory behind benefit-cost analyses. Results are presented in Section 5 with a conclusion evaluating the findings of the study. Figures and tables are provided throughout the report to better illustrate the analysis.

2. FRAMEWORK OF THE ANALYSIS

A comparison of the benefits and costs of a project can give an indication of whether or not a project is worthwhile. To be deemed economically feasible, projects must pass one or more value benchmarks: the total benefits must exceed the total costs on a present value basis; and/or the rate of return on the funds invested should exceed the cost of raising capital, often defined as the long-term treasury rate or the social discount rate. A fundamental tenet of the benefit-cost analysis approach is that only those benefits that are directly attributable to the construction and operation of the project and are incremental are included in the estimation of benefits and costs.

For this analysis, the cost to build and operate represents the foregone value of an alternative investment. The benefits of the project refer to the improvement in the social well-being delivered by the project.

2.1 Benefit-Cost Analysis

In the benefit-cost analysis for the main wharf expansion, benefits are estimated for current and future users on an incremental basis; that is, the change in welfare that consumers and, more generally, society derive from the port's improvement, as compared to the current situation. As in most transportation projects, the benefits derived from the implementation of an infrastructure project are actually a reduction in the costs associated with transportation activities. For example, the reduction of costs due to the expansion of the NH Port Authority main wharf affects users differently, depending on their preferences and the way the project changes their individual transportation costs. The primary users of the main wharf are the shippers that utilize the port for their freight transport.

The benefits of a project are the cost reductions that may result from the project's implementation. These cost reductions may come in the form of average time saved by users, reductions in operating expenses, reduction of pollution, or more generally, a combination of these effects.

2.1.1 Principles

The Benefit-Cost Analysis was conducted by HDR| Decision Economics using methods and parameters consistent with US Department of Transportation and specifically Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grants guidance. The following principles guide the estimation of benefits and costs in the analysis:

- Only incremental benefits and costs are measured.
 - Incremental benefits of the project include transportation cost savings for the users of the main wharf.
 - Incremental costs of implementation of the project include initial and recurring costs. Initial costs refer to capital costs incurred for design and

construction of the main wharf improvement. Recurring costs include incremental operating costs and maintenance expenses. Only additions in costs to the current operations and planned investments are considered in the analysis.

- Benefits and costs are valued at their opportunity costs.
 - The benefits stemming from the implementation of the main wharf expansion are those above and beyond the benefits that could be obtained from the best transportation alternative.

2.1.2 Measurement Data and Assumptions

As part of the TIGER II Grant application process, which was the impetus behind this analysis, benefits and costs associated with specific long term outcomes criteria were estimated. Table 1 presents the benefits measured in this project application as they relate to the five long term outcomes identified in the TIGER II grant guidance: State of Good Repair; Economic Competitiveness; Livability; Sustainability; and, Safety.

Table 1: Benefits and Description of Evaluation Criteria Identified in Long Term Outcomes

Criteria	Benefit(s)	Description
State of Good Repair	Pavement Maintenance Savings	Pavement maintenance savings by diverting traffic to marine
	Maintenance and Operating Cost Savings	Savings in costs associated with longer term maintenance and operation of infrastructure
	Vehicle Operating Cost Savings	Reductions in monetary costs to auto/bus drivers diverted to marine
Economic Competitiveness	Long Term Employment	Value of long-term jobs and whether they will be created in areas of economic distress
	Shipper Cost Savings	Cost savings associated with movement of cargo from one mode of transport to another (e.g., truck transport to marine transport)

Livability	Improved Transportation Choices; Increased access for nondrivers, senior citizens and persons with disabilities	Potential passenger and freight ferry benefits with new service to Yarmouth, Nova Scotia
Sustainability	Emissions Reductions	Reductions in pollutants and green house gases due to auto and truck use reductions because freight is diverted off highways and to marine
Safety	Accident Reduction	Reductions in property losses and injuries and deaths due to diversion of truck traffic off of roads
Job Creation and Economic Stimulus	Short Term Employment	Value of new short-term jobs created

2.1.3 Valuation

The valuation of benefits makes use of a number of assumptions that are required to produce monetized values for non-pecuniary benefits. For instance, the different components of time are monetized by using a “value of time” that is assumed to be equivalent to the user’s willingness to pay for time savings in transit. United States Department of Transportation (USDOT) valuation guidance on the preparation of TIGER II applications was used in the analysis. Where USDOT has not provided valuation guidance or a reference to guidance, standard industry practice has been applied.

All benefits and costs are estimated in 2010 dollars in the analysis, and annual costs and benefits are computed over a long-run planning horizon and summarized through a lifecycle cost analysis. The main wharf expansion is assumed to have a useful life of 30 years.

2.1.4 The Opportunity Cost of Capital

The opportunity cost associated with the delayed consumption of benefits and the alternative uses of the capital for the implementation of the project is measured by the discount rate. All benefits and costs are discounted to reflect the opportunity costs of committing resources to the project. Calculated real discount rates are applied to all future costs and benefits as a representation of how the public sector evaluates investments. A 7 percent real discount rate is used in the analysis, with a sensitivity test at 3 percent.

2.1.5 Model Structure

When conducting a benefit-cost analysis, a baseline scenario is compared to an alternative. For this study, the current main wharf condition is considered the baseline condition. The expansion

of the wharf is the alternative. Data from numerous sources are combined using a variety of relationships and TIGER II guidance to develop benefit and cost estimates.

3. NH PORT AUTHORITY ACTIVITY

3.1 Freight Capacity at the Port

The following section provides information about capacity at the main wharf today and in the future, should the main wharf be expanded. The port's ability to expand its operations is significantly limited by the wharf condition and size at this time. If no improvements are made, operations will be reduced at the NH Port Authority. If the main wharf is expanded, operations will increase and the port will be positioned to expand its existing customer base and cargo.

It should also be noted that there has been considerable interest in initiating passenger and freight ferry service between Portsmouth and Yarmouth, Nova Scotia. Although still in the initial stages, expansion of the main wharf would further promote the opportunity for the new ferry service. There are several key advantages to Portsmouth for the proposed ferry service:

- The Port is located at a highway node, and I-95 is very accessible from the Port.
- Rail service is available.
- A marine facility already exists.

3.1.1 Activity Data

The Port currently handles more than 247,000 tons per year. The volume of tonnage from cargo ships is expected to have minimal growth in the “no build” scenario – a rate of 0.8 percent per year. In the “build” situation, with the expansion of the Port, tonnage is expected to increase at an average of 15 percent over the first five years, with a spike in the first two. This would lead to an expected increase in tonnage handled of nearly 50,000 tons the first year after the improvement, bringing total tonnage to slightly less than 300,000. After the initial growth, it is expected that growth would level off to approximately 1 percent annually with 467,987 tons handled annually by 2025.

Many of the benefits estimated in the Benefit-Cost Analysis are due to reduced auto and truck VMT and VHT that result from diverting cargo from trucks to marine vessels. In the analysis, it was assumed that existing operations would increase by a small amount, 0.8 percent per year.

With the expanded main wharf, it is assumed that the freight handled by the port will increase an average of 15 percent the first five years after the improvement is made, and an additional one percent thereafter. Some of this freight growth will be new, and some will be due to the improved port and its ability to manage freight that is currently being transported by truck from larger ports to Portsmouth.

Because the use of marine vessels, rather than trucks, takes some traffic off of the roadways, it would be expected that vehicle miles traveled (VMT) would decrease with the improved wharf.

The reduction in VMT also relieves congestion and results in reduced travel time (VHT). Using these VMT and VHT data, as well as other information provided by the TIGER II Grant guidelines and other sources, estimation of benefits due to the improved main wharf were made. A full description of these benefits measures is provided later in the report.

4. BENEFITS AND COSTS ASSOCIATED WITH MAIN WHARF EXPANSION

The benefit-cost analysis was conducted using methods and parameters consistent with US Department of Transportation guidance.

4.1 Benefits

Five categories of benefits were measured for this analysis: 1) shipper cost savings; 2) vehicle operating cost savings; 3) accident reduction benefits; 4) emission reduction benefits; and 5) pavement maintenance benefits. Costs include capital construction costs and operating and maintenance (O&M) costs for the NH Port Authority Main Wharf Expansion project. A description of the benefits associated with the main wharf improvements is provided in the following subsections.

4.1.1 Shipper Cost Savings

The primary benefit of the port improvement project is to divert cargo from trucks on the very congested highways of the Northeast to marine vessels. The costs to shippers of transporting goods on the highway are relatively higher than the costs for shipping goods on marine vessels. This is partially due to the size of ships being able to handle much more cargo than individual trucks. Because the wharf improvement will induce some goods movement by ship, rather than truck, significant shipper cost savings are expected due to the port expansion project.

As a sensitivity test, the value of shipper cost savings was cut in half from \$0.06 per ton mile to \$0.03 per ton mile. As discussed in Section 5.2, this reduction in per ton mile shipping cost savings does lower the estimated benefit-cost ratio but it is still estimated to be well above 1.0.

4.1.2 Vehicle Operating Cost Savings

With the implementation of the proposed improvements, the main wharf will become an option for some freight transport customers whose needs cannot currently be met. These customers may be utilizing trucks to transport their cargo, contributing to congestion on the roadways. With the wharf improvement, heavier cargo and larger vessels can be accommodated. This means that some freight that is currently being transported by trucks on the highways will now be moved by marine vessels. The reduced congestion decreases vehicle miles traveled, which results in reduced costs for maintaining and operating autos and trucks. In the analysis, vehicle operating costs include fuel, oil, depreciation, tire wear, and maintenance and repair.

4.1.3 Accident Reduction Benefits

The reduction of accident costs, like other variable costs, is dependent on the reduction of vehicle-miles. Because the port improvements will induce some customers who currently utilize trucking to transport goods using marine transport, VMT on the roadways will be decreased. The reduction in vehicles on the road is combined with a multiplier, which is a weighted average of

fatal, injury, and property damage only (PDO) accidents. This calculation provides an estimate of the accident reduction benefits associated with the expanded main wharf.

4.1.4 Emissions Reduction Benefits

Emissions reduction benefits are due to decreased auto and truck VMT, resulting from the ability of some freight customers who use trucks today to utilize the port once the wharf is expanded. In addition, emissions are further reduced because transporting cargo by marine vessel results in lower emissions than transporting that same cargo by truck. When the wharf work is completed, reduced VMT will lead to emission savings. Emissions measured include VOC (HC), CO, CO₂, NOX, SO₂, and PM, varying by auto and truck. The expansion of the main wharf will result in emissions benefits.

4.1.5 Pavement Maintenance Savings

Pavement maintenance cost reduction is another benefit of reduced vehicle traffic. In addition to the costs that individual drivers incur for auto and truck trips, there are costs in terms of damage to the road surface. Pavement maintenance savings result from reduced auto and truck VMT. Because VMT decreases when the main wharf is improved, there are savings in pavement maintenance costs associated with the project completion.

4.1.6 Other Potential Benefits

There have been discussions regarding initiating passenger and freight ferry service from Portsmouth to Yarmouth, Nova Scotia. While this new service is not guaranteed, the expansion of the main wharf will make the Port of NH more suitable for this type of service. According to preliminary discussions, ferry service would be expected to transport 150,000 passengers per year and 25,000-35,000 automobiles annually. In addition, the ferry would likely carry 30-35 tractor trailers each day. With each of the 35 trucks hauling 88,000 pounds, the port could experience an increase of 3 million pounds of cargo one way each day of service. Items such as tires, aerospace parts, and fish product that would be delivered to other locations in New England would likely be shipped. To be conservative, given the uncertainty of this potential port activity, the benefits of passenger ferry service were not incorporated into the benefit-cost analysis but are a possible additional category of benefit of this project.

4.1.7 Construction and Operating and Maintenance Costs

The NH Port Authority main wharf improvement will extend the length of the wharf, as well as improve its structural integrity. Construction is estimated to cost \$14 million, with the improvements occurring over an 18 month period of time. Maintenance costs would be decreased by \$1.5 million with the main wharf improvements.

5. BENEFITS AND COSTS ESTIMATION

5.1 Estimation of Benefits and Costs

The following section provides detail on the benefits and costs to automobile and truck travelers, as well as shippers. For the purpose of estimating the costs and benefits, it is assumed that the construction of the expanded wharf will begin in 2011 and be completed in 2012. The entire project is anticipated to take 18 months to complete. Operating and maintenance costs occur annually, while construction costs are only incurred in the relevant construction period. Benefits, driven by the increase in cargo moving through the port rather than by truck, also increase annually.

5.1.1 Shipper Cost Savings

The “no build” situation for the NH Port Authority Main Wharf involves doing nothing now, and doing a small maintenance in 2015. In the “build” scenario, the port will be enhanced to add an annual average of fifteen percent to capacity for the first five years after the wharf improvement is complete. After the initial fifteen percent increase, port traffic volumes are expected to increase by one percent annually. This additional capacity will allow cargo that would have been transported by truck to be transported by ship, thus removing approximately 50,000 tons from the highway in its first year with annual increases thereafter.

Benefits are calculated through the 30 year useful life of the port facility, assuming that the improvements take place immediately and are completed in 2012, ready for expanded service immediately upon completion. To calculate the amount of highway mileage reduction, an average truck tonnage of 25 tons per truck is applied to the share of tonnage from each of the major ports in the region to determine the number of trucks removed and the length of the trip. The benefits will depend on the average tonnage carried by truck. The more tonnage a truck is able to carry, the fewer trucks it will take to move the freight to its destination. The major ports that are included (and their respective tonnage shares) are: New York/New Jersey (50%), Portland, ME (20%), Boston (18%), Halifax, (12%). The length of trip was calculated based on the distance between each port and the wharf. The trip lengths varied from 50 (Portland) to 638 (Halifax) miles. In order to determine the total VMT savings, the share of tonnage attributed to each port is multiplied by the distance of the trip. In addition to the length of haul based on the share of tonnage from each port, a factor of 10 miles per trip for “local” miles was removed from the truck length. These are the truck miles that will occur, regardless of whether the trip is via truck or ship, to take the goods to their final destination. Cost savings to shippers over the useful life of the main wharf amount to \$93.8 million.

If shipper-cost savings are reduced to \$0.03 per ton-mile, the benefits to shippers of the change in mode are reduced to \$46.9 million.

5.1.2 Vehicle Operating Cost Savings

Vehicle operating costs (VOC) are an integral element of the generalized cost of traveling. These costs are typically the most recognized of user costs because they usually include some out-of-pocket expenses associated with owning, operating, and maintaining a vehicle. The cost components of VOC measured in this analysis include: fuel and oil consumption, maintenance and repairs, tire wear, and vehicle depreciation.

The estimation of VOC is based on consumption and depreciation rate tables from the FHWA's HERS, and the individual cost components vary by auto and truck. The benefits directly stem from reduced VMT because the expansion of the main wharf will offer shippers an alternative to trucking their freight. As a result, some freight that is currently being transported on the region's highways will now be moved by ship, reducing the total VMT.

Vehicle operating cost savings were estimated to be \$28.7 million for expansion of the NH Port Authority main wharf.

5.1.3 Accident Reduction Benefits

Reduced vehicle traffic will also decrease the likelihood and cost of accidents. The National Highway Traffic Safety Administration (NHTSA) provides guidance on the rates per 100 million VMT for accidents and fatalities. These accident rates were applied to the annual VMT estimates to determine the number of accidents by category: injury, fatality, and property damage. Estimates for the cost of each type of accident from US Department of Transportation were then applied to the number of accidents by type to monetize the benefits associated with fewer accidents.

The reduction of accident costs, like other variable costs, is dependent upon the reduction of vehicle-miles. The reduction in vehicles on the road is combined with a multiplier, which is a weighted average of fatal, injury, and property damage only (PDO) accidents. In the Benefit-Cost Analysis conducted for this application, accident reduction benefits are estimated to be \$3.2 million.

5.1.4 Congestion Reduction Benefits – Emissions Savings

Congestion reduction benefits are due to reduced auto and truck VMT, based on estimates of truck traffic in the Portsmouth-Kittery region before, during, and after the main wharf is expanded. When the wharf improvements are completed, congestion will be reduced in the region. In addition to reducing travel time, the decreased congestion will reduce the emissions produced by auto and truck VMT.

Auto and truck emissions benefits are calculated as the change before and after the implementation of the project. The Environmental Protection Agency's values of grams per mile of emission were used to estimate the change in emissions from reduced VMT and were monetized using estimates of dollars per ton of emission from FHWA's HERS and the Victoria Transport Policy Institute. Emissions measured include VOC (HC), CO, CO₂, NO_x, SO₂, and PM, varying by auto and truck. The investment in the main wharf expansion will result in emissions benefits totaling \$2.0 million.

5.1.5 Congestion Reduction Benefit -- Pavement Maintenance Savings

In addition to the costs that individual drivers incur for auto and truck trips, there are costs in terms of damage to the road surface. A pavement maintenance cost reduction is another benefit of reduced vehicular traffic.

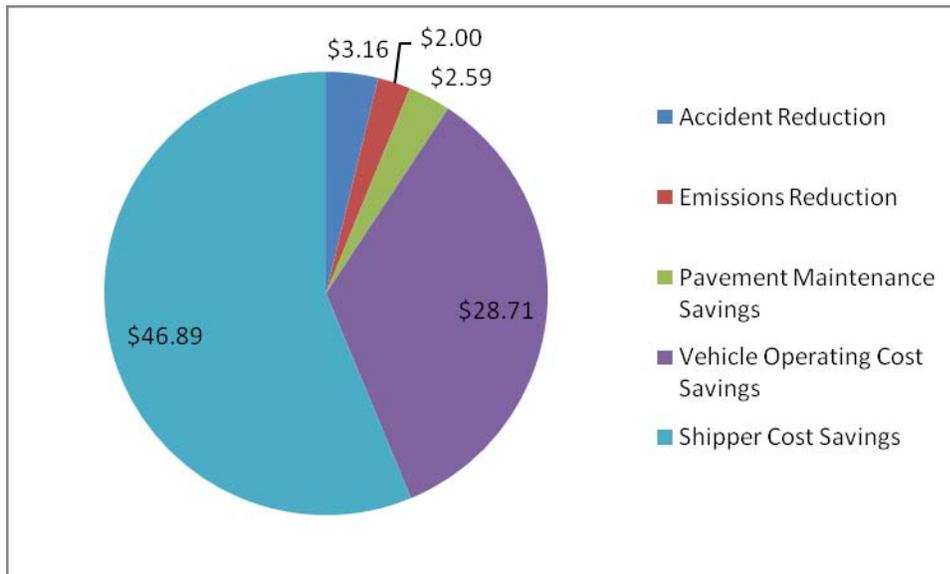
Because VMT decrease when the wharf improvements are done, there are savings in pavement maintenance costs associated with the project completion. Based on the Federal Cost Allocation study of 1997, a pavement maintenance cost of \$0.001 (in 2010 dollars) was used for autos and \$0.13 per mile for trucks. A reduction in traffic leads directly to a reduction in these maintenance costs.

Pavement maintenance cost savings are estimated to be \$2.6 million, as a result of the improved wharf at the NH Port Authority.

5.2 Summary of Benefit-Cost Results

The expansion of the main wharf at the NH Port Authority will result in total benefits of \$41.2 million, when discounted by 7 percent. The present value of total costs associated with this project is \$11.8 million, and the net present value of the project is \$29.4 million. The BCR is 3.5 at 7 percent and 6.2 at a 3 percent discount rate. As shown in Figure 1, expansion of the main wharf will have the most significant impact on shipper costs.

Figure 1: Total Benefits of NH Port Authority Main Wharf Expansion



A summary table of the benefits and costs associated with the main wharf expansion is provided in

Table

2.

Table 2: Summary Table of Benefits and Costs for NH Port Authority Main Wharf

7% Discount Rate		3% Discount Rate	
BENEFITS	Millions of 2010\$	BENEFITS	Millions of 2010\$
Accident Reduction	\$ 3.2	Accident Reduction	\$ 3.2
Emissions Reduction	\$ 2.0	Emissions Reduction	\$ 2.0
Pavement Maintenance Savings	\$ 2.6	Pavement Maintenance Savings	\$ 2.6
Vehicle Operating Cost Savings	\$ 28.7	Vehicle Operating Cost Savings	\$ 28.7
Shipper Cost Savings	\$ 93.8	Shipper Cost Savings	\$ 93.8
TOTAL BENEFITS	\$ 130.2	TOTAL BENEFITS	\$ 130.2
PV of Total Benefits	\$ 41.2	PV of Total Benefits	\$ 75.7
COSTS		COSTS	
Maintenance Costs	\$ (1.5)	Maintenance Costs	\$ (1.5)
Capital Costs	\$ 14.0	Capital Costs	\$ 14.0
TOTAL COSTS	\$ 12.5	TOTAL COSTS	\$ 12.5
PV of Total Costs	\$ 11.8	PV of Total Costs	\$ 12.2
Net Present Value (NPV)	\$ 29.4	Net Present Value (NPV)	\$ 63.5
Benefit-Cost Ratio (BCR)	3.5	Benefit-Cost Ratio (BCR)	6.2

As a sensitivity test, the shipper cost savings associated with moving goods via ship rather than truck was reduced from \$0.06 per ton-mile to \$0.03 per ton-mile. Figure 2 below shows the new breakdown of benefits, In this case, the share of savings due to shipper-cost reduction accounts for slightly less than 56 percent of benefits. The second largest category is vehicle operating cost savings, accounting for nearly 35 percent of benefits.

Figure 2: Total Benefits of NH Port Authority Main Wharf Expansion, Reduced Shipper Cost Savings

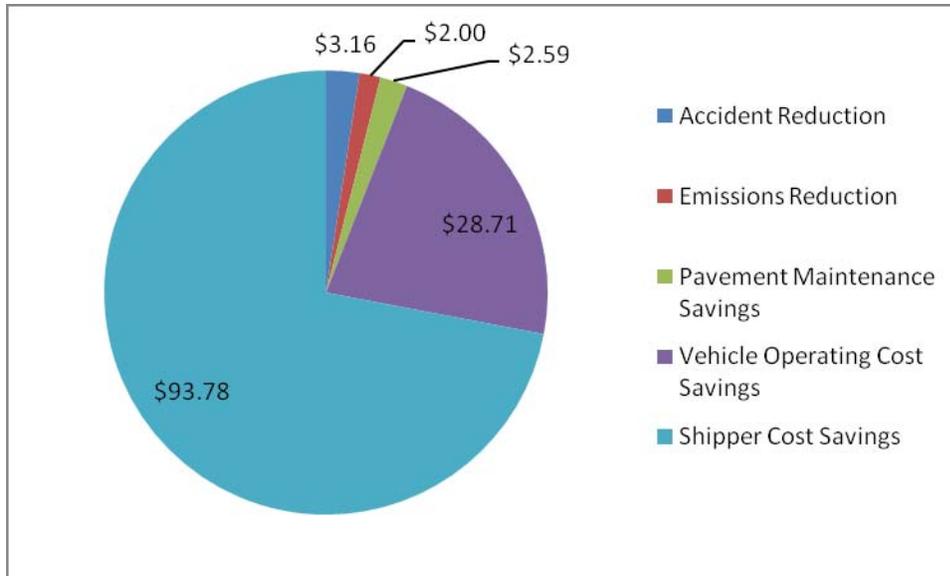


Table 5 indicates the Summary of Benefits and Costs in this sensitivity analysis at both a 3 percent and 7 percent discount rate, resulting in BCRs of 2.3 and 4.0 respectively.

Table 5: Summary Table of Benefits and Costs for NH Port Authority Main Wharf, Sensitivity Analysis

7% Discount Rate			3% Discount Rate		
BENEFITS		Millions of 2010\$	BENEFITS		Millions of 2010\$
Accident Reduction	\$	3.2	Accident Reduction	\$	3.2
Emissions Reduction	\$	2.0	Emissions Reduction	\$	2.0
Pavement Maintenance Savings	\$	2.6	Pavement Maintenance Savings	\$	2.6
Vehicle Operating Cost Savings	\$	28.7	Vehicle Operating Cost Savings	\$	28.7
Shipper Cost Savings	\$	46.9	Shipper Cost Savings	\$	46.9
TOTAL BENEFITS		\$ 83.3	TOTAL BENEFITS		\$ 83.3
PV of Total Benefits		\$ 26.6	PV of Total Benefits		\$ 48.6
COSTS			COSTS		
Maintenance Costs	\$	(1.5)	Maintenance Costs	\$	(1.5)
Capital Costs	\$	14.0	Capital Costs	\$	14.0
TOTAL COSTS		\$ 12.5	TOTAL COSTS		\$ 12.5
PV of Total Costs		\$ 11.8	PV of Total Costs		\$ 12.2
Net Present Value (NPV)	\$	14.8	Net Present Value (NPV)	\$	36.4
Benefit-Cost Ratio (BCR)		2.3	Benefit-Cost Ratio (BCR)		4.0