Memorandum

Date: November 21, 2018

To: ADOT&PF

From: Patrick Burden and Leah Cuyno

Re: Benefit-Cost Analysis of Central Region Bridge Rehabilitation and Replacement

This memorandum is provided in support of the Alaska Department of Transportation & Public Facilities (ADOT&PF) Bridge Section's application for grant funding for the FHWA's Competitive Highway Bridge Program for Fiscal Year 2018.

This memorandum describes the benefit-cost analysis (BCA) conducted for the proposed bridge rehabilitation projects in ADOT&PF's Central Region. A BCA spreadsheet model was developed to determine the net present value (NPV) of the expected benefits of 3 proposed bridge projects in the Central Region. The analysis also considered the cost effectiveness of bundling the projects during construction to generate cost savings.

Net Present Value and Benefit-Cost (B/C) Ratio

The following table summarizes the expected outcomes with respect to benefits and costs of the 3 bridge projects in the ADOT&PF Central Region. All 3 proposed projects have an NPV and a B/C ratio greater than 1. Constructing the 3 bridge rehabilitation projects as a bundle would be more cost effective, with an estimated construction cost savings of more than $3 million.

Table 1. Expected Net Benefits (in millions of 2018 $) and B/C Ratio of the Proposed Central Region Bridge Rehabilitation Projects

Central Region Projects	Present Value of Estimated Benefits	Present Value of Estimated Costs	Net Present Value	B/C Ratio
Snow River West (603)	$5,050.18	$2.95	$5,047.23	1,713
Snow River Center (605)	$5,050.53	$7.44	$5,043.09	679
Victor Creek (607)	$5,054.47	$9.76	$5,044.71	518
Total (*as separate projects*)	$15,155.18	$20.15	$15,135.03	752
Total (as *bundled*)	$15,155.18	$16.76	$15,138.41	904

Source: Northern Economics estimates based on the B/C model developed for this study.

Proposed Bridge Rehabilitation and Replacement Projects in the Central Region

Three bridges in the ADOT&PF Central Region have been identified as priority projects for rehabilitation/replacement: 1) the Snow River West (#603) Bridge; 2) the Snow River Center (#605) Bridge; and 3) Victor Creek (#607) Bridge. Both Bridge 603 and Bridge 605 are proposed to be rehabilitated while Bridge 607 is proposed to be replaced.

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The 3 bridges are located in the Kenai Peninsula Borough beginning about 17 miles north of Seward and 110 miles south of Anchorage. They serve as a critical supply chain for populations in both the incorporated City of Seward, and unincorporated Census Designated Places of Primrose, Bear Creek and Moose Pass, Alaska and are vital economic links for seafood processors, the tourism industry and an important route for residents in Southcentral Alaska who recreate in Seward.

These bridge projects are part of ADOT&PF's Seward Highway MP 17-22.5 Rehabilitation project. The project's goal is to resurface, restore, and rehabilitate the corridor, and by doing so improve the driving surface, and extend the service life of the roadway corridor.

These bridge projects are expected to impact motorists who travel on the Seward Highway. The Seward Highway is the only way to drive to Seward and parts of the Kenai Peninsula, which are popular recreation destinations. The roadway is located in a constricted valley between the Kenai Lake and steep mountain walls. Narrow, curvy highway design means there are limited sight distances and passing areas, so traffic becomes congested in summer. Because of the challenging topography, roadway shoulders and bridges are narrow, and the ditches are inadequate.

In 2017, the annual average daily traffic measured along this highway was 2,030 vehicles. Snow River West and Snow River Center Bridges are respectively, on mileposts 17.1 and 17.7 of the Seward Highway. Victor Creek Bridge is on milepost 19.7 of the Seward Highway.

Assumptions and Values of Key Input Parameters

All benefits and costs in the analysis are presented in 2018 dollars. The analysis uses 2018 as the base year and all future benefits and costs are discounted to 2018 dollars using a 7 percent real discount rate. The Alaska Consumer Price Index (CPI) is used as the cost deflator. [The Alaska CPI and the 2018 Deflator is shown in the *Alaska CPI* tab of the BC spreadsheet model].

General model assumptions used in the BCA are shown in Table 2 below.

Table 2. General Model Assumptions used in the Benefit Cost Analysis

B/C Model Parameters	Value
Year of dollar values in the model	2018
Discount Rate (Real), percent	7
Design Life of New Bridge, # of years	75
Design Life of Rehabilitated Bridge, # of years	50
Occupancy rate for personal vehicles, # of persons	1.7
Occupancy rate for buses, # of persons	10.7
Occupancy rate for commercial vehicles, # of persons	1.0
Replacement Year for Polyester Concrete Overlay	30
Operating Period for this Analysis, # of years	30

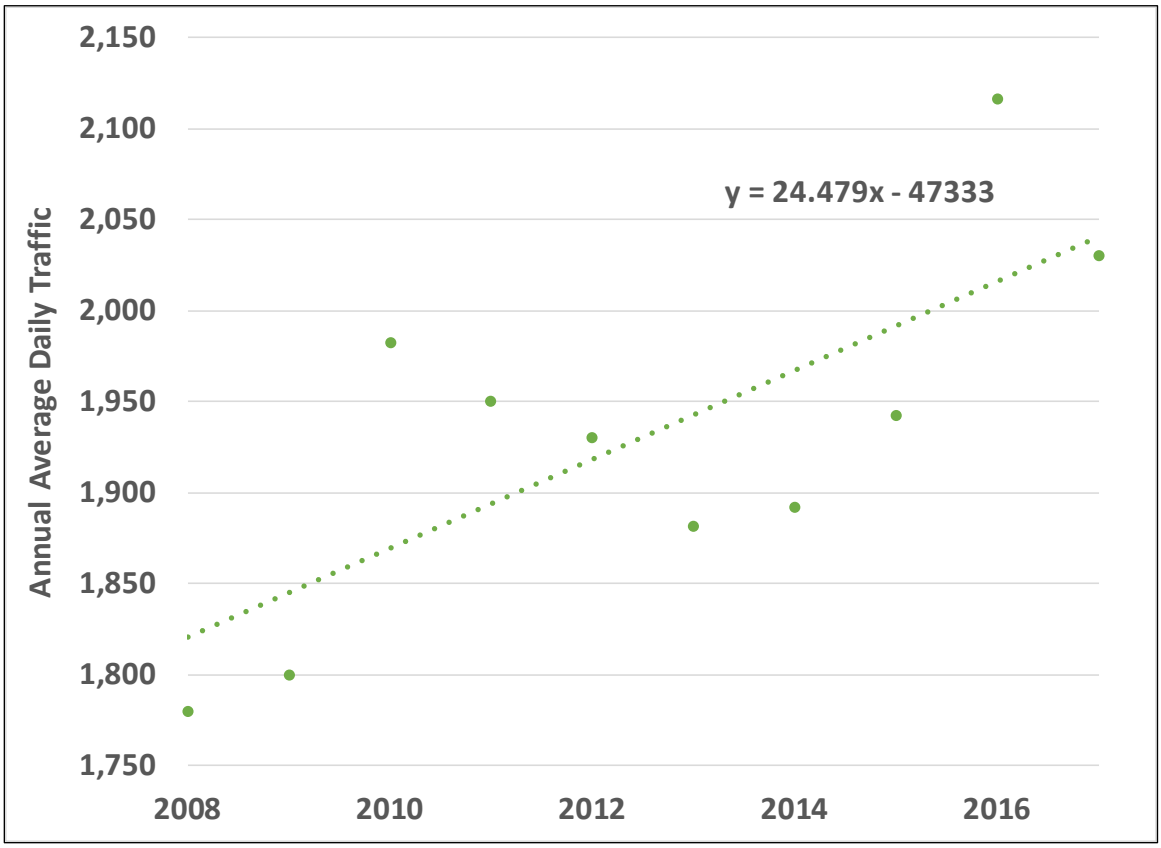
Sources:

1) Discount rate is based on the Office of Management and Budget Circular A-94.

2) Occupancy rates for personal vehicles and for buses are from "Average Vehicle Occupancy Factors for Computing Travel Time April 2018." https://www.fhwa.dot.gov/tpm/guidance/avo_factors.pdf. Accessed on Oct. 20, 2018.
3) Design life of a new/rehabilitated bridge is based on AASHTO bridge codes, provided by ADOT&PF.

The projected traffic volumes, measured as annual average daily traffic (AADT), were based on historical annual traffic volume reports for the Central Region for years 2008 to 2017. Traffic counts were measured on Milepost 16.97 of the Seward Highway (Junction with Primrose Road). The projected volumes were determined using a simple regression using the past 10 years of data. Figure 1 shows the historical data and the resulting regression equation used for the projections. [The projected traffic volumes are shown in the *Traffic* tab of the BC spreadsheet model].

Figure 1. Historical Annual Average Daily Traffic Volume and Trendline Equation



Source: Historical Annual Traffic Volume Reports for Central Region, ADOT&PF.

The total projected AADT counts were allocated to different types of vehicles according to the percentages shown in the table below.

Table 3. Allocation of Traffic Volume per Type of Vehicle

Types of Vehicles	Percent of Annual Average Daily Traffic
Commercial vehicles	
Trucks (Classes 5-13)	13.0
Buses (Class 4)	1.6
Other Business Travel	6.8
Personal	78.6

Sources:

1) Commercial vehicle estimates are based on the latest information available on the Seward Highway which was in 2013.
2) Other Business Travel vehicle estimates are based on *The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations Revision 2 (2016 Update)*, page 10, which states that Intercity business travel by surface mode is 21.4 percent; with the remainder being personal travel. The commercial vehicle percentage (14.6 percent) was subtracted from business travel to arrive at Other Business Travel percentage (6.8 percent).

Baseline (No Build) Description

Snow River West and Snow River Center Bridges

Snow River West (603) and Snow River Center (605) bridge decks have exceeded their expected service life. The current NBI rating for both the 603 and the 605 bridge decks is a 4.

Given this current NBI rating, the following are assumed under the Baseline for this analysis:

- The 603 and 605 bridge decks will drop to an NBI rating 3 at the next inspection cycle (Year 2019).
- The 603 and 605 bridge decks will have 2.6 years at NBI rating 3 before closure at NBI rating 2.
- Load limits are imposed the year following the inspection resulting in a rating 3 (Year 2020).
- In the third year of the NBI rating 3 (year 2022), single lane operations will be put in place. Single lane operations will result in an average delay of 6 minutes per vehicle.
- Bridges will be closed at the end of year 2022.

Victor Creek Bridge

The Victor Creek (607) bridge deck has exceeded its expected service life. Its current NBI rating is a 5.

Given this current NBI rating, the following are assumed under the No Build Baseline:

- The 607 bridge deck rating will drop to 4 during the next inspection cycle (year 2019).
- The AASHTOWare BrM deterioration model suggests that 607 bridge deck would have 5 years of service at rating 4 (end of 2024) and 2.6 years at rating 3 before closure at rating 2 (end of 2027).
- At NBI rating 3, load limits are imposed (2025).

- In the third year of the NBI rating 3 (2027), single lane operations will be put in place.
- Bridge is closed at end of 2027.

Project Benefits

The benefits of the project are evaluated based on the avoided costs associated with imposing the no build or baseline conditions described above. Without the proposed bridge rehabilitation and replacement projects, load limits will be imposed when these bridges reach an NBI rating of 3, and in the 3rd year of NBI rating 3, single lane operations will be in effect, causing traffic disruptions and delays. These effects were quantified, and the values represent the benefits of rehabilitating Bridges 603 and 605 and replacing Bridge 607.

1) **Avoided Costs of Load Limits**

Load limits imposed on the bridges are expected to divert 2 percent of truck traffic to barges or landing craft that will transport the heavy trucks (trailers) between Whittier and Seward. Diverting trailer traffic to barges reduces the operating costs and travel time of affected trucks (trailers) by approximately 1 hour which is the difference between driving to Whittier (60.4 miles) and Seward (125 miles). The reduction in travel time and trailer operating costs are shown as negative values in Table 4 and Table 5. The cost of transporting the trailers are shown as marine transport cost in the tables below. The marine transport cost is based on the quote from Dojer Services for a landing craft that operates from Whittier for a one-way trip to or from Seward (48-hour round trip) of $5,000; the cost per year adds up to $1.8 million.

Load limits will also result in an increase in truck traffic by 2 percent, as some loads will have to be split between trucks to stay within the load limits. This in turn increases operating costs and travel time of affected trucks. The travel time (one-way) to Seward is 1 hour and 20 minutes.

Note that the net effect of the load limit is that the total number of trucks on the Seward Highway remains the same over time.

The marginal costs of operating a truck per hour are based on the published report by the American Transportation Research Institute (ATRI)-- *An Analysis of the Operational Costs of Trucking* released in October 2018. The operating costs includes fuel, repair and maintenance, insurance, permits/licenses, and tires. [Assumptions and calculations for vehicle operating costs are shown in *Vehicle Opg Cost* tab in the BC spreadsheet model].

The values of travel time for truck drivers are based on hourly compensation of heavy and tractor-trailer and light truck or delivery service drivers as published by the Bureau of Labor Statistics (BLS). [Wage and income data are shown in the *Wage & Income* tab in the BC spreadsheet model].

Load limits on Bridges 603 and 605 are in effect from 2021 through 2024 and load limits on Bridge 607 are in effect in years 2025 through 2028.

Table 4. Estimated Net Effects of Load Limits Imposed on the Snow River West and Snow River Center Bridges, in 2018 $

Category	Net Present Value	2019	2020	2021	2022
Reduced Truck Operating Cost	-$374,611	$0	-$151,068	-$152,817	-$154,566
Increased Truck Operating Cost	$498,232	$0	$200,920	$203,247	$205,573
Reduced Driver Travel Time	-$376,024	$0	-$151,638	-$153,394	-$155,149
Increased Driver Travel Time	$500,112	$0	$201,678	$204,013	$206,349
Marine Transport Cost	$4,476,053	$0	$1,825,000	$1,825,000	$1,825,000
Net Effect of Load Limits	$4,723,762	$0	$1,924,893	$1,926,049	$1,927,206

Source: Northern Economics estimates based on the BC model developed for this study.

Table 5. Estimated Net Effects of Load Limits Imposed on the Victor Creek Bridge, in 2018 $

Category	Net Present Value	2019 to 2024	2025	2026	2027
Reduced Truck Operating Cost	-$280,418	$0	-$159,814	-$159,814	-$161,564
Increased Truck Operating Cost	$372,956	$0	$212,553	$212,553	$214,880
Reduced Driver Travel Time	-$283,453	$0	-$160,417	-$162,173	-$163,929
Increased Driver Travel Time	$376,992	$0	$213,355	$215,691	$218,026
Marine Transport Cost	$3,191,364	$0	$1,825,000	$1,825,000	$1,825,000
Net Effect of Load Limits	$3,377,441	$0	$1,930,676	$1,931,256	$1,932,413

Source: Northern Economics estimates based on the BC model developed for this study.

2) Avoided Costs of Single Lane Operations

Single lane operations will take effect for Bridges 603 and 605 in year 2022 and in year 2027 for the Bridge 607.

Single lane operations will cause a 6-minute delay on the 603 and 605 bridges and a 4-minute delay on the Bridge 607. The time delay was quantified for each type of vehicle using the appropriate compensation or wage data for the type of travel [see *Wage & Income* tab in the BC spreadsheet model].

Table 6. Net Present Value of the Estimated Effect of Single Operations on the 603 and 605 Bridges, in 2018 $

Type of Travel	**Net Present Value**
Truck Drivers	$301,620
Bus Drivers	$30,233
Bus (Passengers)	$206,765
Other Business Travel Time	$169,104
Personal Travel Time	$1,791,348
Total	**$2,499,070**

Source: Northern Economics estimates based on the BC model developed for this study.

Table 7. Net Present Value of the Estimated Effect of Single Operations on the 607 Bridge, in 2018 $

Type of Travel	Net Present Value
Truck Drivers	$597,698
Bus Drivers	$59,910
Bus (Passengers)	$409,731
Other Business Travel Time	$335,100
Personal Travel Time	$3,549,777
Total	**$4,952,217**

Source: Northern Economics estimates based on the BC model developed for this study.

3) Avoided Costs of Bridge Closures

As noted in the baseline description above, Bridges 603 and 605 will be closed at the end of year 2022 and the Bridges 607 will be closed at the end of year 2027. These bridge closures will then prevent any road traffic passing through since there are no alternate roads or detours that can be used. The following travel scenarios are therefore assumed following the bridge closures:

- People will travel between Seward and Anchorage via the Alaska Railroad in the summer months. There will be no winter service for passengers due to avalanche threat per the Alaska Railroad.
- Trucks and other vehicles will travel between Seward and Anchorage throughout the year on rail flatcars.[1,2]
- In the winter months, people will use the Alaska Marine Highway System (AMHS) ferries and travel between Homer and Seward on the ferry. About 600 passengers can be accommodated on a Columbia-class ferry.[3]

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[1] Public data on Alaska Railroad Corporation (ARRC) operating costs are not available. However, ARRC did provide a cost estimate for unit trains to move vehicles. This cost was used in place of operating cost data to determine the cost per truck and other vehicles. The ARRC unit train cost does not include the costs of loading and securing vehicles and trucks to the flatcars or the cost for maintaining the rail line during the winter and removing snow. There is currently no winter service on the Seward/Anchorage route. It is thought that with these cost omissions, the ARRC unit train cost may approach the actual operating cost for the entire winter service and the unit train cost is used as a proxy for operating cost.

[2] Summer passenger service between Seward, where a number of cruise ships berth, and Anchorage is primarily to move cruise line-owned railcars with ARRC adding additional railcars to meet the demand of other travelers. It is believed that the revenues generated by pulling the cruise line-owned railcars cover the entire cost of operating the passenger service on that route. ARRC offers two classes of service, the Gold Star service which is similar to that offered by the cruise lines, and the Adventure Travel. The Gold Star service round trip fare is $360 for an adult while the Adventure Travel round trip fare is $175 or $87.50 each way (https://www.alaskarailroad.com/ride-a-train/fares. Accessed on November 1, 2018). The Adventure Fare is thought to approach the actual operating cost of the passenger service and is used as a proxy since operating cost data are not publicly available.

[3] Public data on operating cost per mile or hour for the Alaska Marine Highway System are not available. There is currently no regular AMHS service to Seward. The estimated fare for providing service between Seward and Homer is $112 for passengers. This fare is likely below AMHS' operating cost since the 2017 operating revenues of approximately $46 million were about a third of the operating expenditures of $135 million (Alaska Marine Highway Fund Annual Financial Report 2017. Available at http://www.dot.state.ak.us/amhs/doc/reports/afr_17.pdf. Accessed on October 30, 2018.). Adding service to

- Passengers not traveling in vehicles can use bus service from Homer to and from Anchorage.
- Other Business travelers are assumed to use air taxi service.[4]

The costs that motorists will have to incur after the bridge closures, using the alternate modes of travel—rail, ferry, and air, as noted above, were quantified using current fares and information from the Alaska Railroad Corporation on costs required to accommodate additional ridership (including locomotives, rail cars, and flatcars). The travel time delays and gain (via air travel) were also quantified. Table 8 and Table 9 show the net present values of the estimated costs of the bridge closures.

The assumptions, data, and calculations for the various avoided costs (and benefit) associated with the bridge closures are provided in the *ARRC Cost* tab, *AMHS Cost* tab, and *Air Travel tab* in the BC spreadsheet model.

Table 8. Net Present Value of Estimated Effect of the 603 and 605 Bridge Closures, *in millions* of 2018 $

Cost Category	Net Present Value
ARRC Cost to Transport Trucks/Trailers to/from Seward	$361.86
ARRC Cost to Transport Automobiles to/from Seward	$1,149.73
ARRC Cost to Transport Passengers from mid-May to Mid-September	$434.54
ARRC Travel Time Cost for Passengers	$224.41
AMHS Cost to Transport Passengers from Mid-September to Mid-May	$633.51
Bus Service to Anchorage from mid-September to mid-May	$253.45
AMHS and Bus Travel Time Cost for Passengers	$1,954.15
Air Travel Cost Seward/Anchorage	$47.23
Air Travel Time Cost (Benefit) for Passengers	-$0.04
Total NPV of Bridge Closure	**$5,059**

Source: Northern Economics estimates based on the BC model developed for this study.

Seward does not consider cost or impacts to other communities that may experience reduced service. It is also assumed that the Seward dock is in acceptable condition to accept AMHS ferries; dock repair/rehabilitation costs are not included.

[4] There is no scheduled air taxi service between Anchorage and Seward. Estimates were prepared based on passenger fares for communities between Anchorage and several communities in the Copper River valley. A mileage-based average was prepared and used for the air miles between Anchorage and Seward. The cited air service provides passenger service on days when the air service flies mail between Anchorage and the communities, so the fares are supported by the mail contract. The fares are much less per mile than competing air taxi service and are used as a proxy for aircraft operating costs.

Table 9. Net Present Value of Estimated Effect of the 607 Bridge Closure, *in millions* of 2018 $

Cost Category	Net Present Value
ARRC Cost to Transport Trucks/Trailers to/from Seward	$238.08
ARRC Cost to Transport Automobiles to/from Seward	$781.70
ARRC Cost to Transport Passengers from mid-May to Mid-September	$296.86
ARRC Travel Time Cost for Passengers	$153.31
AMHS Cost to Transport Passengers from Mid-September to Mid-May	$432.79
Bus Service to Anchorage from mid-September to mid-May	$173.15
AMHS and Bus Travel Time Cost for Passengers	$1,335.00
Air Travel Cost Seward/Anchorage	$32.26
Air Travel Time Cost (Benefit) for Passengers	-$0.03
Total NPV of Bridge Closure	**$3,443**

Source: Northern Economics estimates based on the BC model developed for this study.

4) Avoided Baseline Maintenance and Operating Costs

Table 10 shows the net present values and the future avoided maintenance and operating costs for the three bridges. The baseline costs are quantified only until the last year the bridges will be open to motorists.

The data, assumptions, and calculations are shown in the *M&O* tab in the BC spreadsheet model.

Table 10. Net Present Value of the Estimated Baseline Maintenance and Operating Costs for Bridges 603, 605, and 607, in 2018 $

Bridge/Cost Category	NPV	2019	2020	2021	2022	2023	2024	2025	2026	2027
Snow River West (603)										
Pavement	$68	$0	$78	$0	$0					
Bridge	$11,806	$0	$4,814	$4,814	$4,814					
Total	$11,874	$0	$4,892	$4,814	$4,814					
Snow River Center (605)										
Pavement	$223	$0	$256	$0	$0					
Bridge	$30,662	$0	$12,502	$12,502	$12,502					
Total	$30,885	$0	$12,757	$12,502	$12,502					
Victor Creek (607)										
Pavement	$426	$0	$0	$0	$282	$0	$87	$426	$0	$0
Bridge	$2,085	$0	$374	$374	$374	$374	$374	$2,085	$0	$374
Total	$2,510	$0	$374	$374	$655	$374	$460	$2,510	$0	$374

Source: Northern Economics estimates based on the BC spreadsheet model developed for this study; ADOT&PF provided historical maintenance costs for the bridges.

5) Residual Value of Bridge

The residual values for the bridges were quantified and included in the BCA. For this calculation, it is assumed that the value (=capital cost) of the bridge depreciates in a linear manner over its service life. The design life for a rehabilitated bridge is 50 years and the design life of a new bridge is 75 years, while the operating period assumed for this analysis is 30 years.

The discounted residual values for the three bridges are shown in the table below.

Table 11. Estimated Discounted Residual Values of Bridges 603, 605, and 607, in 2018 $

Bridge	Present Value
Snow River West (603)	$225,072
Snow River Center (605)	$561,463
Victor Creek (607)	$766,387

Source: Northern Economics estimates based on the BC spreadsheet model developed for this study; ADOT&PF provided capital costs of the bridge rehabilitation and replacement projects.

6) Disbenefits of Pollutant Emissions

This analysis evaluated the net costs of emissions under the baseline conditions (without the bridge projects) and with the projects. This includes the reduction in vehicle emissions and the increase in emissions from the alternate modes of travel, in the absence of the bridges—ferry, bus, and rail. The costs of emissions are based on the recommended monetized values provided in the U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs. The Guidance only provided monetized costs for volatile organic compounds (VOCs), nitrogen oxides (NO_x), particulate matter (PM), and sulfur dioxide (SO_2). According to the document, DOT does not currently have a recommended value for the damage costs from CO_2 emissions; hence CO_2 emissions cost were not monetized). SO_2 emissions were also not monetized since there no data were found on SO_2 emissions from locomotives, passenger vehicles, and trucks. Aircraft emissions factors are also not available; small aircraft engines such as those that would be used to travel between Anchorage and Seward are not covered by current EPA regulations thus there is no information on their emissions.

The data, assumptions, and calculations for the costs of emissions are in provided in the *Emissions* tab of the BC spreadsheet model.

The analysis shows that total emissions would be lower under the baseline case due to the mass transit nature of the alternative modes of travel, hence, the emissions costs are shown as negative values in the estimated project benefits.

Table 12. Estimated Effects of Net Emissions, in 2018 $

Bridge	Net Present Value
603 and 605 Bridges	-16,111,961
607 Bridge	-$11,006,246

Source: Northern Economics estimates based on the BC spreadsheet model developed for this study

7) Safety Benefits

The potential for safety benefits was reviewed in this BCA, particularly with respect to the proposed widening of the lane-width for Bridge 607. However, there is not enough historical data on bridge crashes in Alaska to allow a quantitative analysis of safety benefits. The data available show only three crashes over the 4-year period that ADOT&PF provided data for the nine bridges being evaluated under the grant program and none of the incidents occurred in narrow bridges. Safety benefits could be realized with the widening of the lanes but there is no basis at this point to quantify the potential benefit of crash avoidance.

Project Costs

Total project costs in this BCA include the estimated costs of rehabilitation of Bridges 603 and 605 and replacement of Bridge 607, as well as the future maintenance and operations of the bridges

1) Capital Costs

The bridge rehabilitation and replacement costs (undiscounted) broken down by cost category for each bridge project are shown in Table 13. The table also compares the total costs for all the bridges if they were implemented separately versus the total costs for all the bridges if they were implemented together (or bundled).

Table 13. Estimated Project Costs of Bridges 603, 605, and 607, Undiscounted, in 2018 $

Cost Category	Snow River West	Snow River Center	Victor Creek	All Bridges (Separate)	All Bridges (Bundled)
Administrative and legal expenses	$50,000	$100,000	$200,000	$350,000	$100,000
Land, structures, rights-of-way, appraisals, etc.	$25,000	$25,000	$500,000	$550,000	$500,000
Relocation expenses and payments	$0	$0	$100,000	$100,000	$100,000
Architectural and engineering fees	$400,000	$600,000	$900,000	$1,900,000	$1,150,000
Other architectural/engineering fees	$150,000	$350,000	$600,000	$1,100,000	$600,000
Project inspection fees	$365,065	$1,051,161	$1,230,641	$2,646,867	$1,800,850
Site work	$158,655	$89,640	$178,150	$426,445	$396,765
Demolition and removal	$3,440	$3,505	$200,270	$207,215	$204,100
Construction	$1,334,982	$4,627,095	$5,143,785	$11,105,862	$10,695,987
Equipment	$158,000	$308,000	$378,000	$844,000	$413,000
Miscellaneous	$170,250	$227,563	$253,000	$650,813	$295,813
Sub-total	$2,815,393	$7,381,963	$9,683,845	$19,881,201	$16,256,514
Contingencies	$240,000	$240,000	$720,000	$1,200,000	$1,200,000
Total Costs	$3,055,393	$7,621,963	$10,403,845	$21,081,201	$17,456,514

Source: Alaska Department of Transportation and Public Facilities (ADOT&PF).

The BC spreadsheet model provides several cost information with varying levels of detail. These are shown in the following tabs—i) Construction Cost Estimate, ii) Budget 603, iii) Budget 605, iv) Budget 607, and v) Budget Combined.

2) Maintenance and Operations Costs

New bridges in Alaska are designed to be resilient structures with limited maintenance due to logistical challenges associated with short construction seasons and remote locations. Besides wearing surface replacement and minor upkeep, maintenance and operations work is assumed to be minimal.

Table 14 shows the discounted maintenance costs of the rehabilitated bridges and the new Victor Creek Bridge.

The cost includes replacement cost of polyester concrete overlay after 30 years for the Snow River Bridges. The Victor Creek Bridge is anticipated to have asphalt wearing surface to maintain including crack sealing, patching, overlays, and rehabilitations, plus minor annual activities such as sweeping.

Data, assumptions, and calculations are provided in the *M&O* tab in the BC spreadsheet model.

Table 14. Present Value of Maintenance and Operating Costs of the Rehabilitated Bridges 603 and 605 and New Bride 607, in 2018 $

Bridge/Cost Category	Present Value
Snow River West	
Pavement	$85,503
Bridge	$6,563
Total	**$92,066**
Snow River Center	
Pavement	$294,046
Bridge	$22,655
Total	**$316,701**
Victor Creek	
Pavement	$30,027
Bridge	$9,440
Total	**$39,467**

Source: Based on Alaska Department of Transportation and Public Facilities (ADOT&PF) Transportation Asset Management Plan and historical data on maintenance and operating costs, and Northern Economics assumptions about minor annual activities.

Summary Results: Benefit-Cost Analysis

The proposed bridge rehabilitation and replacement projects in the Central Region all have positive net benefits and B/C ratios greater than 1.

Table 15. Net Present Values of Proposed Central Region Bridge Projects' Benefits and Costs

Category	Net Present Value				
Project Benefits	Snow River West	Snow River Center	Victor Creek	All Bridges (Separate)	All Bridges (Bundled)
Avoidance of Load Limit Costs	$4.72	$4.72	$3.38	$12.82	$12.82
Avoidance of Single Lane Operation	$2.50	$2.50	$2.50	$7.50	$7.50
Avoidance of Bridge Closure	$5,494.05	$5,494.05	$5,494.05	$16,482.15	$16,482.15
Avoidance of M&O Costs until Bridge Closure	$0.01	$0.03	$0.00	$0.05	$0.05
Residual Value of Bridge after 2049	$0.23	$0.56	$0.77	$1.55	$1.55
Net Disbenefit of Emissions	-$16.11	-$16.11	-$11.01	-$43.23	-$43.23
Total Project Benefits	$5,050.18	$5,050.53	$5,054.47	$15,155.18	$15,155.18
Project Costs					
Capital Expenditures	$2.86	$7.12	$9.72	$19.70	$16.31
M&O Expenditures	$0.09	$0.32	$0.04	$0.45	$0.45
Total Project Costs	$2.95	$7.44	$9.76	$20.15	$16.76
Net Benefits	$5,047	$5,043	$5,045	$15,135	$15,138
B/C Ratio	1,713	679	518	752	904

Source: Northern Economics estimates based on the BC spreadsheet model developed for this study.