APPENDIX B

Benefit Cost Analysis

Benefit-Cost Analysis Supplementary Documentation

U.S. DOT Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant Program

Spotted Road Interchange Safety and Mobility Improvement Project

Spokane International Airport

April 13, 2022

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Executive Summary

Served by seven airlines and two air cargo carriers, Spokane International Airport is the second largest airport in the State of Washington and is recognized by the Federal Aviation Administration (FAA) as a small hub. The Airport is an employment hub for over 3,000 people and has an important and expanding airfield and aerospace industry cluster. The Airport has a $725 million annual economic impact on the Spokane Region[1].

Traffic in the Spokane International Airport area is currently transiting on two very busy inbound and outbound airport access roads known as Airport Drive Inbound and Airport Drive Outbound. Vehicles use Airport Drive Inbound and Outbound and cross Spotted Road to access the Airport, nearby U.S. Highway 2, and Interstate 90. Spotted Road is a key component of the Critical Urban Freight Corridor, providing access to the Airport Industrial Park. The Spotted Road/Airport Drive intersections' geometry have deficiencies creating potential safety issues, and improvements are necessary to address them. The combination of lower speed traffic trying to cross Airport Drive Inbound and Airport Drive Outbound with higher speed traffic at two intersecting points has led to multiple frequent accidents, many of which were serious injury accidents and fatalities. These problems persist despite the installation of additional traffic safety measures. In addition, vehicles on Spotted Road approaching the intersections experience significant delays while waiting for the gap on Airport Drive to cross, which further results in vehicle fuel costs and increased emissions due to idling.

The Spotted Road Interchange Safety and Mobility Improvement Project (the Project) will construct an overpass to grade separate Spotted Road from Airport Drive Inbound and Airport Drive Outbound, providing continuous / free flow traffic for vehicles on Spotted Road travelling through the intersections. As a result, accidents at the two intersections can be fully mitigated in addition to realizing reductions in-vehicle travel time, fuel costs, and emissions due to avoided vehicle idling.

Figure 1 below highlights the proposed concept of the Spotted Road Overpass project.

[1] Spokane International Airport. *About Spokane International Airport.* Accessed March 25, 2022 https://business.spokaneairports.net/about-spokane-international

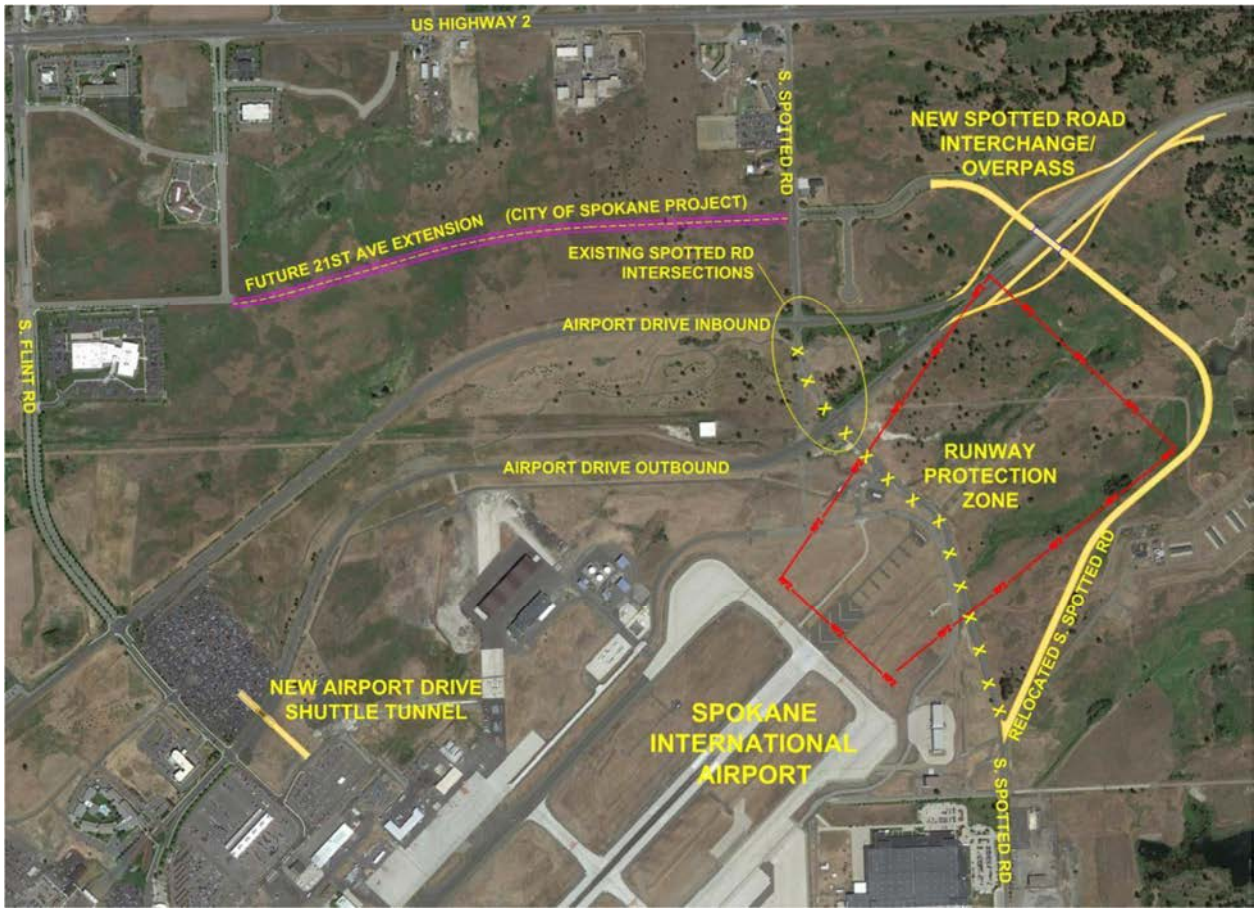

Figure 1: Spotted Road Overpass Project Concept

A Benefit-Cost Analysis (BCA) of the Project was conducted in conformance with federal guidance regarding evaluation methods and monetization values recommended by the U.S. Department of Transportation (U.S. DOT) in its March 2022 *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*. **Table ES - 1** provides a summary of the changes and associated benefits that are expected from the Project.

Table ES - 1: Summary of Infrastructure Improvements and Associated Benefits

Current Status or Baseline & Problems to be Addressed	Changes to Baseline / Alternatives	Type of Impacts	Economic Benefit	Summary of Results	Page Reference
Traffic in the Spokane International Airport heavily relies on Airport Drive Inbound and Airport Drive Outbound roadways and Spotted Road to access the airport, US. Highway 2, and Interstate 90. Spotted Road is a part of the Critical Urban Freight Corridor providing access to the Airport Industrial Park. However, the Spotted Road/Airport Drive intersections and geometry have deficiencies causing potential safety concerns and have led to multiple accidents, many of which were serious injury accidents and even some fatalities. In addition, vehicles on Spotted Road approaching the intersections experience significant delay while waiting for the gap on Airport Drive to cross, which further results in vehicle fuel costs and increased emissions.	The Project will construct an overpass to grade-separate Spotted Road from the Airport Drive Inbound and Airport Drive Outbound, providing straight through flow for vehicles on Spotted Road travelling through the intersections. As a result, accidents at the two intersecting points can be fully mitigated in addition to realizing reductions in vehicle travel time, fuel costs, and emissions due to avoided vehicle idling.	Travel time savings from eliminated congestion at the Spotted Road/Airport Drive intersection. This is offset from the additional travel time due to vehicles driving a longer distance on the new overpass.	Travel Time Savings	**$1.9 M**	Page 27
		Avoided vehicle collisions from the grade-separation of Spotted Road from Airport Drive.	Improved Safety and Reduced Accident Costs	**$32.6 M**	Page 19
		Reduced maintenance costs by replacing part of the existing Spotted Road with an overpass.	Reduced Maintenance Costs	**$2.5 M**	Page 20
		Vehicle fuel costs savings due to avoided idling at intersections but offset with the vehicle fuel costs from driving a longer distance on the new overpass.	Vehicle Operating Cost Savings	**-$0.4 M**	Page 22
		Reduced emissions by avoided vehicle idling at the Spotted Road/Airport Drive intersections. This is offset from the additional emissions generated by vehicles driving a longer distance on the new overpass.	Reduced Emission Costs	**-$0.1 M**	Page 25
		Residual value of the Spotted Overpass at the end of the study period.	Residual Value of Asset	**$0.0 M**	Page 22
		Improved travel time reliability as a result of grade separating Spotted Road from Airport Drive.	Improved Travel Time Reliability	***Not Monetized***	Page 27

The period of analysis used in the estimation of benefits and costs corresponds to 37 years, including 7 years of design, engineering, and construction, as well as 30 full years of operation. The total costs consist of $27.6 million in capital expenditures, in 2020 dollars. The capital expenditure for this Project, by year, is presented in **Table ES - 2**, while **Table ES - 3** presents the capital expenditures by funding sources. Meanwhile, **Table ES - 4** presents the total benefits from the Project, by merit criteria.

Table ES - 2: Summary of Capital Expenditures, 2020 Dollars

Calendar Year	Capital Expenditures
2019	$1.0 M
2020	$1.4 M
2021	$0.9 M
2022	$1.4 M
2023	$0.5 M
2024	$15.7 M
2025	$6.7 M
Total	**$27.6 M**

Table ES - 3: Summary of Project Costs in 2020 Dollars, by Funding Sources (Undiscounted)

Project Cost Component	Agencies				Total
	WSDOT	Airport Improvement Program	Local Match	USDOT RAISE	
Planning Studies/Mitigation	$0.1 M	$ -	$2.8 M	$ -	$2.9 M
Enviro/Prelim Design	$ -	$ -	$0.4 M	$ -	$0.4 M
Design	$ -	$ -	$1.9 M	$ -	$1.9 M
Construction	$ -	$4.8 M	$3.8 M	$13.7 M	$22.4 M
Total	**$0.1 M**	**$4.8 M**	**$8.9 M**	**$13.7 M**	**$27.6 M**

Table ES - 4: Summary of Capital Expenditures, 2020 Dollars

Merit Criteria	Benefit Category	Over the Project Lifecycle	
		In Constant Dollars	Discounted
Safety	Improved Safety and Reduced Accident Costs	$124.7 M	$32.6 M
State of Good Repair	Reduced Maintenance Costs	$8.3 M	$2.5 M
	Residual Value of Asset	$ -	$ -
Economic Competitiveness	Vehicle Operating Cost Savings	-$1.1 M	-$0.4 M
Environmental Sustainability	Reduced Emission Costs	-$0.2 M	-$0.1 M
Quality of Life	Travel Time Savings	$12.8 M	$1.9 M
	Improved Travel Time Reliability	*Not Monetized*	*Not Monetized*
Total		**$144.6 M**	**$36.5 M**

Based on the BCA conducted (see **Table ES - 4**), the Project is expected to generate $36.5 million in discounted benefits, while only costing $21.7 million (discounted) based on a 3 percent real discount rate for carbon dioxide (CO_2)-related impacts and a 7 percent real discount rate for all other impacts per the U.S. DOT BCA guidance. This translates to a net present value (NPV) of $14.8 million and a benefit-cost ratio of 1.7. Additional detailed breakdowns of the analysis, including the various assumptions and methodologies, are presented in the rest of this document.

Table ES - 5: Overall Results of the Benefit-Cost Analysis, 2020 Dollars

Project Evaluation Metric	Discounted
Total Discounted Benefits	$36.5 M
Total Discounted Costs	$21.7 M
Net Present Value	$14.8 M
Benefit / Cost Ratio	1.7
Discounted Payback Period (years)	13.8 years
Internal Rate of Return (%)	11.4%

In addition to the monetized benefits summarized above, the Project would generate benefits that are difficult to quantify. These benefits are described below.

Improved Travel Time Reliability

Vehicles approaching the Spotted Road/Airport Drive can experience significant delays while waiting for the gap to cross the two intersections, which causes variability in travel time. Grade separating Spotted Road from Airport Drive with an overpass will reduce vehicle wait times at intersections and improve travel time reliability. However, the reliability benefits are difficult to monetize in absence of detailed modelling for different roadway users.

Finally, **Table ES - 6** to **Table ES - 9** provides various summaries of the relevant data and calculations used to derive the benefits and costs of the Projects. Additional details can be found in the BCA Model submitted with this application.

Table ES - 6: Summary of Total Project Benefits and Costs, 2020 Dollars

Calendar Year	Project Year	Total Benefits (Undiscounted)	Total Capital Costs (Undiscounted)	Undiscounted Net Benefits	Discounted Total Benefits	Discounted Total Costs	Discounted Net Benefits
2019	1	$ -	$1,036,097	-$1,036,097	$ -	$1,108,623	-$1,108,623
2020	2	$ -	$1,381,462	-$1,381,462	$ -	$1,381,462	-$1,381,462
2021	3	$ -	$863,414	-$863,414	$ -	$806,929	-$806,929
2022	4	$ -	$1,440,150	-$1,440,150	$ -	$1,257,883	-$1,257,883
2023	5	$ -	$480,050	-$480,050	$ -	$391,864	-$391,864
2024	6	$ -	$15,659,231	-$15,659,231	$ -	$11,946,353	-$11,946,353
2025	7	$ -	$6,711,099	-$6,711,099	$ -	$4,784,921	-$4,784,921
2026	8	$3,041,879	$ -	$3,041,879	$2,026,141	$ -	$2,026,141
2027	9	$3,117,782	$ -	$3,117,782	$1,940,706	$ -	$1,940,706
2028	10	$3,196,721	$ -	$3,196,721	$1,859,521	$ -	$1,859,521
2029	11	$3,273,698	$ -	$3,273,698	$1,779,591	$ -	$1,779,591
2030	12	$3,359,940	$ -	$3,359,940	$1,706,864	$ -	$1,706,864
2031	13	$3,447,152	$ -	$3,447,152	$1,636,471	$ -	$1,636,471
2032	14	$3,481,085	$ -	$3,481,085	$1,544,316	$ -	$1,544,316
2033	15	$3,639,798	$ -	$3,639,798	$1,508,990	$ -	$1,508,990
2034	16	$3,749,431	$ -	$3,749,431	$1,452,634	$ -	$1,452,634
2035	17	$3,862,985	$ -	$3,862,985	$1,398,608	$ -	$1,398,608
2036	18	$3,981,111	$ -	$3,981,111	$1,346,955	$ -	$1,346,955
2037	19	$4,113,342	$ -	$4,113,342	$1,300,558	$ -	$1,300,558
2038	20	$4,252,826	$ -	$4,252,826	$1,256,611	$ -	$1,256,611
2039	21	$4,378,786	$ -	$4,378,786	$1,209,087	$ -	$1,209,087
2040	22	$4,449,889	$ -	$4,449,889	$1,148,222	$ -	$1,148,222
2041	23	$4,644,458	$ -	$4,644,458	$1,119,945	$ -	$1,119,945
2042	24	$4,790,468	$ -	$4,790,468	$1,079,486	$ -	$1,079,486
2043	25	$4,936,184	$ -	$4,936,184	$1,039,435	$ -	$1,039,435
2044	26	$5,089,462	$ -	$5,089,462	$1,001,506	$ -	$1,001,506
2045	27	$5,259,930	$ -	$5,259,930	$967,266	$ -	$967,266
2046	28	$5,437,324	$ -	$5,437,324	$934,410	$ -	$934,410
2047	29	$5,630,532	$ -	$5,630,532	$904,260	$ -	$904,260
2048	30	$5,832,840	$ -	$5,832,840	$875,427	$ -	$875,427
2049	31	$6,045,402	$ -	$6,045,402	$847,942	$ -	$847,942
2050	32	$6,276,768	$ -	$6,276,768	$822,763	$ -	$822,763
2051	33	$6,460,681	$ -	$6,460,681	$791,470	$ -	$791,470
2052	34	$6,781,263	$ -	$6,781,263	$776,444	$ -	$776,444
2053	35	$7,057,501	$ -	$7,057,501	$755,257	$ -	$755,257
2054	36	$7,358,965	$ -	$7,358,965	$736,065	$ -	$736,065
2055	37	$7,680,154	$ -	$7,680,154	$718,020	$ -	$718,020
Total		**$144,628,356**	**$27,571,503**	**$117,056,853**	**$36,484,972**	**$21,678,035**	**$14,806,937**

Table ES - 7: Summary of Total Project Benefits, by Benefit, 2020 Dollars (Undiscounted)

Calendar Year	Benefit Year	Travel Time Savings	Improved Safety and Reduced Accident Costs	Reduced Maintenance Costs	Vehicle Operating Cost Savings	Reduced Emission costs	Residual Value of Asset
2026	1	-$41,806	$2,841,106	$287,574	-$38,655	-$6,340	$ -
2027	2	-$36,092	$2,912,134	$287,574	-$39,624	-$6,211	$ -
2028	3	-$28,920	$2,984,937	$287,574	-$40,691	-$6,179	$ -
2029	4	-$20,298	$3,059,561	$282,126	-$41,610	-$6,081	$ -
2030	5	-$9,755	$3,136,050	$282,126	-$42,484	-$5,996	$ -
2031	6	$1,011	$3,214,451	$282,126	-$44,423	-$6,012	$ -
2032	7	$12,968	$3,294,812	$224,616	-$45,271	-$6,040	$ -
2033	8	$32,320	$3,377,183	$282,126	-$45,777	-$6,053	$ -
2034	9	$55,194	$3,461,612	$284,668	-$45,977	-$6,066	$ -
2035	10	$82,242	$3,548,153	$284,668	-$46,003	-$6,074	$ -
2036	11	$114,249	$3,636,856	$282,126	-$45,964	-$6,156	$ -
2037	12	$152,651	$3,727,778	$284,668	-$45,613	-$6,142	$ -
2038	13	$198,142	$3,820,972	$284,668	-$44,847	-$6,110	$ -
2039	14	$228,511	$3,916,497	$284,668	-$44,745	-$6,146	$ -
2040	15	$261,827	$4,014,409	$224,616	-$44,786	-$6,178	$ -
2041	16	$298,358	$4,114,769	$282,126	-$44,514	-$6,282	$ -
2042	17	$338,395	$4,217,638	$284,668	-$43,857	-$6,377	$ -
2043	18	$381,095	$4,323,079	$282,126	-$43,568	-$6,548	$ -
2044	19	$423,638	$4,431,156	$284,668	-$43,356	-$6,645	$ -
2045	20	$481,907	$4,541,935	$284,668	-$41,897	-$6,683	$ -
2046	21	$546,662	$4,655,484	$282,126	-$40,247	-$6,700	$ -
2047	22	$618,646	$4,771,871	$284,668	-$37,962	-$6,691	$ -
2048	23	$698,693	$4,891,168	$284,668	-$35,034	-$6,653	$ -
2049	24	$788,067	$5,013,447	$282,126	-$31,657	-$6,580	$ -
2050	25	$887,526	$5,138,783	$284,668	-$27,665	-$6,544	$ -
2051	26	$998,257	$5,267,253	$224,616	-$23,121	-$6,325	$ -
2052	27	$1,121,600	$5,398,934	$284,668	-$17,881	-$6,058	$ -
2053	28	$1,259,062	$5,533,907	$282,126	-$11,857	-$5,737	$ -
2054	29	$1,412,347	$5,672,255	$284,668	-$4,950	-$5,355	$ -
2055	30	$1,583,377	$5,814,061	$284,668	$2,952	-$4,904	$ -
Total		**$12,839,877**	**$124,732,253**	**$8,343,178**	**-$1,101,085**	**-$185,867**	**$ -**

Table ES - 8: Summary of Pertinent Quantifiable Data (1/2)

Calendar Year	Benefit Year	Avoided Motor Oil Consumption (quarts)	Avoided Gasoline Consumption (gallons)	Avoided Diesel Consumption (gallons)	Personal Hours Saved (hours)	Fatalities Avoided (fatalities)	Injuries Avoided (injuries)
2026	1	-302	-5,643	-9,836	-2,128	0.12	5.56
2027	2	-302	-5,705	-10,041	-1,837	0.12	5.70
2028	3	-301	-5,753	-10,244	-1,472	0.12	5.84
2029	4	-297	-5,788	-10,444	-1,033	0.13	5.99
2030	5	-292	-5,804	-10,640	-496	0.13	6.14
2031	6	-287	-5,821	-10,840	51	0.13	6.29
2032	7	-280	-5,827	-11,040	660	0.13	6.45
2033	8	-266	-5,751	-11,202	1,645	0.14	6.61
2034	9	-247	-5,637	-11,351	2,809	0.14	6.77
2035	10	-224	-5,479	-11,481	4,186	0.15	6.94
2036	11	-195	-5,266	-11,590	5,815	0.15	7.12
2037	12	-160	-4,983	-11,668	7,769	0.15	7.30
2038	13	-116	-4,622	-11,711	10,084	0.16	7.48
2039	14	-90	-4,441	-11,852	11,630	0.16	7.67
2040	15	-61	-4,230	-11,984	13,325	0.16	7.86
2041	16	-28	-3,986	-12,104	15,184	0.17	8.05
2042	17	9	-3,706	-12,213	17,222	0.17	8.25
2043	18	48	-3,399	-12,314	19,395	0.18	8.46
2044	19	87	-3,099	-12,425	21,560	0.18	8.67
2045	20	144	-2,620	-12,451	24,526	0.19	8.89
2046	21	208	-2,071	-12,448	27,821	0.19	9.11
2047	22	279	-1,443	-12,411	31,485	0.20	9.34
2048	23	360	-726	-12,336	35,559	0.20	9.57
2049	24	452	95	-12,216	40,107	0.21	9.81
2050	25	554	1,027	-12,046	45,169	0.21	10.06
2051	26	669	2,086	-11,819	50,805	0.22	10.31
2052	27	798	3,285	-11,527	57,082	0.22	10.57
2053	28	943	4,644	-11,163	64,078	0.23	10.83
2054	29	1,106	6,180	-10,716	71,879	0.23	11.10
2055	30	1,289	7,918	-10,174	80,583	0.24	11.38
Total		**3,498**	**-76,563**	**-344,285**	**653,464**	**5.10**	**244**

Table ES - 9: Summary of Pertinent Quantifiable Data (2/2)

Calendar Year	Benefit Year	CO_2 Emissions Avoided (tons)	NO_X Emissions Avoided (tons)	PM Emissions Avoided (tons)	SO_2 Emissions Avoided (tons)	VOC Emissions Avoided (tons)
2026	1	-89.39	-0.05	-0.0014	-0.0005	-0.0070
2026	2	-89.00	-0.04	-0.0012	-0.0005	-0.0061
2027	3	-88.55	-0.03	-0.0010	-0.0005	-0.0054
2028	4	-88.03	-0.03	-0.0009	-0.0005	-0.0047
2029	5	-87.43	-0.03	-0.0008	-0.0005	-0.0041
2030	6	-88.13	-0.02	-0.0007	-0.0005	-0.0037
2031	7	-88.79	-0.02	-0.0007	-0.0005	-0.0034
2032	8	-89.10	-0.02	-0.0006	-0.0005	-0.0031
2033	9	-89.25	-0.02	-0.0006	-0.0005	-0.0028
2034	10	-89.24	-0.01	-0.0005	-0.0005	-0.0026
2035	11	-89.01	-0.01	-0.0005	-0.0005	-0.0023
2036	12	-88.51	-0.01	-0.0004	-0.0005	-0.0021
2037	13	-87.71	-0.01	-0.0004	-0.0005	-0.0019
2038	14	-87.73	-0.01	-0.0004	-0.0005	-0.0018
2039	15	-87.66	-0.00	-0.0004	-0.0005	-0.0016
2040	16	-88.18	-0.00	-0.0004	-0.0005	-0.0016
2041	17	-88.59	-0.00	-0.0004	-0.0005	-0.0016
2042	18	-88.93	-0.00	-0.0004	-0.0005	-0.0015
2043	19	-89.35	-0.00	-0.0004	-0.0005	-0.0015
2044	20	-89.05	0.00	-0.0004	-0.0005	-0.0014
2045	21	-88.51	0.00	-0.0004	-0.0005	-0.0014
2046	22	-87.68	0.00	-0.0004	-0.0005	-0.0013
2047	23	-86.53	0.01	-0.0004	-0.0005	-0.0012
2048	24	-85.01	0.01	-0.0004	-0.0005	-0.0011
2049	25	-83.07	0.01	-0.0004	-0.0005	-0.0010
2050	26	-80.81	0.01	-0.0003	-0.0004	-0.0009
2051	27	-78.02	0.01	-0.0003	-0.0004	-0.0008
2052	28	-74.62	0.02	-0.0003	-0.0004	-0.0006
2053	29	-70.54	0.02	-0.0003	-0.0004	-0.0005
2054	30	-65.68	0.02	-0.0003	-0.0004	-0.0003
Total		**-2,572**	**-0.19**	**-0.02**	**-0.01**	**-0.07**

1 Introduction

This document provides detailed technical information on the economic analyses conducted in support of the United States Department of Transportation (U.S. DOT) Fiscal Year (FY) 2022 Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant Application for the Spokane International Airport's Spotted Interchange Safety and Mobility Improvement Project (Project). This document includes the following:

- Section 2, Methodological Framework: Introduces the conceptual framework used in the Benefit-Cost Analysis (BCA).
- Section 3, Overview: Provides an overview of the Project, including a brief description of existing conditions and proposed alternatives; a summary of cost estimates and schedule; and a description of the types of effects that the Project is expected to generate.
- Section 4, General Assumptions: Discusses the general assumptions used in the estimation of project costs and benefits.
- Section 5, Demand Projections: Provides estimates of travel demand and traffic volumes.
- Section 6, Benefits Measurement, Data, and Assumptions: Details the specific data elements and assumptions used to address the goals of the Project to comply with RAISE program requirements.
- Section 7, Summary of Findings and Benefit-Cost Outcomes: Provides estimates of the net present value (NPV), its benefit-cost ratio (BCR), and other evaluation metrics.
- Section 8, Benefit Cost Analysis Sensitivity: Provides the outcome of the sensitivity analysis that evaluates the difference assumptions made in the analysis, and the impact that the variability of those assumptions may have on the overall results.

Additional data tables are provided within the BCA modeling including annual estimates of benefits and Costs to assist with U.S. DOT in its review of the application.[2]

[2] While the models and software themselves do not accompany this appendix, they are provided separately as part of the application

2 Methodological Framework

The BCA conducted for this Project includes monetized benefits and costs measured using U.S. Department of Transportation (U.S. DOT) guidance, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, as well as the quantitative and qualitative merits of the Project. A BCA provides estimates of the benefits that are expected to accrue over a specified period and compares them to the anticipated costs. Costs include both the resources required to develop the Project and the costs of maintaining the new or improved asset over time. Estimated benefits are based on the projected impacts of the Project on both users and non-users of the facility, valued in monetary terms.[3]

While a BCA is just one of many tools that can be used in making decisions about infrastructure investments, U.S. DOT believes that it provides a useful benchmark from which to evaluate and compare potential transportation investments.[4]

The specific methodology employed for this application was developed using the BCA guidance developed by U.S. DOT and is consistent with the RAISE program guidelines. In particular, the methodology involves:

- Establishing existing and future conditions under the Base Case (No Build) and Alternative Case (Build) scenarios;
- Assessing benefits with respect to each of the merit criteria identified in the Notice of Funding Opportunity (NOFO);
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using U.S. DOT guidance for the valuation of safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs with the real discount rates recommended by the U.S. DOT (3 percent for CO_2-related impacts and 7 percent for all other impacts); and
- Conducting a sensitivity analysis to assess the impacts of changes in key assumptions.

[3] *U.S. DOT, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022*

[4] *Ibid.*

3 Overview

Served by seven airlines and two air cargo carriers, Spokane International Airport is the second largest airport in the State of Washington and is recognized by the Federal Aviation Administration (FAA) as a small hub. The Airport is an employment hub for over 3,000 people and has an important and expanding airfield and aerospace industry cluster. The Airport has a $725 million annual economic impact on the Spokane Region[5].

Traffic in the Spokane International Airport area is currently transiting on two very busy inbound and outbound airport access roads known as Airport Drive Inbound and Airport Drive Outbound. Vehicles use Airport Drive Inbound and Outbound and cross Spotted Road to access the Airport, nearby U.S. Highway 2, and Interstate 90. Spotted Road is a key component of the Critical Urban Freight Corridor, providing access to the Airport Industrial Park. The Spotted Road/Airport Drive intersections' geometry have deficiencies creating potential safety issues, and improvements are necessary to address them. The combination of lower speed traffic trying to cross Airport Drive Inbound and Airport Drive Outbound with higher speed traffic at two intersecting points has led to multiple frequent accidents, many of which were serious injury accidents and fatalities. These problems persist despite the installation of additional traffic safety measures. In addition, vehicles on Spotted Road approaching the intersections experience significant delays while waiting for the gap on Airport Drive to cross, which further results in vehicle fuel costs and increased emissions due to idling.

The Spotted Road Interchange Safety and Mobility Improvement Project (the Project) will construct an overpass to grade separate Spotted Road from Airport Drive Inbound and Airport Drive Outbound, providing continuous / free flow traffic for vehicles on Spotted Road travelling through the intersections. As a result, accidents at the two intersections can be fully mitigated in addition to realizing reductions in-vehicle travel time, fuel costs, and emissions due to avoided vehicle idling.

Figure 2 below highlights the proposed concept of the Spotted Road Overpass project.

[5] Spokane International Airport. *About Spokane International Airport.* Accessed March 25, 2022 https://business.spokaneairports.net/about-spokane-international

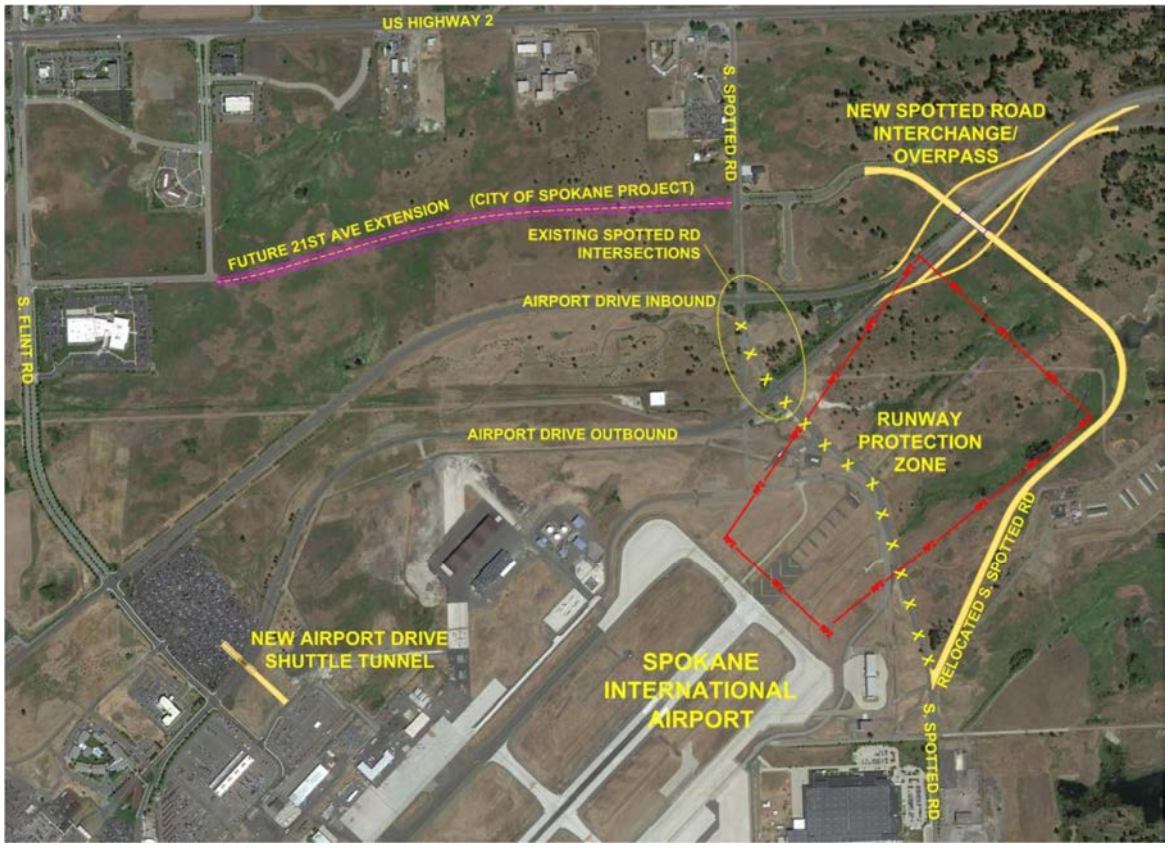

Figure 2: Spotted Road Overpass Project Concept

3.1 Base Case

In the No Build Case, all traffic travelling on Spotted Road and Airport Drive roads will continue to interface at the Spotted Road/Airport Drive intersections. The combination of lower speed traffic on Spotted Road trying to cross the inbound and outbound of Airport Drive roads with higher speed traffic is likely to cause many accidents, including serious injuries and fatalities. In addition, vehicles transiting on Spotted Road will have to stop and wait for a gap to cross the Spotted Road/Airport Drive intersections, resulting in travel time delays, and additional vehicle operating costs and emissions from idling. Moreover, the existing Spotted Road will require significant maintenance costs, as well as rehabilitation and reconstruction in future years.

3.2 Alternative Case

In the Build Case, the Project will relocate the Spotted Road/Airport Drive interchange to the east and construct a new grade-separated Spotted Road overpass above and across Airport Drive, which will provide straight through free flow traffic for vehicles on Spotted Road travelling through the Spotted Road/Airport Drive intersections. As a result, accidents happening at the two intersections will be fully avoided. In addition, vehicle wait times, operating costs, and emissions associated with idling at the intersections can be eliminated. However, there are slight disbenefits associated with the longer route travelled on the overpass (compared to the existing Spotted Road).

3.3 Project Cost and Schedule

The Project leverages funding to provide optimal project cost delivery. **Table 1** summarizes the Project's annual capital expenditures. Construction is expected to be complete in 2025 to allow the Spotted Road Overpass to be fully operational in 2026. For this BCA, all benefits begin to accrue after substantial completion of the Project and starting in the first year of operations.

Table 1: Expenditure Profile, 2020 Dollars

Calendar Year	Capital Expenditures
2019	$1,036,097
2020	$1,381,462
2021	$863,414
2022	$1,440,150
2023	$480,050
2024	$15,659,231
2025	$6,711,099
Total	**$27,571,503**

3.4 Project Benefit Impacts

The benefits associated with the Project are presented in **Table 2**, grouped by the various merit criteria.

Table 2: Expected Effects on Benefit Categories

Merit Criteria	Impact Categories	Description	Inclusion
Safety	Improved Safety and Reduced Accident Costs	Avoided vehicle collisions from the grade-separation of Spotted Road from Airport Drive.	Monetized
State of Good Repair	Reduced Maintenance Costs	Reduced maintenance costs by replacing part of the existing Spotted Road with an overpass.	Monetized
	Residual Value of Asset	Residual value of the Spotted Overpass at the end of the study period.	Monetized
Economic Competitiveness	Vehicle Operating Cost Savings	Vehicle fuel costs savings due to avoided idling at intersections but offset with the vehicle fuel costs from driving a longer distance on the new overpass.	Monetized
Environmental Sustainability	Reduced Emission Costs	Reduced emissions by avoided vehicle idling at the Spotted Road/Airport Drive intersections. This is offset from the additional emissions generated by vehicles driving a longer distance on the new overpass.	Monetized
Quality of Life	Travel Time Savings	Travel time savings from eliminated congestion at the Spotted Road/Airport Drive intersection. This is offset from the additional travel time due to vehicles driving a longer distance on the new overpass.	Monetized
	Improved Travel Time Reliability	Improved travel time reliability as a result of grade separating Spotted Road from Airport Drive.	Qualitative

4 General Assumptions

The BCA measures benefits against costs throughout a period of analysis, beginning at the start of construction and including 30 full years of operations.

The monetized benefits and costs are estimated in 2020 dollars, with future dollars discounted in compliance with U.S. DOT RAISE requirements.

A breakdown of the general assumptions used in the analysis for the Project is presented in **Table 3**.

Table 3: General Assumptions Used in the Analysis

Variable Name	Unit	Value	Source
Real Discount Factor	%	7%	U.S. DOT BCA Guidance, March 2022.
Real Discount Factor - CO_2-Related Impacts	%	3%	
Base Year of Analysis	year	2020	
First Year of Analysis	year	2019	Project Schedule
Project Completion	year	2025	
First Year of Benefits	year	2026	
End Year of Analysis	year	2055	Calculated value based on first year of benefit and the years of benefits
Years of Benefits	years	30	Based on the maximum benefit years for BCA from the U.S. DOT's March 2022 BCA Guidance.
Average Distance Travelled, Southbound of Spotted Road - No Build	miles	0.9	Weighted average distances for vehicles travelling through Spotted Road/Airport Drive intersections, based on the percent share of traffic from each direction. Distance retrieved from Google maps, and provided by JUB Airport Traffic Study, 2015.
Average Distance Travelled, Northbound of Spotted Road - No Build	miles	0.7	
Average Distance Travelled, Southbound of Spotted Road - Build	miles	1.0	
Average Distance Travelled, Northbound of Spotted Road - Build	miles	1.2	
Grams per Short Ton	grams	907,185	Known
Short Ton per Metric Ton	ton/metric ton	1.1	
Days per Year	days	365	
Feet per Mile	feet	5,208	

5 Demand Projections

Accurate demand projections are important to ensure reasonable BCA output results. The magnitudes of the long-term benefits accruing over the project study period are a function of vehicular traffic within the project area.

5.1 Methodology

Robust traffic projections are important to ensure the reasonable BCA output results. Historical vehicles approaching the Spotted Road/Airport Drive intersections during the AM and PM peak hours were collected by Iteris as part of the traffic count collection and traffic study conducted for Spokane International Airport[6]. Daily peak hour[7] traffic counts for August, October and December of 2019 are shown in **Table 4** and **Table 5** below.

Table 4: Daily Peak Hour Traffic at Spotted Road / Airport Drive Intersection – August & October

	Aug-19				Oct-19			
	North Leg		South Leg		North Leg		South Leg	
	T	R/L	T	R/L	T	R/L	T	R/L
AM Peak Hour Traffic								
Inbound & Spotted	40	16	58	54	61	16	40	61
Outbound & Spotted	49	7	94	10	71	10	80	9
PM Peak Hour Traffic								
Inbound & Spotted	71	29	58	66	60	13	57	61
Outbound & Spotted	75	11	104	12	80	4	104	18

Note: T means through traffic, while R/L means turning traffic

Table 5: Daily Peak Hour Traffic at Spotted Road / Airport Drive Intersection – December

	Dec-19			
	North Leg		South Leg	
	T	R/L	T	R/L
AM Peak Hour Traffic				
Inbound & Spotted	44	13	58	57
Outbound & Spotted	46	8	96	15
PM Peak Hour Traffic				
Inbound & Spotted	54	11	32	52
Outbound & Spotted	68	7	75	12

Note: T means through traffic, while R/L means turning traffic

An average was taken between AM and PM peak hour traffic to obtain the daily peak hour average, which was then prorated to Average Daily Traffic (ADT) using the percent share of peak hour traffic to ADT. An annual growth rate of 2.5 percent was applied to forecast future traffic volumes based on a 2015 airport traffic study.

[6] Iteris. *Spokane International Airport – Traffic Count Collection and Traffic Study*. 2019.

[7] AM peak hours is defined as between 10:45 AM and 11:45 AM, while PM peak hours are defined as between 1:00 PM and 2:00 PM. Definition obtained from: Iteris. *Spokane International Airport – Traffic Count Collection and Traffic Study*. 2019.

5.2 Assumptions

All assumptions used in the estimation of traffic demand for the Project are provided in **Table 6**.

Table 6: Assumptions used in the Estimation of Demand

Variable Name	Unit	Value	Source
Traffic Annual Growth Rate	%	2.5%	Spokane International Airport Traffic Study, 2015. Prepared by JUB Engineers Inc.
Percent Share of Trucks in the Study Area	%	20.0%	Calculated value.
Percent Share of Passenger Cars in the Study Area	%	80.0%	Average percent share of passenger cars in the area. Information retrieved from Spokane International Airport Traffic Count Collection and Traffic Study, 2019, prepared by Iteris.
Percent Share of Peak Hour Traffic	%	8.4%	Calculated based on the percent share of peak hour counts over average daily traffic on Flightline Avenue near Spokane International Airport.

5.3 Demand Projections

The resulting projections for annual traffic volume at the Spotted Road and Airport Drive intersection are presented in **Table 7**. Further details are available in the accompanying BCA spreadsheet model.

Table 7: Traffic Volume Projections

Spotted Road/Airport Drive Intersection	In Project Opening Year (2026)	2036	2046
Inbound & Spotted	978,016	1,251,943	1,602,593
Outbound & Spotted	962,650	1,251,943	1,602,593

6 Benefits Measurement, Data, and Assumptions

This section describes the measurement approach used for each benefit or impact category identified in **Table 2** and provides an overview of the associated methodology, assumptions, and estimates.

6.1 Safety

Accident costs and impacts on life, limb, and property are a significant component of road user costs. Road safety is a key economic factor in the planning of roads, as well as an important indicator of transportation efficiency, while outside the economic context, highway safety is often the subject of public concern.

The proposed Project would contribute to full accident mitigation by grade separating Spotted Road from Airport Drive Inbound and Outbound, such that lower speed traffic on Spotted Road can cross inbound and outbound of Airport Drive directly without interfering with higher speed traffic. However, vehicles will experience a slightly longer route when travelling on the overpass, compared to the existing Spotted Road, which will bring a minor safety disbenefit to the overall result The Project would help promote U.S. DOT's long-term safety outcome through reducing potential accidents by avoiding the need to transport both freight and passengers using the same roadways.

The Project is expected to generate substantial benefits in line with the "Safety" merit criteria, with the specific benefits described below. The safety benefits are monetized using the assumptions presented in **Table 8**.

Table 8: Assumptions used to Monetize Safety Benefits

Variable Name	Unit	Value	Source
Value of a Statistical Life	2020$/fatality	$11,600,000	USDOT BCA Guidance. March 2022. Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses (2016) https://www.transportation.gov/officepolicy/transportation-policy/reviseddepartmental-guidance-on-valuation-of-astatistical-life-in-economic-analysis Values in 2020$.
MAIS Factor - Serious Injury	fraction of VSL	0.105	US Department of Transportation. Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses. March 2021.
MAIS Factor - Moderate Injury	fraction of VSL	0.047	
MAIS Factor - Minor Injury	fraction of VSL	0.003	
Cost of Serious Injury ($/injury)	2020$/injury	$1,218,000	Calculated based on the MAIS factor relative to the value of statistical life and the value of statistical life obtained from the USDOT BCA Guidance. March 2022.
Cost of Moderate Injury ($/injury)	2020$/injury	$545,200	
Cost of Minor Injury ($/injury)	2020$/injury	$34,800	

6.1.1 Improved Safety and Reduced Accident Costs

6.1.1.1 METHODOLOGY

Safety benefits were estimated by monetizing the avoided fatalities and injuries as a result of the Spotted Road overpass. Total fatalities and injuries at the Spotted Road/Airport Drive intersections from 2010 to 2019 were provided by Spokane International Airport, as shown in **Table 9** below.

The BCA assumes that accidents at the Spotted Road/Airport Drive intersections in the No Build case grow at the same rate as the traffic volume. These accidents can be fully avoided by grade separating the Spotted Road in the Build case.

Table 9: Historical Fatalities and Injuries at Spotted Road / Airport Drive Intersections

Incident Type	2010-2019 Total	10-Year Average	Source
Fatalities	1	0.10	Spokane International Airport. Accident data provided by Spokane Regional Transportation Council on behalf of WSDOT. Accidents for Spotted Road with Airport Drive Inbound and Outbound are used.
Serious Injury	2	0.20	
Evident Injury (Moderate)	17	1.70	
Possible Injury (Minor)	30	3.00	

In order to estimate the disbenefit associated with the longer route travelled on the overpass compared to the existing Spotted Road, accident rates in Spokane County were calculated on a per mile basis, which were then applied to the incremental vehicle miles travelled (difference between the No Build and Build cases) to estimate the number of fatalities and injuries.

The fatalities and injuries were then monetized based on assumptions in **Table 10**. The difference in total accident costs between No Build and Build cases determines the improved safety and avoided accident costs.

6.1.1.2 ASSUMPTIONS

The assumptions used in the estimation of improved safety and reduced accident costs are summarized in **Table 10**.

Table 10: Assumptions used in the Estimation of Improved Safety and Reduced Accident Costs

Variable Name	Unit	Value	Source
Fatal Crashes per Million VMT	fatal crashes/ million vmt	0.01	Calculated based on total vehicle miles travelled and total crashes by type in Spokane County in 2019. Total vehicle miles travelled retrieved from Washington State Department of Transportation, Highway Performance Monitoring System. Total crashes by type obtained from Washington State Department of Transportation, Crash Data Portal on all types of roadways.
Serious Injury Crashes per Million VMT	injury crashes/ million vmt	0.03	
Minor Injury Crashes per Million VMT	injury crashes/ million vmt	0.59	
Fatalities per Fatal Crash	fatalities/fatal crash	1.02	Calculated from Spokane County crash statistics between 2016 and 2020. Crash

Variable Name	Unit	Value	Source
Serious Injuries per Serious Injury Crash	injuries/injury crash	1.17	statistics obtained Washington State Department of Transportation, Crash Data Portal on all types of roadways.
Minor Injuries per Minor Injury Collision	injuries/injury crash	1.27	Washington State Department of Transportation. 2015 Annual Collision Summary. https://www.wsdot.wa.gov/mapsdata/crash/pdf/2015_Annual_Collision_Summary.pdf
Crash Reduction Factor by adding the Spotted Road Overpass	%	100%	Assuming Spotted Road/Airport Drive intersection related incidents can be fully mitigated by grade separating Spotted Road.

6.1.2 Benefit Estimates

Table 11 provides the monetized benefit estimates of safety benefits. The estimated present value of the discounted benefits over the projected 30-year benefit period is $32.6 million.

Table 11: Estimates of Safety Benefits, 2020 Dollars

	Over the Project Lifecycle	
	In Constant Dollars	Discounted
Reduced Fatalities	$59,197,802	$15,477,132
Reduced Injuries	$65,534,451	$17,133,835
Total	**$124,732,253**	**$32,610,967**

6.2 State of Good Repair

The state of good repair benefits are designed to capture benefits from maintaining infrastructure in good condition. This is captured through reduced maintenance costs and the residual value of assets. The residual value captures any useful life left on the assets constructed, and the reduced maintenance costs captures changes in maintenance costs between the No Build and Build Cases.

6.2.1 Reduced Maintenance Costs

6.2.1.1 METHODOLOGY

The existing Spotted Road has been aging, and an increasing amount of maintenance costs have been observed during the past few years as a result of increasing rehabilitation and reconstruction of part of the Spotted Road. This can be reduced significantly by replacing it with the new Spotted Road overpass. Therefore, the reduced maintenance costs captured the difference in maintenance costs between Build and No Build cases.

6.2.1.2 ASSUMPTIONS

Table 12 and **Table 13** highlights the assumptions used to estimate the reduced maintenance costs.

Table 12: Assumptions used in the Estimation of the Reduced Maintenance Costs – Historical Maintenance Costs

Variable Name	Unit	Value	Source
Spotted Road Overpass Annual Maintenance Costs - No Build	2020$/year	$287,574	An average of historical maintenance costs of the existing Spotted Road from 2017 to 2019. Data provided by Spokane International Airport. Value adjusted to 2020$.

Table 13: Assumptions used in the Estimation of the Reduced Maintenance Costs – Future Maintenance Costs

Year	Description	Cost (2020 Dollars)
2026-2028	No Maintenance Required	$-
2029	Striping	$5,448
2030	Striping	$5,448
2031	Striping	$5,448
2032	Crack Seal and Asphalt Surface Treatment (Chip Seal)	$62,958
2033	Striping	$5,448
2034	Patching	$2,906
2035	Patching	$2,906
2036	Striping	$5,448
2037	Patching	$2,906
2038	Patching	$2,906
2039	Patching	$2,906
2040	Crack Seal and Asphalt Surface Treatment (Chip Seal)	$62,958
2041	Striping	$5,448
2042	Patching	$2,906
2043	Striping	$5,448
2044	Patching	$2,906
2045	Patching	$2,906
2046	Striping	$5,448
2047	Patching	$2,906
2048	Patching	$2,906
2049	Striping	$5,448
2050	Patching	$2,906
2051	Crack Seal and Asphalt Surface Treatment (Chip Seal)	$62,958
2052	Patching	$2,906
2053	Striping	$5,448
2054	Patching	$2,906
2055	Patching	$2,906

6.2.2 Residual Value of Capital Assets

6.2.2.1 METHODOLOGY

The residual value of capital assets is calculated in line with U.S. DOT's BCA guidance, based on an estimated useful life of 30 years for the new bridge structures.

6.2.2.2 ASSUMPTIONS

Table 14 highlights the assumptions used in the estimation of the residual value of the capital assets.

Table 14: Assumptions used in the Estimation of the Residual Value of Capital Assets

Variable Name	Unit	Value	Source
Years of Benefits	years	30	Based on the maximum benefit years for BCA from U.S. DOT's March 2022 BCA guidance.
Spotted Road Overpass Useful Life	years	30	Spokane International Airport.

6.2.3 Benefit Estimates

Table 15 shows the estimates of the reduced maintenance costs and the residual value of capital assets. The estimated discounted present value over the projected 20-year benefit period is $2.5 million.

Table 15: Estimates of the State of Good Repair Benefits, 2020 Dollars

	Over the Project Lifecycle	
	In Constant Dollars	Discounted
Reduced Maintenance Costs	$8,343,178	$2,466,457
Residual Value of Asset	$ -	$ -
Total	**$8,343,178**	**$2,466,457**

6.3 Economic Competitiveness

6.3.1 Vehicle Operating Cost Savings

The proposed Spotted Road overpass looks to avoid vehicle operating costs associated with idling at the Spotted Road/Airport Drive intersections, since vehicles will be able to travel through Spotted Road directly, without waiting for gaps to cross at the intersections. However, vehicles will experience a slightly longer route when travelling on the overpass, compared to the existing Spotted Road, which will bring a disbenefit to the overall result.

6.3.1.1 METHODOLOGY

The elimination in vehicle idling time is directly related to the construction of the Spotted Road overpass. Vehicle delay time in the No Build case was multiplied by the fuel and motor oil consumption rate to obtain annual estimates of fuel and motor oil consumptions from idling. These volume estimates were multiplied by the respective cost per unit of fuel and motor oil to derive an estimate of the vehicle operating costs which are fully mitigated in the Build case.

In order to estimate the disbenefit associated with the longer route travelled on the overpass compared to the existing Spotted Road, vehicle miles travelled in No Build and Build cases were

multiplied by the fuel and motor oil consumption rate, and then monetized to get the total vehicle operating costs.

The change in total vehicle operating costs between No Build and Build cases gives the total net impact on vehicle operating costs as a result of the Project.

6.3.1.2 ASSUMPTIONS

Majority of the assumptions used in the estimation of vehicles operating cost savings are summarized in **Table 16**. The remaining assumptions relating to fuel costs are presented in **Table 32** in **Section 9**.

Table 16: Assumptions used in the Estimation of Vehicle Operating Cost Savings

Variable Name	Unit	Value	Source
Motor Oil Consumption at Idle - Autos	quarts/hour	0.03	Based on U.S. DOT: HERS-ST Highway Economic Requirements System (2002) oil consumption of 1.38qt/1000 miles and assuming that "One hour of idle time is equal to approximately 25 miles of driving" (Ford Motor Company, 2011)
Motor Oil Consumption at Idle - Trucks	quarts/hour	0.03	
Motor Oil Consumption, Driving - Autos	quarts/mile	0.00	
Motor Oil Consumption, Driving - Trucks	quarts/mile	0.00	
Gasoline Burned at Idle - Autos	gallons/hour	0.44	US DOE: Alternative Fuels Data Center and Argonne National Laboratory, "Idle Reduction Savings Worksheet" (2018)
Diesel Fuel Burned at Idle - Trucks	gallons/hour	0.90	
Average Automobile Fuel Economy	miles/gallon	36.90	Bureau of Transportation Statistics. Table 4-23 Average Fuel Efficiency of U.S. Light Duty Vehicles
Average Heavy-Duty Diesel Vehicle Fuel Economy	miles/gallon	6.30	EPA. MOBILE6.2 output is for heavy-duty diesel vehicles (HDDV).
Cost of Motor Oil - Autos	2020$/quart	$10.70	Average Oil Price Sourced from HERS Model and Inflated to 2020$ by Motor Oil CPI (BLS CUUR0000SS47021).
Cost of Motor Oil - Trucks	2020$/quart	$4.28	

6.3.2 Benefit Estimates

Table 17 shows the estimated economic competitiveness benefits from vehicle operating cost savings. The estimated discounted present value over the projected 30-year benefit period is -$0.4 million.

Table 17: Estimates of Economic Competitiveness Benefits, 2020 Dollars

	Over the Project Lifecycle	
	In Constant Dollars	Discounted
Vehicle Operating Cost Savings	-$1,101,085	-$359,158
Total	**-$1,101,085**	**-$359,158**

6.4 Environmental Sustainability

Environmental costs are increasingly considered an important component in the evaluation of transportation projects. The primary environmental impact of vehicle use is exhaust emissions, which impose wide-ranging social costs on people, material, and vegetation. The negative effects of pollution depend not only on the quantity of pollution produced, but also on the types of pollutants emitted as well as the local environmental conditions into which the pollution is released.

The proposed Project would reduce vehicle emissions from idling with the construction of the overpass. However, vehicles will experience a slightly longer route when travelling on the overpass, compared to the existing Spotted Road, which results in a small net disbenefit to the overall result.

The assumptions used to monetize the reduction in emissions are summarized in **Table 18**.

Table 18: Assumptions used in the Estimation of Environmental Benefits – Emission Values

Social Cost of Emissions (2020$/metric ton)						
Year	CO_2	NO_X	PM	SO_2	VOC	Source/Comment
2021	$52	$15,600	$748,600	$41,500	$0	
2022	$53	$15,800	$761,600	$42,300	$0	
2023	$54	$16,000	$774,700	$43,100	$0	
2024	$55	$16,200	$788,100	$44,000	$0	
2025	$56	$16,500	$801,700	$44,900	$0	
2026	$57	$16,800	$814,500	$45,700	$0	
2027	$58	$17,100	$827,400	$46,500	$0	
2028	$60	$17,400	$840,600	$47,300	$0	
2029	$61	$17,700	$854,000	$48,200	$0	
2030	$62	$18,100	$867,600	$49,100	$0	
2031	$63	$18,100	$867,600	$49,100	$0	Technical Support Document: Estimating the Benefit per Ton of Reducing $PM_{2.5}$ Precursors from 17 Sectors (February 2018)" https://www.epa.gov/sites/default/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf NO_X, SO_X, and $PM_{2.5}$ values are inflated from 2015 to 2020 dollars using the GDP deflator. Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990 (February 2021) https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf Values are kept constant after 2050.
2032	$64	$18,100	$867,600	$49,100	$0	
2033	$65	$18,100	$867,600	$49,100	$0	
2034	$66	$18,100	$867,600	$49,100	$0	
2035	$67	$18,100	$867,600	$49,100	$0	
2036	$69	$18,100	$867,600	$49,100	$0	
2037	$70	$18,100	$867,600	$49,100	$0	
2038	$71	$18,100	$867,600	$49,100	$0	
2039	$72	$18,100	$867,600	$49,100	$0	
2040	$73	$18,100	$867,600	$49,100	$0	
2041	$74	$18,100	$867,600	$49,100	$0	
2042	$75	$18,100	$867,600	$49,100	$0	
2043	$77	$18,100	$867,600	$49,100	$0	
2044	$78	$18,100	$867,600	$49,100	$0	
2045	$79	$18,100	$867,600	$49,100	$0	
2046	$80	$18,100	$867,600	$49,100	$0	
2047	$81	$18,100	$867,600	$49,100	$0	
2048	$82	$18,100	$867,600	$49,100	$0	
2049	$83	$18,100	$867,600	$49,100	$0	
2050	$85	$18,100	$867,600	$49,100	$0	
2051	$85	$18,100	$867,600	$49,100	$0	
2052	$85	$18,100	$867,600	$49,100	$0	
2053	$85	$18,100	$867,600	$49,100	$0	
2054	$85	$18,100	$867,600	$49,100	$0	
2055	$85	$18,100	$867,600	$49,100	$0	

Notes: GDP = gross domestic product; NOx = nitrogen oxides; PM = particulate matter; SO_2 = sulfur dioxide; VOC = volatile organic compounds

6.4.1 Reduced Emission Costs

6.4.1.1 METHODOLOGY

Vehicle delay time in the No Build case was used to estimate total emissions released from vehicle idling at Spotted Road/Airport Drive intersections, which was then multiplied by the appropriate emission factors for tons of nitrogen oxides (NO_x), particulate matter (PM), sulfur dioxide (SO_2), carbon dioxide (CO_2) and volatile organic compounds (VOC) emitted per year. Each pollutant, measured in tons, is then multiplied by its monetary value, presented in **Table 18**, to get the total emission cost in the No Build case. Grade separating the Spotted Road in the Build case would eliminate emissions related to vehicle idling.

In order to estimate the disbenefit associated with the longer route travelled on the overpass compared to the existing Spotted Road, vehicle miles travelled in No Build and Build cases were used to estimate the total emissions released. Vehicle miles travelled were multiplied by the appropriate emission factors, and then monetized to get the total emission costs.

The change in total emission costs between No Build and Build cases indicates the total avoided emission costs as a result of the Project.

6.4.1.2 ASSUMPTIONS

The assumptions used in the estimation of reduced emissions costs are summarized in **Table 19** and **Table 20** for idling vehicles. Additional assumptions for trucks and automobiles are presented in **Table 30** and **Table 31** in **Section 9**.

Table 19: Assumptions used in the Estimation of Environmental Benefits – Idling Trucks

Idling Truck Emissions (grams/hour)						
Year	CO_2	NO_X	PM	SO_2	VOC	Source/Comment
2020	2,795	11.26	0.548	0.01	1.96	MOVES run in June 2021 for Spokane County, Washington. Truck Emissions used a weighted average of Passenger Truck (80%), Single unit long-haul truck (10%), and Single unit short-haul truck (10%) based on the vehicle type percent share in the study area, with diesel as the fuel type and a speed bin of 2.5 mph to represent emission rates when idling. MOVES values were gathered from 2020, 2030, 2040, 2050 and 2060. Values were interpolated between those years.
2021	2,728	10.28	0.451	0.01	1.67	
2022	2,664	9.39	0.371	0.01	1.42	
2023	2,600	8.57	0.305	0.01	1.21	
2024	2,538	7.83	0.251	0.01	1.03	
2025	2,478	7.15	0.206	0.01	0.87	
2026	2,419	6.52	0.170	0.01	0.74	
2027	2,361	5.96	0.140	0.01	0.63	
2028	2,305	5.44	0.115	0.01	0.54	
2029	2,250	4.97	0.095	0.01	0.46	
2030	2,197	4.53	0.078	0.01	0.39	
2031	2,178	4.40	0.060	0.01	0.35	
2032	2,159	4.26	0.047	0.01	0.31	
2033	2,140	4.13	0.036	0.01	0.28	
2034	2,121	4.00	0.028	0.01	0.25	
2035	2,102	3.88	0.022	0.01	0.22	
2036	2,084	3.76	0.017	0.01	0.20	
2037	2,066	3.65	0.013	0.01	0.17	
2038	2,048	3.53	0.010	0.01	0.16	
2039	2,030	3.42	0.008	0.01	0.14	
2040	2,012	3.32	0.006	0.01	0.12	
2041	2,009	3.31	0.006	0.01	0.12	
2042	2,005	3.30	0.006	0.01	0.12	
2043	2,002	3.29	0.006	0.01	0.12	
2044	1,999	3.28	0.006	0.01	0.12	
2045	1,995	3.27	0.006	0.01	0.12	
2046	1,992	3.26	0.006	0.01	0.12	

Idling Truck Emissions (grams/hour)						
Year	CO_2	NO_X	PM	SO_2	VOC	Source/Comment
2047	1,988	3.25	0.006	0.01	0.12	
2048	1,985	3.24	0.006	0.01	0.12	
2049	1,982	3.22	0.006	0.01	0.12	
2050	1,978	3.21	0.006	0.01	0.12	
2051	1,978	3.21	0.006	0.01	0.12	
2052	1,977	3.21	0.006	0.01	0.12	
2053	1,976	3.21	0.006	0.01	0.12	
2054	1,976	3.21	0.006	0.01	0.12	
2055	1,975	3.21	0.006	0.01	0.12	

Table 20: Assumptions used in the Estimation of Environmental Benefits – Idling Automobiles

Idling Automobiles Emissions (grams/hour)						
Year	CO_2	NO_X	PM	SO_2	VOC	Source/Comment
2020	1,679	0.28	0.008	0.01	0.19	
2021	1,640	0.23	0.008	0.01	0.16	
2022	1,601	0.19	0.008	0.01	0.14	
2023	1,564	0.16	0.007	0.01	0.12	
2024	1,527	0.13	0.007	0.01	0.10	
2025	1,492	0.11	0.007	0.01	0.09	
2026	1,457	0.09	0.007	0.01	0.08	
2027	1,423	0.08	0.006	0.01	0.07	
2028	1,389	0.07	0.006	0.01	0.06	
2029	1,357	0.05	0.006	0.01	0.05	
2030	1,325	0.05	0.006	0.01	0.04	
2031	1,312	0.04	0.006	0.01	0.04	
2032	1,298	0.03	0.006	0.01	0.04	
2033	1,285	0.03	0.006	0.01	0.04	
2034	1,272	0.02	0.006	0.01	0.03	
2035	1,259	0.02	0.005	0.01	0.03	MOVES run in June 2021 for Spokane County, Washington. Passenger cars used as the vehicle type, with gasoline as the fuel type and a speed bin of 2.5 mph to represent emission rates when idling. MOVES values were gathered from 2020, 2030, 2040, 2050 and 2060. Values were interpolated between those years.
2036	1,247	0.02	0.005	0.01	0.03	
2037	1,234	0.01	0.005	0.01	0.03	
2038	1,221	0.01	0.005	0.01	0.03	
2039	1,209	0.01	0.005	0.01	0.03	
2040	1,197	0.01	0.005	0.01	0.02	
2041	1,194	0.01	0.005	0.01	0.02	
2042	1,192	0.01	0.005	0.01	0.02	
2043	1,189	0.01	0.005	0.01	0.02	
2044	1,187	0.01	0.005	0.01	0.02	
2045	1,184	0.01	0.005	0.01	0.02	
2046	1,182	0.01	0.005	0.01	0.02	
2047	1,180	0.01	0.005	0.01	0.02	
2048	1,177	0.01	0.005	0.01	0.02	
2049	1,175	0.01	0.005	0.01	0.02	
2050	1,172	0.01	0.005	0.01	0.02	
2051	1,172	0.00	0.005	0.01	0.02	
2052	1,172	0.00	0.005	0.01	0.02	
2053	1,171	0.00	0.005	0.01	0.02	
2054	1,171	0.00	0.005	0.01	0.02	
2055	1,171	0.00	0.005	0.01	0.02	

6.4.2 Benefit Estimates

Table 21 shows the estimated environmental benefits from reduced emissions. The estimated discounted present value over the projected 30-year benefit period is -$0.1 million.

Table 21: Estimates of Environmental Benefits, 2020 Dollars

	Over the Project Lifecycle	
	In Constant Dollars	Discounted
Greenhouse Gas (GHG)	-$169,984	-$93,866
Critical Air Contaminants (CAC)	-$15,883	-$7,019
Total	**-$185,867**	**-$100,885**

Notes: CAC = criteria air contaminant; GHG = greenhouse gas

6.5 Quality of Life

6.5.1 Travel Time Savings

The proposed Project would generate travel time savings for vehicle drivers and passengers, which falls under the quality-of-life merit criteria. Currently, vehicles travelling through the Spotted Road/Airport Drive intersections have to stop at intersections and wait for the gap to cross. This can be eliminated with the construction of the overpass. However, vehicles will experience a slightly longer route when travelling on the overpass, compared to the existing Spotted Road, which will bring a minor disbenefit.

6.5.1.1 METHODOLOGY

In the No Build case, almost all vehicles approaching the Spotted Road/Airport Drive intersections experience some delay while either waiting for a gap to cross the intersections or waiting for vehicles ahead to cross first. The relationship between traffic volumes on Spotted Road approaching the intersections and vehicle delay time is not linear. Instead, there is an exponential growth in vehicle delay time when more vehicles are observed at the intersections. This means that if the intersections experience twice the usual traffic volume, the delay time will be more than double. A traffic study for Spokane International Airport conducted by JUB Engineers Inc. in 2015 provided daily historical traffic volumes and vehicle delay time during the peak hour at the Spotted Road/Airport Drive intersections, and conducted projections using traffic simulation models for 2019, 2024, and 2034. Results are shown in **Table 22** to **Table 24** below.

Table 22: Historical Traffic Volume

Midday Peak Hour Traffic	2014				2019			
	North Leg		South Leg		North Leg		South Leg	
	T	R/L	T	R/L	T	R/L	T	R/L
Inbound & Spotted	90	35	85	35	105	40	95	40
Outbound & Spotted	90	5	90	10	105	5	100	10

Note: T means through traffic, while R/L means turning traffic

Table 23: Forecast Traffic Volume

Midday Peak Hour Traffic	2024				2034			
	North Leg		South Leg		North Leg		South Leg	
	T	R/L	T	R/L	T	R/L	T	R/L
Inbound & Spotted	125	50	105	45	170	65	125	50
Outbound & Spotted	125	5	110	10	170	10	130	15

Note: T means through traffic, while R/L means turning traffic

Table 24: Historical and Forecast Vehicle Delay (Seconds per Vehicle)

Midday Peak Hour Delay	2014		2019		2024		2034	
	North Leg	South Leg	North Leg	South Leg	North Leg	South Leg	North Leg	South Leg
Inbound & Spotted	14.8	16.8	16.6	19.6	19.9	24.7	40.1	65.3
Outbound & Spotted	20.0	16.6	25.0	25.0	34.5	21.6	147.8	34.9

As a result of this non-linear pattern between peak hour traffic volumes and vehicle delay time at the intersections, the BCA assumed the relationship found in the JUB traffic study report was still valid, and peak hour delay times were applied to the current traffic projection when they matched the closest to the number in the JUB traffic study report. In other words, the relationship between peak hour delay and traffic projection was maintained and applied to years where the data was most suitable. For example, it was assumed the peak hour delay time at Spotted Road/Airport Drive Inbound north leg was still 14.8 seconds when the peak hour traffic reached 125. Therefore, 14.8 seconds of delay was applied to the year when the current peak hour traffic projection was closest to 125. Delay time for other years was either interpolated or applied the delay time Compound Annual Growth Rate (CAGR) between 2014 and 2034. In order to estimate the delay time throughout the day, it was assumed the delay time at Spotted Road/Airport Drive intersections in relation to traffic volumes followed a normal distribution. That is, the average delay time for all vehicles approaching the intersections throughout the day is half of the peak hour delay. Sensitivity analyses were conducted (see **Section 8**) to monetize travel time savings during the peak hour only. Once the Spotted Road overpass is operational, the vehicle idling time at previous intersections can be fully eliminated.

In order to estimate the disbenefit associated with the longer route travelled on the overpass compared to the existing Spotted Road, total vehicle miles travelled in No Build and Build cases were divided by the corresponding driving speed to estimate total vehicle travel time.

Vehicle idling and travel time was then multiplied by the average vehicle occupancy rate in order to estimate personal travel time, which was monetized based on the value of time assumptions. The difference in total travel time savings between No Build and Build cases determines the total travel time savings.

6.5.1.2 ASSUMPTIONS

The assumptions used in the estimation of travel time savings are summarized in **Table 25**.

Table 25: Assumptions used in the Estimation of the Travel Time Savings

Variable Name	Unit	Value	Source
Average Driving Speed - No Build	mph	30	Speed limit for the existing Spotted Road, south of Airport Drive outbound and in between Airport Drive inbound and outbound
Average Driving Speed - Build	mph	35	Speed limit for the proposed Spotted Overpass.
Average Vehicle Occupancy - Auto (All Travel)	people/veh	1.67	USDOT BCA Guidance. March 2022. 2017 National Household Travel Survey.
Average Vehicle Occupancy - Truck	people/veh	1.00	Assuming one truck driver per vehicle.
Value of Travel Time - Auto Passengers (All Purposes)	2020$/hr	$17.80	USDOT BCA Guidance. March 2022. U.S. DOT Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis, https://www.transportation.gov/officepolicy/transportation-policy/reviseddepartmental-guidance-valuationtravel-time-economic
Value of Travel Time - Truck Drivers	2020$/hr	$32.00	

6.5.2 Improved Travel Time Reliability

Vehicles approaching the Spotted Road/Airport Drive can experience significant delays while waiting for the gap to cross the two intersections, which causes variability in travel time. Grade separating Spotted Road from Airport Drive with an overpass will reduce vehicle wait times at intersections and improve travel time reliability. However, reliability benefits are difficult to monetize for different roadway users.

6.5.3 Benefit Estimates

Table 26 shows the estimated quality of life benefits from travel time savings. The estimated discounted present value over the projected 30-year benefit period is $1.9 million.

Table 26: Estimates of Quality of Life Benefits, 2020 Dollars

	Over the Project Lifecycle	
	In Constant Dollars	Discounted
Travel Time Savings	$12,839,877	$1,867,590
Total	**$12,839,877**	**$1,867,590**

7 Summary of Findings and Benefit-Cost Outcomes

Table 27 and **Table 28** summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the Project (37 years). As previously stated, construction is expected to be completed by 2025. Benefits accrue during the full operation of the Project, starting in 2016.

Table 27: Benefit Estimates by Benefit Category, Millions of 2020 Dollars

Merit Criteria	Benefit Category	Over the Project Lifecycle	
		In Constant Dollars	Discounted
Safety	Improved Safety and Reduced Accident Costs	$124.7 M	$32.6 M
State of Good Repair	Reduced Maintenance Costs	$8.3 M	$2.5 M
	Residual Value of Asset	$ -	$ -
Economic Competitiveness	Vehicle Operating Cost Savings	-$1.1 M	-$0.4 M
Environmental Sustainability	Reduced Emission Costs	-$0.2 M	-$0.1 M
Quality of Life	Travel Time Savings	$12.8 M	$1.9 M
	Improved Travel Time Reliability	*Not Monetized*	*Not Monetized*
Total		**$144.6 M**	**$36.5 M**

Table 28: Overall Results of the Benefit Cost Analysis, Millions of 2020 Dollars

Project Evaluation Metric	Discounted
Total Discounted Benefits	$36.5 M
Total Discounted Costs	$21.7 M
Net Present Value	$14.8 M
Benefit / Cost Ratio	1.7
Discounted Payback Period (years)	13.8 years
Internal Rate of Return (%)	11.4%

Considering all monetized benefits and costs, the estimated internal rate of return of the Project is 11.4 percent. With a 3 percent real discount rate for CO_2-related impacts and 7 percent real discount rate for all other impacts, the $21.7 million investment would result in $36.5 million in total benefits for a NPV of $14.8 million and a BCR of approximately 1.7.

8 Benefit Cost Analysis Sensitivity

8.1 Variation in Key Inputs and Assumptions

The BCA outcomes presented in the previous sections rely on a large number of assumptions and long-term projections, all of which are subject to considerable uncertainty.

The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the "critical variables."

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables—how much the final results would vary with reasonable departures from the "preferred" or most likely value for the variable; and
- Assess the robustness of the BCA and evaluate, in particular, whether the conclusions reached under the "preferred" set of input values are significantly altered by reasonable departures from those values.

The outcomes of the quantitative analysis for the Project, using a 3 percent discount rate for CO_2-related impacts and 7 percent discount rate for all other impacts, are summarized in **Table 29**. **Table 29** provides the percentage changes in the Project's NPV associated with variations in variables or parameters, as indicated in the column headers.

Table 29: Sensitivity Analysis Results

Original NPV (Discounted)	Original BCR	Parameter	Change in Parameter Value	New NPV (Discounted)	Change in NPV	New B/C Ratio
$14.8 M	**1.7**	Project Capital Cost	-15% of future project capital cost	$17.7 M	19.4%	1.9
			+15% of future project capital cost	$11.9 M	-19.4%	1.5
		Years of Benefit	20 years of benefit	$8.0 M	-45.8%	1.4
		Off-Peak Delay Time	Assuming vehicles approaching the Spotted Road/Airport Drive intersections do not experience any delay during off-peak hours.	$11.3 M	-24.0%	1.5

Based on the sensitivity analysis, a 15 percent change in the capital costs is expected to only impact the NPV by 19.4 percent, resulting in a BCR ranging from 1.5 to 1.9. Meanwhile, reducing the years of benefits from 30 to 20 is expected to have the largest impact on the results. Specifically, this change reduces the NPV by 45.8 percent but still reports a BCR of 1.4, greater than the 1.0 threshold.

Finally, adjusting the off-peak delay time assumptions such that vehicles approached the Spotted Road/Airport Drive intersection do not experience any delay during the off-peak hours, is expected to result in an NPV of $11.3 million and a BCR of 1.5.

As evident in the table above, regardless of the various scenarios considered, the overall BCR is robust, with a value significantly greater than 1.0.

9 Supplementary Tables

This section contains additional tables highlighting some of the data used in the estimation of the benefits.

Table 30: Emission Factors Assumptions - Trucks While Driving

Year	No Build					Build					Source/Comment
	CO_2	NO_X	PM	SO_2	VOC	CO_2	NO_X	PM	SO_2	VOC	
2020	648	1.78	0.073	0.002	0.245	599	1.57	0.066	0.002	0.220	MOVES run in June 2021 for Spokane County, Washington. Truck Emissions used a weighted average of Passenger Truck (80%), Single unit long-haul truck (10%), and Single unit short-haul truck(10%) based on the vehicle type percent share in the study area, with diesel as the fuel type and an average travel speed of 30 mph in the No Build and 35 mph in the Build. MOVES values were gathered from 2020, 2030, 2040, 2050 and 2060. Values were interpolated between those years.
2021	631	1.60	0.061	0.002	0.207	583	1.40	0.054	0.002	0.186	
2022	615	1.44	0.050	0.002	0.175	568	1.25	0.045	0.002	0.157	
2023	599	1.30	0.042	0.002	0.148	553	1.12	0.037	0.002	0.132	
2024	583	1.17	0.034	0.002	0.125	539	1.00	0.031	0.002	0.111	
2025	568	1.05	0.029	0.002	0.106	525	0.89	0.026	0.002	0.094	
2026	553	0.94	0.024	0.002	0.089	511	0.80	0.021	0.002	0.079	
2027	539	0.85	0.020	0.002	0.076	498	0.71	0.018	0.002	0.067	
2028	525	0.76	0.016	0.002	0.064	485	0.64	0.015	0.002	0.056	
2029	511	0.69	0.013	0.002	0.054	472	0.57	0.012	0.002	0.047	
2030	498	0.62	0.011	0.002	0.046	460	0.51	0.010	0.002	0.040	
2031	493	0.59	0.009	0.002	0.041	456	0.49	0.008	0.002	0.035	
2032	489	0.57	0.008	0.002	0.036	451	0.47	0.007	0.002	0.031	
2033	484	0.55	0.007	0.002	0.032	447	0.45	0.006	0.001	0.028	
2034	480	0.53	0.006	0.002	0.029	443	0.43	0.005	0.001	0.024	
2035	475	0.51	0.005	0.002	0.026	439	0.41	0.004	0.001	0.022	
2036	471	0.49	0.004	0.002	0.023	435	0.39	0.004	0.001	0.019	
2037	467	0.47	0.004	0.002	0.021	431	0.38	0.003	0.001	0.017	
2038	462	0.45	0.003	0.002	0.018	427	0.36	0.003	0.001	0.015	
2039	458	0.43	0.003	0.002	0.016	423	0.34	0.002	0.001	0.013	
2040	454	0.42	0.002	0.002	0.015	419	0.33	0.002	0.001	0.012	
2041	453	0.42	0.002	0.002	0.014	418	0.33	0.002	0.001	0.012	
2042	452	0.41	0.002	0.002	0.014	418	0.33	0.002	0.001	0.012	
2043	451	0.41	0.002	0.002	0.014	417	0.33	0.002	0.001	0.012	
2044	451	0.41	0.002	0.002	0.014	416	0.32	0.002	0.001	0.011	
2045	450	0.41	0.002	0.002	0.014	415	0.32	0.002	0.001	0.011	
2046	449	0.41	0.002	0.001	0.014	415	0.32	0.002	0.001	0.011	
2047	448	0.41	0.002	0.001	0.014	414	0.32	0.002	0.001	0.011	
2048	448	0.41	0.002	0.001	0.014	413	0.32	0.002	0.001	0.011	
2049	447	0.40	0.002	0.001	0.014	413	0.32	0.002	0.001	0.011	
2050	446	0.40	0.002	0.001	0.014	412	0.32	0.002	0.001	0.011	
2051	446	0.40	0.002	0.001	0.014	412	0.32	0.002	0.001	0.011	
2052	446	0.40	0.002	0.001	0.014	412	0.32	0.002	0.001	0.011	
2053	446	0.40	0.002	0.001	0.014	411	0.32	0.002	0.001	0.011	
2054	446	0.40	0.002	0.001	0.014	411	0.32	0.002	0.001	0.011	

Year	No Build					Build					Source/Comment
	CO_2	NO_X	PM	SO_2	VOC	CO_2	NO_X	PM	SO_2	VOC	
2055	445	0.40	0.002	0.001	0.014	411	0.32	0.002	0.001	0.011	

Table 31: Emission Factors Assumptions - Automobiles While Driving

Year	No Build					Build					Source/Comment
	CO_2	NO_X	PM	SO_2	VOC	CO_2	NO_X	PM	SO_2	VOC	
2020	306	0.154	0.002	0.002	0.047	292	0.153	0.002	0.002	0.041	
2021	299	0.130	0.002	0.002	0.041	285	0.129	0.002	0.002	0.036	
2022	292	0.110	0.002	0.002	0.036	278	0.110	0.002	0.002	0.031	
2023	285	0.093	0.002	0.002	0.031	272	0.093	0.002	0.002	0.027	
2024	279	0.079	0.002	0.002	0.027	266	0.079	0.002	0.002	0.024	
2025	272	0.067	0.002	0.002	0.024	259	0.067	0.001	0.002	0.021	
2026	266	0.056	0.001	0.002	0.021	253	0.057	0.001	0.002	0.018	
2027	260	0.048	0.001	0.002	0.018	247	0.048	0.001	0.002	0.016	
2028	253	0.040	0.001	0.002	0.016	242	0.041	0.001	0.002	0.014	
2029	248	0.034	0.001	0.002	0.014	236	0.034	0.001	0.002	0.012	
2030	242	0.029	0.001	0.002	0.012	230	0.029	0.001	0.002	0.011	
2031	239	0.024	0.001	0.002	0.011	228	0.025	0.001	0.002	0.010	
2032	237	0.021	0.001	0.002	0.011	226	0.021	0.001	0.001	0.010	
2033	234	0.017	0.001	0.002	0.010	223	0.017	0.001	0.001	0.009	
2034	232	0.015	0.001	0.002	0.010	221	0.015	0.001	0.001	0.009	
2035	230	0.012	0.001	0.002	0.009	219	0.012	0.001	0.001	0.008	MOVES run in June 2021 for Spokane County, Washington. Passenger cars used as the vehicle type, with gasoline as the fuel type and an average travel speed of 30 mph in the No Build and 35 mph in the Build. MOVES values were gathered from 2020, 2030, 2040, 2050 and 2060. Values were interpolated between those years.
2036	227	0.010	0.001	0.002	0.008	217	0.010	0.001	0.001	0.008	
2037	225	0.009	0.001	0.001	0.008	214	0.009	0.001	0.001	0.007	
2038	223	0.007	0.001	0.001	0.008	212	0.007	0.001	0.001	0.007	
2039	220	0.006	0.001	0.001	0.007	210	0.006	0.001	0.001	0.006	
2040	218	0.005	0.001	0.001	0.007	208	0.005	0.001	0.001	0.006	
2041	218	0.005	0.001	0.001	0.007	207	0.005	0.001	0.001	0.006	
2042	217	0.005	0.001	0.001	0.007	207	0.005	0.001	0.001	0.006	
2043	217	0.004	0.001	0.001	0.007	207	0.005	0.001	0.001	0.006	
2044	216	0.004	0.001	0.001	0.007	206	0.004	0.001	0.001	0.006	
2045	216	0.004	0.001	0.001	0.006	206	0.004	0.001	0.001	0.006	
2046	215	0.004	0.001	0.001	0.006	205	0.004	0.001	0.001	0.006	
2047	215	0.004	0.001	0.001	0.006	205	0.004	0.001	0.001	0.006	
2048	214	0.004	0.001	0.001	0.006	204	0.004	0.001	0.001	0.006	
2049	214	0.003	0.001	0.001	0.006	204	0.003	0.001	0.001	0.006	
2050	214	0.003	0.001	0.001	0.006	204	0.003	0.001	0.001	0.006	
2051	214	0.003	0.001	0.001	0.006	204	0.003	0.001	0.001	0.006	
2052	214	0.003	0.001	0.001	0.006	203	0.003	0.001	0.001	0.006	
2053	213	0.003	0.001	0.001	0.006	203	0.003	0.001	0.001	0.006	
2054	213	0.003	0.001	0.001	0.006	203	0.003	0.001	0.001	0.006	

Year	No Build					Build					Source/Comment
	CO_2	NO_X	PM	SO_2	VOC	CO_2	NO_X	PM	SO_2	VOC	
2055	213	0.003	0.001	0.001	0.006	203	0.003	0.001	0.001	0.006	

Table 32: Fuel Costs

Year	Gasoline	Diesel Fuel	Source
2021	$2.46	$2.58	
2022	$2.34	$2.46	
2023	$2.04	$2.36	
2024	$2.03	$2.47	
2025	$2.01	$2.47	
2026	$2.04	$2.47	
2027	$2.07	$2.48	
2028	$2.11	$2.51	
2029	$2.13	$2.54	
2030	$2.20	$2.53	
2031	$2.29	$2.62	
2032	$2.32	$2.64	
2033	$2.35	$2.66	
2034	$2.37	$2.67	
2035	$2.39	$2.68	
2036	$2.41	$2.71	Based on forecast of transportation fuel costs less Federal and States taxes. Data obtained from US EPA's Annual Energy Outlook 2022 Release. Values deflated to 2020$ from 2021$. Values assumed to be constant after 2050.
2037	$2.43	$2.74	
2038	$2.47	$2.76	
2039	$2.47	$2.78	
2040	$2.50	$2.81	
2041	$2.52	$2.83	
2042	$2.53	$2.83	
2043	$2.56	$2.87	
2044	$2.59	$2.91	
2045	$2.60	$2.93	
2046	$2.63	$2.95	
2047	$2.64	$2.96	
2048	$2.63	$2.96	
2049	$2.64	$2.96	
2050	$2.64	$2.95	
2051	$2.64	$2.95	
2052	$2.64	$2.95	
2053	$2.64	$2.95	
2054	$2.64	$2.95	
2055	$2.64	$2.95	