Cheyenne River
BIA 12 Cherry Creek to Hwy 63
Improvement Project

Benefit-Cost Analysis Report
Oct 2022

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TABLE OF CONTENTS

SECTION I. BCA SUMMARY

OVERVIEW

This memo provides detailed documentation of the Benefit-Cost Analysis (BCA) performed to evaluate the public benefits generated by the Cheyenne River BIA 12 Cherry Creek to Hwy 63 Improvement Project in Cherry Creek, SD. The BCA demonstrates the cost effectiveness of the project for which the project sponsor is seeking Federal support, measured in terms of a benefit-cost ratio (BCR) and net present value (NPV). The Project has independent utility with benefits exceeding cost.

Based upon the BCA presented in the remainder of this document, the project at a 7%/ 3% discounted rate is expected to generate $14.1 million in discounted net benefits and $13.4°million in discounted capital costs. Therefore, the project generates a Net Present Value (NPV) of $0.2 million and a Benefit/ Cost Ratio of 1:1 at 7%/ 3%. Exhibit 1 below summaries the Long-term Outcomes calculated in this BCA.

Exhibit 1: Summary of Benefit Cost Analysis

Cheyenne River BIA 12 Reconstruction Project	Present Value of Capital Costs	PV of Total Benefits	Net Present Value	Benefit/ Cost Ratio
Discounted at 7%/ 3%	($13,3951419)	$14,138,382	$186,963	1:1

I.A.1. Changes since 2020 BCA GUIDANCE

Project costs have also been updated to current cost estimates as of October 2022. USDOT BCA 2022 guidance has been followed to update the standard factors and to update the model to reflect that CO_2 benefits should be discounted at 3 percent..

BCA METHODOLOGY

The BCA methodology used in this analysis is consistent with the U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022. The detailed cost and benefit assumptions are provided in this BCA Appendix. Exhibit 2 describes the Current Status (Baseline- No Build Scenario), the anticipated changes to the baseline (the Build Scenario), types of impacts, population affected, anticipated societal benefits and references to where the details can be found both in this technical memo as well as to which Tab the calculations can be found in the Excel Spreadsheet.

Exhibit 2: Benefit-Cost Analysis Overview Matrix

Metric	No Build	Build	Net Change
Safety – the Project is expected to foster a safe transportation system for the movement of goods and people by reducing accidents in the area related the delays due to the current closure of the bridge			
Projected Accidents 2026-2045			
Collisions- Prop only	40.1	20.4	(19.6)
Injury Accidents	28.1	14.3	(13.7)
Fatalities	0.0	0.0	0.0
Total Accidents	68.1	34.7	(33.4)
State of Good Repair			
Lane Miles	2 lanes	2 lanes	
Condition of Road / Road Rating	gravel/dirt roadway	New paved roadbed	
Economic Competitiveness - Reducing Transportation Cost / Travel Delays			
VHT- 2026-2045			
Autos - VHT	58,846	209	(58,638)
Trucks - VHT	0	0	0
Total - VHT	58,846	209	(58,638)
Environmental Sustainability- Reduction of Energy Use- Gallons of Fuel Used			
Gallons of Fuel Saved			
Autos	22,233	79	(22,154)
Trucks	0	0	0
Total	22,233	79	(22,154)

BACKGROUND

This grant application is for $18 million in NSFTLP FY22 funds to help fund the reconstruction of Cheyenne River BIA 12 from Cherry Creek to Hwy 63.

Exhibit 3: Current Cheyenne River BIA 12

Exhibit 3 above shows the current situation along BIA 12 that provides access to the Cherry Creek Community.

I.C.1 No Build scenario

The No Build alternative represents the base conditions for the project areas. This alternative assumes no significant modifications are made to the roadway systems other than routine maintenance.

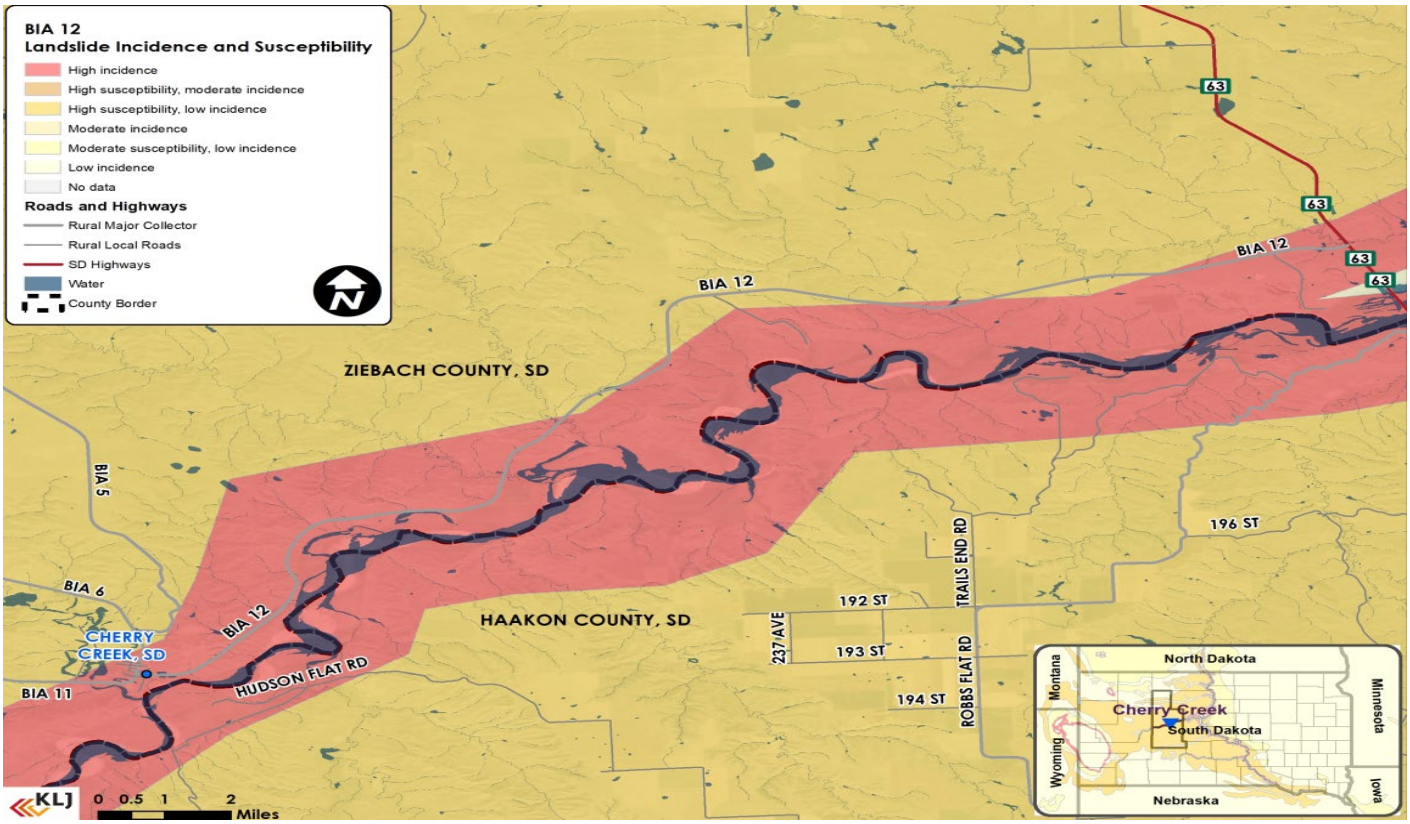
I.C.2 Build Scenario

The preferred alternative encompasses resurfacing a 17.9 mile stretch of BIA Route 12 that was damaged by flooding conditions that occurred in the spring of 2019. Floodwaters over-topped the roadway and caused erosion of roadway surface and in-slopes. The project is needed to improve the roadway stability, increase safety and prevent future deterioration of the roadbed.

BIA Route 12 serves as the primary access for Cherry Creek, SD, which is the largest unincorporated community on the Cheyenne River Reservation. The route connects Cherry Creek, SD to South Dakota Highway 63, as well as access to all services, healthcare, and education. The roadway was originally gravel and later paved with asphalt.

Unfortunately, the asphalt deteriorated to such a point that the tribe pulverized the pavement and now maintains BIA 12 as a gravel road. The project will create a new roadway surface on a foundation of chemically treated base with a chip seal riding surface.

Exhibit 4: Alignment of Proposed Project



I.C.3 BCA Model Development

An Excel spreadsheet-based BCA model was developed for the purpose of this analysis. The model utilizes available data provided by the Project's stakeholders, project specific data elements, and nationally accepted parameters. Many of the national parameters were provided by the United States Department of Transportation (USDOT) specifically for the purposes of Discretionary Grant applications.

I.C.4 Organization of the BCA Memorandum

Section II describes the methodology used in the Analysis.

Section III describes the Project.

Section IV describes the inputs and results of each of the Benefit components of the BCA model. The project specific inputs include items such as freight forecasts, project capital and operating costs, life-cycle costs, annual benefits, and residual value of the project's assets at the end of this analysis.

National modeling parameters include emission rates, crash rates, unit operating costs, values of time, fuel efficiency and monetization factors for all classes of benefits. This section also displays the results of each benefit and cost category.

Section V describes the capital cost components of the BCA model.

Section V summarizes the results of the BCA and the resulting BCA ratio and the Sensitivity Analysis performed on this Project.

I.D. BCA SUMMARY

The results of the BCA analysis indicate a positive Benefit-Cost Ratio. As shown in Exhibit 5, the BCA ratio at a 7%/3% discount rate is 1:1.

Total Discounted Benefits before Maintenance and Residual are estimated to be $12.3 million. These Benefits represent four groups of societal benefits:

Safety – quantified using the reduction of accidents in the area. These savings are monetized using the cost to society of an accident. This Project is anticipated to reduce accidents in the area by 33 accidents over the 20-years post construction saving $0.8 million when discounted.

Environmental Sustainability – quantified by the reduction of fuel usage by vehicle types, autos/ small vans. CO_2 is monetized using the reduction of gallons of fuel used. The savings from decreased dust was not monetized. It is estimated that the completion of this Project will reduce fuel consumption by 22,000 gallons in the 20-year period post construction. The Environmental Savings is estimated at $5,200 when discounted.

Economic Competitiveness – quantified using the estimated hours saved and the reduction of fuel usage which are monetized into reduction of Vehicle Operating costs saved. It is anticipated that Vehicle Hours Traveled will save 58,600 hours of delay due to the availability of the improved BIA 12 road . This estimated to be a travel time savings of $0.2.0 million before discounting and equal to $0.7 million when discounted at 7%

State of Good Repair –The savings of this category has been included in maintenance. It is estimated that the improved road will cost an additional $0.4 million before discounting in road maintenance when the current unimproved gravel road is improved and paved equal to slightly less than $0.1 million when discounted at 7%.

Emergency Response –Completing the reconstruction of this road will reduce emergency response delays which have been monetized as reduction of losses which are estimated to potentially exceed $28 million over the 20 years post construction equaling $10.7 million when discounted at 7%.

Exhibit 5: Benefit Cost Results (20-year analysis - post construction)

Summary Matrix

Areas of Evaluation	Description	Inputs (over the life of the project)	Monetized Value 2020 dollars	Monetized Value Discount Rate 7%/3%
Safety	Crash Reduction Savings	• 49% crash reduction for Property Damage Only, Injury crashes	$ 2,144,966	$ 807,804
Environmental Sustainability	Reduced Pollution	• Emission reductions of: 197 metric tons CO2	$ 17,456	$ 5,163
Economic Competitiveness	Travel Time Savings	• Reduction in 58,600 motor vehicle hours traveled (VHT)	$ 1,936,930	$ 735,284
	Vehicle Operation Cost Savings	• Reduction of 22,000 gallons of fuel	$ 73,787	$ 28,010
State of Good Repair		Not calculated other than in Life cycle		
Emergency Response	Reduction in Losses due to delayed response	• 15,100 response minutes saved	$ 28,275,409	$ 10,736,008
Total Benefits before Maint and Residual Value			$ 32,448,547	$ 12,312,270
Maintenance and Residual		Life Cycle Cost and Residual	$ 8,741,810	$ 1,826,112
Total Benefits			$ 41,190,357	$ 14,138,382
Total Costs			$ 18,673,908	$ 13,951,419
Net Present Value			$ 22,516,449	$ 186,963
Benefit Cost Ratio			2.21	1.01

Total Maintenance and Residual is estimated at $1.8 million when discounted at 7%.

When Total Societal Benefits are added to Maintenance and Residual, Total Benefits from the completion of the Project exceed $14.1 million when discounted.

Total Capital Costs are estimated to be $13.9 million when discounted, producing a Net Present Value of $0.2 million for a Benefit Cost Ratio of 1:1.

SECTION II. METHODOLOGY

A Benefit-Cost Analysis (BCA) is a conceptual framework that quantifies, in monetary terms, as many of the costs and benefits of a project as possible. Benefits are broadly defined. They represent the extent to which people impacted by the project are made better-off, as measured by their own willingness-to-pay. In other words, central to BCA is the idea that people are best able to judge what is "good" for them, i.e. what improves their well-being or welfare. A BCA also adopts the view that a net increase in welfare (as measured by the summation of individual welfare changes) is a good thing, even if some groups within society are made worse off. A project or proposal would be rated positively if the benefits to some are large enough to compensate the losses of others.

Finally, a BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns.

The specific methodology developed for this application was designed using the above BCA principles and is consistent with the INFRA, RAISE and NSFTLP guidelines. The methodology involves:

- Establishing existing and future conditions under the build and no-build scenarios.
- Assessing benefits with respect to each of the five long-term outcomes 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. Department of Transportation (USDOT) guidance for the valuation of travel time savings, 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 USDOT at 7% for non-CO_2.benefits and costs and 3% for CO_2 benefits.

II.A PERIOD OF ANALYSIS

The period of analysis used in the estimation of benefits and costs corresponds to 27 years, consisting of 3 years prior, the current year (2022), 1 year to obligate the funds, 2 years of construction and 20 years of operation after the completion Project including a residual value in year 27. The $20 million Project (2022 dollars) is expected to be funded through federal and local sources. The Tribe is submitting a NSFTLP FY22 Construction Grant request for $18.1°million of the total future project cost. Sources of information are noted under each benefit category in Section IV.

SECTION III. PROJECT DESCRIPTION

Requested funds will used to complete Final engineering, Environmental documentation and Construction in support of the completion of the Project. It is estimated that the completion of the Project improvements will improve safety, decrease delays, and increase mobility of motorized using this road.

Project comparison is with the most likely alternative and a "No Build" scenario

III.A BASE CASE- "NO BUILD SCENARIO"

The base case in the BCA represents the current state "No Build"

The No-Build alternative will continue to be an "as is" status, causing public safety concerns and significant traffic delays.

III.B BUILD ALTERNATIVE

To be conservative in the analysis the analysis estimates that as of 2026, Cheyenne River BIA 12 will be an improved 2-lane paved route, with geometric improvements, and safety enhancements to include rumble strips, and durable markings.

III.C ASSUMPTIONS

For the purposes of this analysis, the proposed project is compared with a no build alternative. The analysis includes total future project costs construction for a total project cost of $20°million ($2022). The BCA was run for a period of 27 years, beginning with 2019 through the construction phase including a residual value calculated in 2045 of $9.1 million ($2020), for the remaining estimated life of the improvements of the project elements.

Estimation of costs and benefits are limited to the 2019 to 2045period. The analysis incorporates assumptions based upon the completion of the improvements in 2025, with full project opening in 2026.

Estimated delays and traffic data were developed based upon historical information gathered by the Tribe and their consulting engineers.

III.D PROJECT BACKGROUND

About the Project

The Cheyenne River Tribe is requesting NSFTLP support in the amount of $18,073,290 for completion of the **BIA 12 Cherry Creek to Hwy 63 Improvement Project (The Project)**. BIA 12 is located on the Cheyenne River Sioux Tribal Reservation. It provides access to Hwy 63, which is the primary connector to the community of Eagle Butte, approximately 40 miles away. Eagle Butte is the largest community on the Reservation (population 1,458). It is the center of

Tribal government as well as essential services, employment, and amenities on the Reservation. BIA 12 to Hwy 63 is approximately 18 miles in length and is the primary connecting roadway for the community of Cherry Creek.

The BIA 12 roadway is an existing route located entirely on the Cheyenne Creek Reservation. It is currently a gravel road in poor and deteriorating condition. It has experienced several gravel and mud slides, causing, at best, unsafe roadway conditions and, at worst, partial closure of the roadway, resulting in the inability of Cherry Creek residents to access critical services in neighboring communities.

The Project proposes reconstruction of the existing gravel roadway to include paving of the entire 18 miles, creating 12-foot driving lanes and 2-foot shoulders. Additional safety features include slope flattening, stabilizing of the road base, installation of guardrails on bridges and in other high-risk areas, and inclusion of both center and side rumble strips. Completion of the Project will provide year-round, all-weather access.

The Project furthers the goals of Department of Transportation (DOT) including addressing safety and state of good repair as well as improving the quality of life for residents of Cherry Creek on the Cheyenne River Reservation and the traveling public in general. The project addresses significant physical deficiencies in the current roadway and supports economic vitality at a regional level as well as critical accessibility and connectivity in a rural and remote location.

This Project is a stand-alone project that creates *independent utility* to meet current and future mobility needs of the area. This project is necessary for the predictable, reliable and safe movement of both people and potentially future goods within the area.

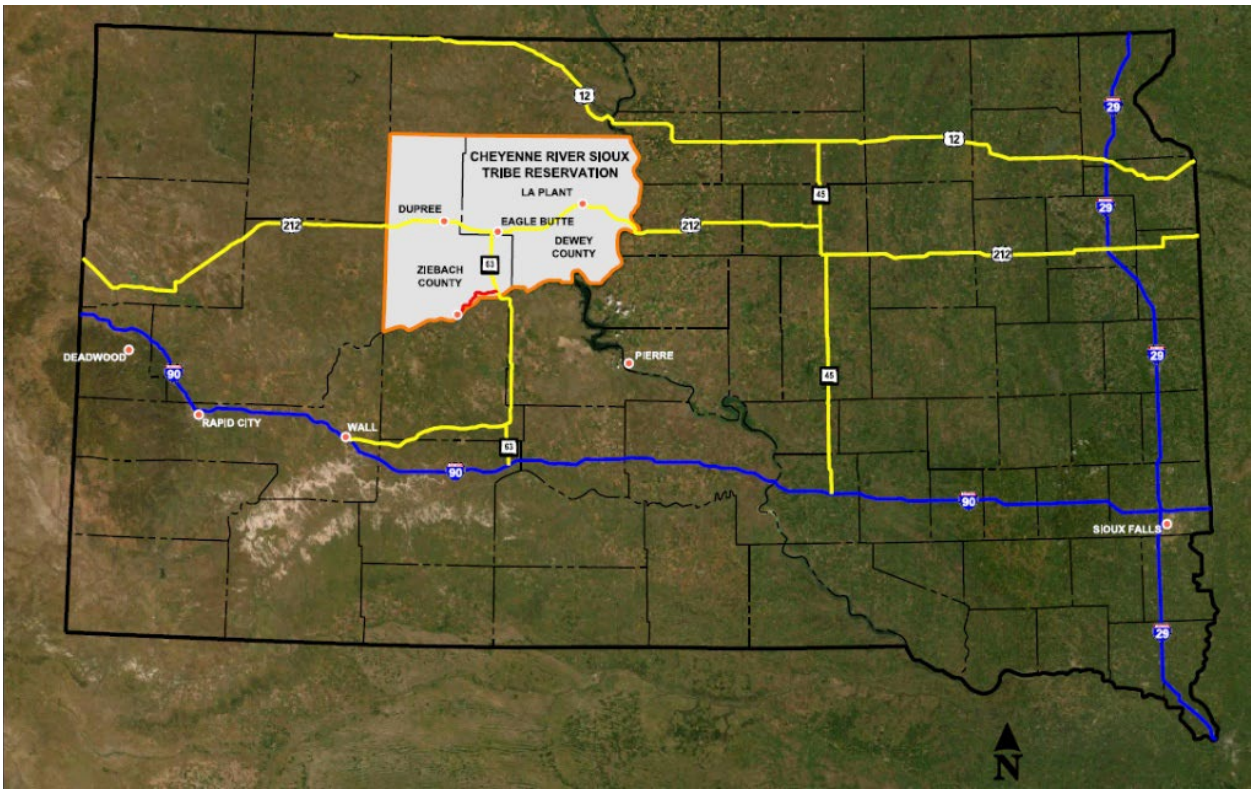
The current condition of the BIA 12is insufficient to meet the traffic needs and presents safety, access, and environmental risks. The existing roadway is a gravel/dirt road with no lane designations, or shoulders. It is does not meet the traffic needs and, in the summer/fall months creates significant dust pollution issues.

The Cheyenne River Indian Reservation is the 4th largest Reservation in the United States with a land mass of approximately 4,300 square miles. It is in South Dakota and is located predominantly in Dewey and Ziebach counties, but also has small parcels of trust land located off the Reservation in Stanley, Haakon, and Meade counties. According to Bureau of Indian Affairs (BIA), there are nearly 16,000 enrolled members of the Tribe with approximately 70 percent of those members, around 11,200 individuals, living on the Reservation (approximately 2,600 members more than the 2022 Census Reservation estimated population data).

The Project is located between the unincorporated community of Cherry Creek (population 282) and the community of Eagle Butte. BIA 12, which connects Cherry Creek to Hwy 63, is approximately 18 miles of gravel roadway. (See: Vicinity Map).

Although there are other gravel/rural routes between Cherry Creek and Eagle Butte, BIA 12 to Hwy 63 is the most direct route (approximately 40 miles total) and the safest route for residents traveling for employment, essential services, and amenities. This is also a school bus and emergency services route.

Exhibit 6: Vicinity Map



III.E IMPACTS

The Project includes the resurfacing of BIA 12 which will:

- Improve safety through improved traffic flow
- Improve safety through decreased delay times for emergency response units
- Reduce fuel consumption and greenhouse gas emissions
- Improve ease of movement for people

SECTION IV. PROJECT BENEFITS

This section describes the key assumptions and results of each of the anticipated project benefit category. Each Category describes the calculation of the benefit and displays the anticipated annual project benefits associated with the No-Build and Build scenarios.

IV.A SUMMARY OF DETAILED BENEFITS

Exhibit 7: Annual Benefits by year

Annual Public Benefits								
Calendar Year	Annual Traffic Trips Delayed	Total Time Saved	Op Cost Saved	Accidents Reduced	Emergency Response Delay Reductions	Non-CO_2 Emission Reductions	CO_2 Emission Reductions	Total Public Benefits
2020								
2021					$ -			
2022					$ -			
2023					$ -			
2024					$ -			
2025					$ -			
2026	3,266	$ 96,754	$ 3,686	$ 85,762	$ 1,413,770	$ 192	$ 561	$ 1,600,725
2027	3,266	$ 96,764	$ 3,686	$ 108,282	$ 1,413,770	$ 196	$ 570	$ 1,623,268
2028	3,267	$ 96,774	$ 3,687	$ 108,292	$ 1,413,770	$ 199	$ 580	$ 1,623,303
2029	3,267	$ 96,783	$ 3,687	$ 108,303	$ 1,413,770	$ 203	$ 590	$ 1,623,337
2030	3,267	$ 96,793	$ 3,687	$ 108,314	$ 1,413,770	$ 207	$ 600	$ 1,623,372
2031	3,268	$ 96,803	$ 3,688	$ 108,325	$ 1,413,770	$ 207	$ 610	$ 1,623,403
2032	3,268	$ 96,812	$ 3,688	$ 108,336	$ 1,413,770	$ 207	$ 620	$ 1,623,434
2033	3,268	$ 96,822	$ 3,688	$ 108,347	$ 1,413,770	$ 207	$ 640	$ 1,623,475
2034	3,269	$ 96,832	$ 3,689	$ 108,357	$ 1,413,770	$ 207	$ 650	$ 1,623,505
2035	3,269	$ 96,842	$ 3,689	$ 108,368	$ 1,413,770	$ 207	$ 660	$ 1,623,536
2036	3,269	$ 96,851	$ 3,690	$ 108,379	$ 1,413,770	$ 207	$ 679	$ 1,623,577
2037	3,270	$ 96,861	$ 3,690	$ 108,390	$ 1,413,770	$ 207	$ 689	$ 1,623,608
2038	3,270	$ 96,871	$ 3,690	$ 108,401	$ 1,413,770	$ 207	$ 699	$ 1,623,639
2039	3,270	$ 96,880	$ 3,691	$ 108,412	$ 1,413,770	$ 207	$ 709	$ 1,623,670
2040	3,271	$ 96,890	$ 3,691	$ 108,422	$ 1,413,770	$ 207	$ 719	$ 1,623,700
2041	3,271	$ 96,900	$ 3,691	$ 108,433	$ 1,413,770	$ 207	$ 729	$ 1,623,731
2042	3,271	$ 96,910	$ 3,692	$ 108,444	$ 1,413,770	$ 207	$ 739	$ 1,623,762
2043	3,272	$ 96,919	$ 3,692	$ 108,455	$ 1,413,770	$ 207	$ 759	$ 1,623,803
2044	3,272	$ 96,929	$ 3,692	$ 108,466	$ 1,413,770	$ 207	$ 769	$ 1,623,834
2045	3,272	$ 96,939	$ 3,693	$ 108,477	$ 1,413,770	$ 207	$ 778	$ 1,623,865
Total	**65,385**	**$ 1,936,930**	**$ 73,787**	**$ 2,144,966**	**$ 28,275,409**	**$ 4,107**	**$ 13,350**	**$ 32,448,547**

Over the Analysis, $1.9 million in Travel Time Value savings, $0.07 million operating cost savings as calculated in fuel savings, $2.1 million in Safety savings, $28.3 million is reduced loss from reduced delays in Emergency Response, and $0.02 million in Environmental Savings. Total Societal Benefits before Maintenance and Residual exceed $32 million.

The analysis as detailed below quantifies monetized benefits which include:

- Safety savings
  - Crash Reduction savings
- Emissions savings
- Economic Competitiveness
  - Time travel savings
  - Operating Cost savings as calculated as Fuel savings

- State of Good Repair- a reduction in maintenance is shown in Maintenance.
- Emergency Response – a reduction in potential loss due to reduced delay to arrival at the scene,

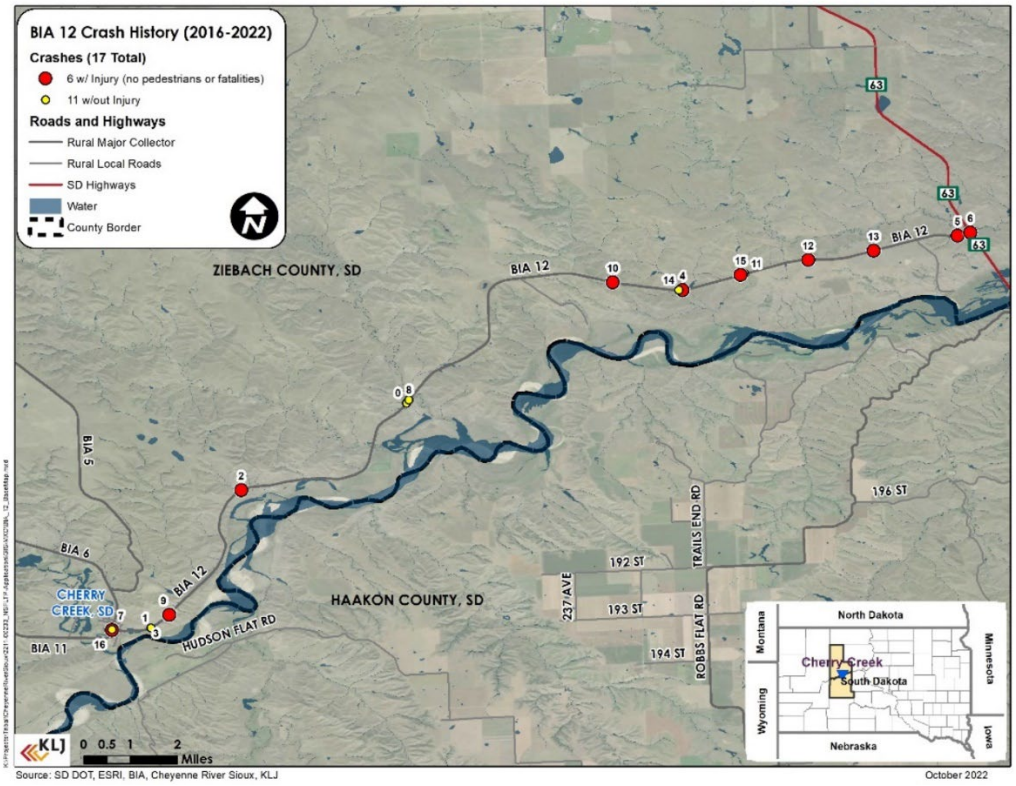
These benefits are driven by increased safety measures and improved travel conditions recognized through the implementation of the Build scenario.

The remainder of this document discusses the summary of findings for each category at the USDOT recommended discount rate(s). This BCA has been developed in accordance with the March 2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs with an analysis period post-construction of 20-years. The BCA follows guidance set forth in the Notice of Funding Opportunity for NSFTLP Discretionary Grants as issued in August 2022.

IV.A.1 SAFETY BENEFITS

Safety benefits were calculated through crash reduction savings as a result of road improvements on BIA 12

Exhibit 8: Crash Locations 2016-2022



Prevention of Accidents and Injuries

In estimating preventable accidents, the Tribe provided a 5-year crash history from 2016-2022.

Exhibit 9: Crash Analysis No Build vs. Build

	Total per Injury Type- 2016-2020	Value per Injury Type	Value of Injuries	No Build Annual Average	Build Annual Average
Property Damage Only	10	$ 4,600	$ 46,000	$ 2.00	0.98
Non-capacitating	0	$ 151,100	$ -	$ -	0.00
Incapacitating	7	$ 557,800	$ 3,904,600	$ 1.40	0.69
Killed	0	$ 11,600,000	$ -	$ -	0.00
Total Crashes	**17**			**$ 3.40**	**1.67**

The Project will significantly improved safety on BIA 12 reducing accidents and delays. Thus, is anticipated to prevent accidents and crashes in the area. Based upon the anticipated improvements, it is estimated that accidents in the area will be reduced by 49 percent.

Exhibit 10: Safety Benefits- Accident Reduction

		No Build			BUILD			Net Reduction in Accidents							
Calendar Year	Project Year	Annual number of Property Damage Only	Annual number of non-capacitating Injuries	Annual number of Fatalities	Annual number of Property Damage Only	Annual number of Injuries	Annual number of Fatalities	Net Number of Annual Property Damage Only	Net Number of Annual Injuries	Net Number of Annual Fatalities	Value of Annual Property Damage Only	Value of Annual Injuries	Value of Annual Fatalities	Annual Crash Savings	Annual Crash Savings 7% discount
Annual Growth rate		0.01%	0.01%	0.01%	0.01%	0.01%	0.01%								
2017		2.0	1.4	0.0											
2018		2.0	1.4	0.0											
2019		2.0	1.4	0.0											
2020		2.0	1.4	0.0											
2021		2.0	1.4	0.0											
2022		2.0	1.4	0.0											
2023		2.0	1.4	0.0											
2024		2.0	1.4	0.0											
2025		2.0	1.4	0.0											
2026	1	2.0	1.4	0.0	1.02	0.71	-	(0.98)	(0.69)	-	$ (4,513)	$ (81,250)	$ -	$ 85,762	$ 57,147
2027	2	2.0	1.4	0.0	1.02	0.71	-	(0.98)	(0.69)	-	$ (4,513)	$ (103,769)	$ -	$ 108,282	$ 67,432
2028	3	2.0	1.4	0.0	1.02	0.71	-	(0.98)	(0.69)	-	$ (4,513)	$ (103,779)	$ -	$ 108,292	$ 63,027
2029	4	2.0	1.4	0.0	1.02	0.71	-	(0.98)	(0.69)	-	$ (4,514)	$ (103,789)	$ -	$ 108,303	$ 58,910
2030	5	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,514)	$ (103,800)	$ -	$ 108,314	$ 55,061
2031	6	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,515)	$ (103,810)	$ -	$ 108,325	$ 51,464
2032	7	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,515)	$ (103,821)	$ -	$ 108,336	$ 48,102
2033	8	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,516)	$ (103,831)	$ -	$ 108,347	$ 44,960
2034	9	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,516)	$ (103,841)	$ -	$ 108,357	$ 42,023
2035	10	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,517)	$ (103,852)	$ -	$ 108,368	$ 39,278
2036	11	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,517)	$ (103,862)	$ -	$ 108,379	$ 36,712
2037	12	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,517)	$ (103,872)	$ -	$ 108,390	$ 34,313
2038	13	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,518)	$ (103,883)	$ -	$ 108,401	$ 32,072
2039	14	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,518)	$ (103,893)	$ -	$ 108,412	$ 29,977
2040	15	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,519)	$ (103,904)	$ -	$ 108,422	$ 28,018
2041	16	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,519)	$ (103,914)	$ -	$ 108,433	$ 26,188
2042	17	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,520)	$ (103,924)	$ -	$ 108,444	$ 24,477
2043	18	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,520)	$ (103,935)	$ -	$ 108,455	$ 22,878
2044	19	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,521)	$ (103,945)	$ -	$ 108,466	$ 22,881
2045	20	2.0	1.4	0.0	1.02	0.72	-	(0.98)	(0.69)	-	$ (4,521)	$ (103,956)	$ -	$ 108,477	$ 22,883
Total Benefits 2026-2045		**40.078**	**28.055**	**0.000**	**20.440**	**14.308**	**0.000**	**(19.64)**	**(13.75)**	**0.00**	**($90,336)**	**($2,054,630)**	**$0**	**$2,144,966**	**$807,804**

Total Safety benefits are estimated at $2.1 million before discounting and $0.8 million when discounted at 7 percent.

IV.A.2: EMISSION SAVINGS

Exhibit 11: Assumptions for Emission Savings

Assumptions and Factors		Source	
VOC produced when idling grams/hour (light-duty gasoline-fueled vehicles - up to 6000lbs GVW gasoline fueled passenger cars.)	2.683	EPA Office of Transportation and Air Quality (EPA420-F-08-025) October 2008 Table 1: LDGV https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EVXV.PDF?Dockey=P100EVXV.PDF	
VOC produced when idling grams/hour (heavy-duty diesel vehicles - trucks)	3.868	EPA Office of Transportation and Air Quality (EPA420-F-08-025) October 2008 https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EVXV.PDF?Dockey=P100EVXV.PDF	
NOx produced when idling grams/hour (light-duty gasoline-fueled vehicles - up to 6000lbs GVW gasoline fueled passenger cars.)	3.515	EPA Office of Transportation and Air Quality (EPA420-F-08-025) October 2008 https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EVXV.PDF?Dockey=P100EVXV.PDF	
NOx produced when idling grams/hour (heavy-duty diesel vehicles - trucks)	39.0515	EPA Office of Transportation and Air Quality (EPA420-F-08-025) October 2008 https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EVXV.PDF?Dockey=P	
$PM_{2.5}$ produced when idling grams/hour (light-duty gasoline-fueled vehicles - up to 6000lbs GVW gasoline fueled passenger cars.)	0	EPA Office of Transportation and Air Quality (EPA420-F-08-025) October 2008 https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EVXV.PDF?Dockey=P100EVXV.PDF	
$PM_{2.5}$ produced when idling grams/hour (heavy-duty diesel vehicles - trucks)	1.092	EPA Office of Transportation and Air Quality (EPA420-F-08-025) October 2008 https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EVXV.PDF?Dockey=P100EVXV.PDF	
CO2 produced grams/gallon (gasoline)	8,887	USDOT BCA Guidance Table A-7 pg.34, References and Notes	
CO2 produced grams/gallon (diesel)	10,180	USDOT BCA Guidance Table A-7 pg.34, References and Notes	
1 gram = .000001 metric tons	0.000001		
1 gram = .000001 short tons	0.0000011		
1 metric ton = 1.1015 short tons	1.1015	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Mar 2022, pg. 38	
Gasoline consumed per hour idling (value for large sedan used)	0.34	gallons	Fuel consumption reference
Diesel consumed per hour idling (tractor-semitrailer)	0.64	gallons	Fuel consumption reference
Life of project (years)	20		
ADT % passenger vehicles	100.0%	Developed through 2019 VISSIM Microsimulation Traffic Analysis in the project area	
ADT % trucks	0.0%	Developed through 2019 VISSIM Microsimulation Traffic Analysis in the project area	
Days per year	365		
VOC $/short ton	see annual costs	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Mar 2022, Table A-6: Damage Cost for Pollutant Emissions per MT pg. 38	
CO2 $/metric ton (2019-2034)	"		
CO2 $/metric ton (2035-2045)	"		
NOx $/short ton	"		
PMs $/short ton	"		
Liters per gallon	3.78541178		
Posted Speed Limit	30	miles per hour	
Fuel usage - Autos mpg	24.7	Texas Transportation Institute. A Modal Comparison of Domestic Freight Transportation Effects on the General Public. Jan 2017	
Fuel usage - Trucks mpg	6		

CO_2 Emission Reductions

Emission savings were calculated based upon fuel saving from the reduction of fuel usage. CO_2 was calculated using a conversion rate of 8,887 grams per gallon of gasoline. Once the Metric Tons (MT) of CO_2 were estimated, the dollar savings was calculated using the cost per MT of CO_2 as provided in the March 2022 BCA Guidance.

It is estimated that the completion of this Project will save 197 MT of CO_2 equating to $0.013 million in CO_2 emissions over the analysis period. When discounted at 3% per the 2022 Guidance, CO_2 emission savings is estimated to be $0.003 million.

Other Emissions Savings

Emission savings were calculated based upon fuel saving from the reduction of fuel used during BIA 12 blockages/ closures based upon the factors shown in the Assumptions below.

Exhibit 12: Environmental Benefits

Environmental Savings Benefits - Build vs No Build															
Calendar Year	Project Year	No-BUILD	BUILD	VHT Savings (annual)	Percent of VHT - All Purpose	Percent of VHT - Truck	Gasoline Savings - All Purpose	Diesel Savings - Trucks		CO2 savings	NOx Savings	$PM_{2.5}$ Savings	CO_2 savings	NOx Savings	$PM_{2.5}$ Savings
		VHT			100%	0%	**Gallons** .34 gallons consumed per hour of item time	**Gallons** .64 gallons consumed per hour of item time		grams/gallon	grams/hour	grams/hour	metric ton	metric ton	metric ton
2019	0		-	-	-	-	-	-		-	-	-	-	-	-
2020	0		-	-	-	-	-	-		-	-	-	-	-	-
2021	0	3,265	-	-	-	-	-	-		-	-	-	-	-	-
2022	0	3,265	-	-	-	-	-	-		-	-	-	-	-	-
2023	0	3,265	-	-	-	-	-	-			-	-	-	-	-
2024	0	3,266	-	-	-	-	-	-		-	-	-	-	-	-
2025	0	3,266	-												
2026	1	3,266	12	3,255	3,255	-	1,107	-		9,834,841	11,441	-	10	0.011	-
2027	2	3,267	12	3,255	3,255	-	1,107	-		9,835,828	11,442	-	10	0.011	-
2028	3	3,267	12	3,256	3,256	-	1,107	-		9,836,815	11,443	-	10	0.011	-
2029	4	3,267	12	3,256	3,256	-	1,107	-		9,837,802	11,444	-	10	0.011	-
2030	5	3,268	12	3,256	3,256	-	1,107	-		9,838,790	11,445	-	10	0.011	-
2031	6	3,268	12	3,257	3,257	-	1,107	-		9,839,777	11,447	-	10	0.011	-
2032	7	3,268	12	3,257	3,257	-	1,107	-		9,840,765	11,448	-	10	0.011	-
2033	8	3,269	12	3,257	3,257	-	1,107	-		9,841,752	11,449	-	10	0.011	-
2034	9	3,269	12	3,257	3,257	-	1,108	-		9,842,740	11,450	-	10	0.011	-
2035	10	3,269	12	3,258	3,258	-	1,108	-		9,843,728	11,451	-	10	0.011	-
2036	11	3,270	12	3,258	3,258	-	1,108	-		9,844,715	11,452	-	10	0.011	-
2037	12	3,270	12	3,258	3,258	-	1,108	-		9,845,703	11,453	-	10	0.011	-
2038	13	3,270	12	3,259	3,259	-	1,108	-		9,846,692	11,455	-	10	0.011	-
2039	14	3,271	12	3,259	3,259	-	1,108	-		9,847,680	11,456	-	10	0.011	-
2040	15	3,271	12	3,259	3,259	-	1,108	-		9,848,668	11,457	-	10	0.011	-
2041	16	3,271	12	3,260	3,260	-	1,108	-		9,849,656	11,458	-	10	0.011	-
2042	17	3,272	12	3,260	3,260	-	1,108	-		9,850,645	11,459	-	10	0.011	-
2043	18	3,272	12	3,260	3,260	-	1,109	-		9,851,633	11,460	-	10	0.011	-
2044	19	3,272	12	3,261	3,261	-	1,109	-		9,852,622	11,462	-	10	0.011	-
2045	20	3,273	12	3,261	3,261	-	1,109	-		9,853,611	11,463	-	10	0.011	-
During 20 year Analysis Period		**62,125**	**232**	**65,159**	**65,159**	**-**	**22,154**	**-**		**196,884,463**	**229,035**	**-**	**197**	**0**	**-**

It is estimated that the Project will save 197 MT of CO_2, and very limited NOx over the analysis period.

Exhibit 13: Environmental Savings

Calendar Year	Project Year	Monetized value of VOC savings	Monetized value of NOx savings	Monetized value of PMs savings	Total Savings Non-CO_2	Discounted 7%	Monetized value of CO2 savings	Total Savings CO_2	Discounted 3%
2019	0	-	-	-	-	-			
2020	0	-	-	-	-	-			
2021	0	-	-	-	-	-			
2022	0	-	-	-	-	-			
2023	0	-	-	-	-	-			
2024	0	-	-	-	-	-			
2025	0								
2026	1	-	$ 192	$ -	$ 192	$ 196	$ 561	$ 561	$ 167
2027	2	$ -	$ 196	$ -	$ 196	$ 170	$ 570	$ 570	$ 165
2028	3	$ -	$ 199	$ -	$ 199	$ 160	$ 580	$ 580	$ 163
2029	4	$ -	$ 203	$ -	$ 203	$ 152	$ 590	$ 590	$ 161
2030	5	$ -	$ 207	$ -	$ 207	$ 144	$ 600	$ 600	$ 159
2031	6	$ -	$ 207	$ -	$ 207	$ 135	$ 610	$ 610	$ 156
2032	7	$ -	$ 207	$ -	$ 207	$ 127	$ 620	$ 620	$ 154
2033	8	$ -	$ 207	$ -	$ 207	$ 120	$ 640	$ 640	$ 152
2034	9	$ -	$ 207	$ -	$ 207	$ 113	$ 650	$ 650	$ 152
2035	10	$ -	$ 207	$ -	$ 207	$ 106	$ 660	$ 660	$ 150
2036	11	$ -	$ 207	$ -	$ 207	$ 100	$ 679	$ 679	$ 148
2037	12	$ -	$ 207	$ -	$ 207	$ 94	$ 689	$ 689	$ 146
2038	13	$ -	$ 207	$ -	$ 207	$ 88	$ 699	$ 699	$ 144
2039	14	$ -	$ 207	$ -	$ 207	$ 83	$ 709	$ 709	$ 142
2040	15	$ -	$ 207	$ -	$ 207	$ 78	$ 719	$ 719	$ 139
2041	16	$ -	$ 207	$ -	$ 207	$ 74	$ 729	$ 729	$ 137
2042	17	$ -	$ 207	$ -	$ 207	$ 61	$ 739	$ 739	$ 132
2043	18	$ -	$ 207	$ -	$ 207	$ 62	$ 759	$ 759	$ 133
2044	19	$ -	$ 207	$ -	$ 207	$ 63	$ 769	$ 769	$ 134
2045	20	$ -	$ 207	$ -	$ 207	$ 64	$ 778	$ 778	$ 135
During 20 year Analysis Period		**-**	**4,107**	**-**	**4,107**	**2,192**	**13,350**	**13,350**	**2,971**
							17,456		5,163

Total Savings before discounting is estimated to be $17,456 and $5,163 when discounted.

IV.A.3: ECONOMIC COMPETITIVENESS

The Project will enhance local, regional, and national economic competitiveness of the project area by providing more efficient motor vehicle travel and transportation of people to and from the Cherry Creek area. This project monetizes three areas of economic competitiveness:

1. Travel time savings
2. Fuel savings

The Project provides economic benefits in travel time savings of $1.9 million in 2020 dollars. Fuel savings of $0.07 million in 2020 dollars are recognized through the reduction in vehicle hours traveled due to potential road closures.

Travel Time Savings

The proposed improvements will allow traffic to travel through the project area without delay or the need for detours, resulting in a reduction of 58,600 vehicle hours traveled as a result of idling during delays. When fully discounted, monetized benefits of Travel Time Savings over the life of the project exceed $0.7 million.

The time savings calculations for delay times were calculated for this project. Presently, 100 percent of traffic through the project area is passenger traffic. Per 2022 USDOT BCA Guidance, hourly value of time rates were used as follows: $17.80 for all-purpose passenger traffic (1.67 passengers per vehicle. It is estimated that traffic counts grow approximately 0.01 percent annually.

Exhibit 14: Assumptions used in calculating Travel Time Savings

Travel Time Savings					
Vehicles per day	195	2021 numbers; average counts on BIA 12	**Days per year**	365	
Cars/Personal	100%	Tribal data	**Annual growth rate**	0.01%	engineer's estimate
Trucks	0%	Tribal data	**Accident induced delay**	23	hours/year
			Road Closure delays due to slides / floods	3242	
			Direct Build - no delay	0	hours/year
			Net Delay	3265	hours/year
Passengers per vehicle (All purposes)	1.67	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Mar 2022	**Hourly Value of Travel Time (all purposes)**	$ 17.80	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Mar 2022
Passengers per truck	1	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Mar 2022	**Hourly Value of Travel Time (truck drivers)**	$ 32.00	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Mar 2022

Value of Time

Value of time savings was calculated on travel time costs for traffic delays due to roadway closures/ delays. Per 2022 BCA Guidance, for Discretionary Grant hourly value of time rates were used as follows: $17.80 for all purpose passenger traffic (1.67 passengers per vehicle).

Exhibit 15: Detour Routes if the Road is closed or blocked

Exhibit 16 Average Added Route Miles if Detour Required

Detour routes		
Cherry Creek to Eagle Butte, 39.0 miles	39.2	miles
Cherry Creek to Eagle Butte Detour 1, 51.9 miles	51.9	miles
Cherry Creek to Eagle Butte Detour 2, 96.4 miles	96.4	miles
	34.95	added miles if detour required
Cherry Creek to Pierre, 45.3 miles	45.3	miles
Cherry Creek to Pierre detour, 77.6 miles	77.6	miles
	32.3	

Exhibit 16 shows the average detour required if BIA 12 is closed for any reason is approximately 35 additional miles of travel between Cherry Creek and Eagle Butte.

Exhibit 17: Probability of Road Closure due to Floods / Slides

Probablity of Road Close due to Flood/ slides		
Annual Probablity of Closure	0.1428	once every 7 years based upon historical rec
Length of Closure	4	months
Monthly Trips	5931	
Estimate of Annual trips delayed	3388	
Estimated Average annual hours of delay	3,242	

Exhibit 17 shows the assumptions used in the Travel Time Savings calculations. Based upon historical closures of BIA 12 due to flooding / slides, it is estimated that a road closure occurs approximately every 7 years and lasts up to 4 months. The calculation is based upon the probability of an annual closures at 1 every 7 years or 14.28 percent per year times the average monthly trips to get Estimated Annual trips delayed. The Estimate Annual trips delayed is multiplied by the difference in travel time between the direct route and the detour route to calculate the Estimated Average Annual Hours of Delay.

Exhibit 18 below shows the results of the calculation to be a Travel Time Savings of $1.9 million in ($2020) and at 7 percent discount $0.7 million in Total Travel Time Value over the 20-year period post construction of the Project. It is estimated that construction of the Project will save vehicle occupants over 58,600 hours during the 20-year analysis period.

Exhibit 18. Travel Time Value Savings

Calendar Year	Project Year	Base Condition- Delay (vehicle hours/year)	Preferred Alternative (vehicle hours/year)	Difference in VHT (vehicle hours/year)	Annual Savings in VHT (cars/personal)	Annual Savings in VHT (Trucks)	Annual Savings in Constant Dollars	Present Value of Savings (dollars) (7% discount rate)
					100%	0%		
2020			-	-				
2021		3,265	-					
2022		3,265	-					
2023		3,265	-					
2024		3,266	-					
2025		3,266						
2026	1	3,266	12	3,255	$ 96,754	$ -	$ 96,754	$ 64,471
2027	2	3,267	12	3,255	$ 96,764	$ -	$ 96,764	$ 60,260
2028	3	3,267	12	3,256	$ 96,774	$ -	$ 96,774	$ 56,323
2029	4	3,267	12	3,256	$ 96,783	$ -	$ 96,783	$ 52,644
2030	5	3,268	12	3,256	$ 96,793	$ -	$ 96,793	$ 49,205
2031	6	3,268	12	3,257	$ 96,803	$ -	$ 96,803	$ 45,990
2032	7	3,268	12	3,257	$ 96,812	$ -	$ 96,812	$ 42,986
2033	8	3,269	12	3,257	$ 96,822	$ -	$ 96,822	$ 40,178
2034	9	3,269	12	3,257	$ 96,832	$ -	$ 96,832	$ 37,553
2035	10	3,269	12	3,258	$ 96,842	$ -	$ 96,842	$ 35,100
2036	11	3,270	12	3,258	$ 96,851	$ -	$ 96,851	$ 32,807
2037	12	3,270	12	3,258	$ 96,861	$ -	$ 96,861	$ 30,664
2038	13	3,270	12	3,259	$ 96,871	$ -	$ 96,871	$ 28,661
2039	14	3,271	12	3,259	$ 96,880	$ -	$ 96,880	$ 26,788
2040	15	3,271	12	3,259	$ 96,890	$ -	$ 96,890	$ 25,038
2041	16	3,271	12	3,260	$ 96,900	$ -	$ 96,900	$ 23,403
2042	17	3,272	12	3,260	$ 96,910	$ -	$ 96,910	$ 21,874
2043	18	3,272	12	3,260	$ 96,919	$ -	$ 96,919	$ 20,445
2044	19	3,272	12	3,261	$ 96,929	$ -	$ 96,929	$ 20,447
2045	20	3,273	12	3,261	$ 96,939	$ -	$ 96,939	$ 20,449
Total Benefits 2026-2045		**58,846**	**209**	**58,638**	**1,936,930**	**$ -**	**$ 1,936,930**	**$ 735,284**

Operating Cost as calculated by Fuel Savings

The calculation uses an estimated average consumption per hour of 0.34 gallons (gasoline) for passenger vehicles. The national average price of gasoline in 2020 dollars is $3.33 per gallon.

Fuel savings were calculated using base condition and preferred alternative traffic volumes developed through the traffic analysis and forecasting model. Fuel savings also assume that 100 percent of the ADT is person vehicle traffic.

Exhibit 19: Assumptions for Fuel Usage

Vehicle Use Assumptions			
National average fuel consumption per hour - Trucks	0.64	gallons	A Glance at Clean Freight Strategies
National average fuel consumption per hour - cars	0.34	gallons	DOE, Office of Energy Efficiency & Renewable Energy. Fuel consumption reference. Source: Argonne National Laboratory, Idling Reduction Savings Calculator, accessed December 2014.
Average price of gasoline- Sept 2022 PADD2 in 2020$	$3.33	per gallon	https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_m.htm
Average price of diesel-Sept 2022 PADD2 in 2020$	$4.57	per gallon	
ADT Percentage passenger traffic	100.0%		Developed through Traffic Analysis in the project area
ADT Percentage truck/bus traffic	0.0%		Developed through Traffic Analysis in the project area

Exhibit 20: Fuel Savings

Calendar Year	Project Year	Base Condition	BUILD Alternative	VHT Savings (annual)	Percent of VHT - All Purpose	Percent of VHT - Truck	Gasoline Savings - All Purpose	Diesel Savings - Trucks	Monetized Gasoline Savings - All Purpose	Monetized Diesel Savings - Truck	Total Savings	Discounted 7%
		Daily VHT (see travel time savings tab)			100%	0%	Gallons .34 gallons consumed per hour of item time	Gallons .64 gallon consumed per hour of item time	$3.33/gallon	$4.57/gallon		
2020												
2021		3,265										
2022		3,265										
2023		3,265										
2024		3,266										
2025		3,266	-									
2026	1	3,266	12	3,255	3,255	-	1,107	-	3,686	-	$ 3,686	$ 2,456
2027	2	3,267	12	3,255	3,255	-	1,107	-	3,686	-	$ 3,686	$ 2,296
2028	3	3,267	12	3,256	3,256	-	1,107	-	3,687	-	$ 3,687	$ 2,146
2029	4	3,267	12	3,256	3,256	-	1,107	-	3,687	-	$ 3,687	$ 2,005
2030	5	3,268	12	3,256	3,256	-	1,107	-	3,687	-	$ 3,687	$ 1,874
2031	6	3,268	12	3,257	3,257	-	1,107	-	3,688	-	$ 3,688	$ 1,752
2032	7	3,268	12	3,257	3,257	-	1,107	-	3,688	-	$ 3,688	$ 1,638
2033	8	3,269	12	3,257	3,257	-	1,107	-	3,688	-	$ 3,688	$ 1,531
2034	9	3,269	12	3,257	3,257	-	1,108	-	3,689	-	$ 3,689	$ 1,431
2035	10	3,269	12	3,258	3,258	-	1,108	-	3,689	-	$ 3,689	$ 1,337
2036	11	3,270	12	3,258	3,258	-	1,108	-	3,690	-	$ 3,690	$ 1,250
2037	12	3,270	12	3,258	3,258	-	1,108	-	3,690	-	$ 3,690	$ 1,168
2038	13	3,270	12	3,259	3,259	-	1,108	-	3,690	-	$ 3,690	$ 1,092
2039	14	3,271	12	3,259	3,259	-	1,108	-	3,691	-	$ 3,691	$ 1,020
2040	15	3,271	12	3,259	3,259	-	1,108	-	3,691	-	$ 3,691	$ 954
2041	16	3,271	12	3,260	3,260	-	1,108	-	3,691	-	$ 3,691	$ 892
2042	17	3,272	12	3,260	3,260	-	1,108	-	3,692	-	$ 3,692	$ 833
2043	18	3,272	12	3,260	3,260	-	1,109	-	3,692	-	$ 3,692	$ 779
2044	19	3,272	12	3,261	3,261	-	1,109	-	3,692	-	$ 3,692	$ 779
2045	20	3,273	12	3,261	3,261	-	1,109	-	3,693	-	$ 3,693	$ 779
Total Benefits 2026-2045		**65,391**	**232**	**65,159**	**65,159**	**-**	**22,154**	**-**	**$ 73,787**	**-**	**$ 73,787**	**$ 28,010**

It is estimated that Fuel savings in 2020 dollars will exceed $73,700 equal to $28,010 when discounted at 7 percent.

IV.A.4. STATE OF GOOD REPAIR

The Project will focus on the state of good repair through improved efficiency and operational considerations. These costs are reflected in the maintenance costs.

IV.A.5. EMERGENCY RESPONSE

The monetized value for emergency response delays is based on FEMA's model for loss of fire services. This analysis looks at probability of loss of property due to delayed fire services. Following FEMA's model as recommended in the 2022 USDOT BCA guidance, a total annual loss of $1.4 million ($2020) was monetized over the analysis period.

Exhibit 21: Assumptions for Emergency Response Loss due to delayed response

References			
Road closure induced emergency response delays per year	1.1		
Average delay time due to closure / required detour	57	minutes	
Average loss per structure fire (2015 dollars, adjusted for inflation per http://www.usinflationcalculator.com/) Source: http://www.nfpa.org/research/reports-and-statistics/fires-in-the-us/overall-fire-problem/fire-loss-in-the-united-states	$ 20,519		
90th percentile fire response time (US Fire Administration) http://nfa.usfa.dhs.gov/downloads/pdf/statistics/v5i7.pdf	11	minutes	Average response time is 8 minutes, to be conservative we choose the 90th percentile, 11 minutes.
Average loss per response minute	$ 1,865		
Months/year	12		

Exhibit 22: Emergency Response Time Savings

Emergency Response Time Savings Benefits - Build vs No Build						
Calendar Year	Project Year	Base Condition (minutes)	Preferred Alternative (minutes)	Response Time Savings (minutes)	Annual Savings in Constant Dollars	Annual Savings 7% discount
		Closure induced response time delay				
2021						
2022						
2023						
2024						
2025						
2026	1	758	0	758	$ 1,413,770	$ 942,055
2027	2	758	0	758	$ 1,413,770	$ 880,425
2028	3	758	0	758	$ 1,413,770	$ 822,827
2029	4	758	0	758	$ 1,413,770	$ 768,997
2030	5	758	0	758	$ 1,413,770	$ 718,689
2031	6	758	0	758	$ 1,413,770	$ 671,672
2032	7	758	0	758	$ 1,413,770	$ 627,731
2033	8	758	0	758	$ 1,413,770	$ 586,664
2034	9	758	0	758	$ 1,413,770	$ 548,285
2035	10	758	0	758	$ 1,413,770	$ 512,415
2036	11	758	0	758	$ 1,413,770	$ 478,893
2037	12	758	0	758	$ 1,413,770	$ 447,564
2038	13	758	0	758	$ 1,413,770	$ 418,284
2039	14	758	0	758	$ 1,413,770	$ 390,919
2040	15	758	0	758	$ 1,413,770	$ 365,345
2041	16	758	0	758	$ 1,413,770	$ 341,444
2042	17	758	0	758	$ 1,413,770	$ 319,107
2043	18	758	0	758	$ 1,413,770	$ 298,230
2044	19	758	0	758	$ 1,413,770	$ 298,230
2045	20	758	0	758	$ 1,413,770	$ 298,230
Total Benefits During Project Life (2026-2045)				15,158	$ 28,275,409	$ 10,736,008

It is estimated that road closures could cause an annual response time delay of 758 minutes, when monetized $28.3 million in 2020 dollars or $10.7 million when discounted at 7 percent over the life of the project.

SECTION V. PROJECT COSTS

V.1. CAPITAL COSTS

Exhibit 23: Summary of Project Capital Costs

Costs in $2020

Project Component	2020	2021	2022	2023	2024	2025	Total Costs
BIA 12 Upgrade			$ -	$ -	$ 10,428,191	$ 7,821,143	$ 18,249,334
Estimated Construction Cost		$ -	$ -	$ -	$ 10,428,191	$ 7,821,143	$ 18,249,334
Estimated Engineering, Contingencies and Taro Fee included above							
Estimated Total Project Cost	$ -	$ -	$ -	$ -	$ 10,428,191	$ 7,821,143	$ 18,249,334
Estimated Total Project Cost (7% discount)	$ -	$ -	$ -	$ -	$ 7,955,617	$ 5,576,367	$ 13,531,984

Total Project Costs are estimated to be $18.2 million in $2020 and $13.5 million when discounted at 7 percent based upon the October 2022 estimate.

V.2. PROJECT SCHEDULE

Exhibit 24: Project Schedule

Project Schedule

	2020				2022				2023				2024				2025			
NSFRLP Award Announcement																				
Obligation of NSFTLP FY22 Funds									■	■	■	■								
Advertise /Bidding													■							
Purchase Construction Materials													■							
Construction														■	■	■	■	■	■	
Project Close-out																				■

Footnote*

Applicant may request Pre-Award match credit for eligible costs between the grant award date and the date of obligation.

Project Completion

With a successful award in Sprint 2023, the project can go to bid in Q1 2024 and be completed in Q3 2025 followed by a 90-day close-out period.

.V.3. LIFE CYCLE COSTS

KLJ, the Tribe's consulting engineers have estimated the life cycle cost of the No-Build versus the Build scenarios as presented in Exhibit 25.

Exhibit 25: Life Cycle Costs Assumptions

Assumption for Maintenance of the Corridor						
No Build	Facility		Unit	Annual Maintenance	life	in service
				Cost per Year		
	Roadway		Annual	$ 66,857		
Build	Facility		Unit	Annual Maintenance	life	in service
				Cost per Year		
	Roadway	Chip and seal	Every 7 years	$ 860,000		2026
				$ 860,000		

Currently, over $66,800 is spent on average on the maintenance of the Project. Based upon the improvements, it is estimate that the improved roadway will require approximately $860,000 in maintenance for chip and seal every 7 years.

Exhibit 26: Maintenance Cost

Calendar Year	Project Year	$2020 No Build	$2020 Build	Total Maintenance Savings	Discounted at 7%
2019					
2020					
2021					
2022					
2023					
2024					
2025					
2026	1	$ 66,857	$ -	$ 66,857	$ 44,550
2027	2	$ 66,857		$ 66,857	$ 41,635
2028	3	$ 66,857		$ 66,857	$ 38,911
2029	4	$ 66,857		$ 66,857	$ 36,366
2030	5	$ 66,857		$ 66,857	$ 33,987
2031	6	$ 66,857		$ 66,857	$ 31,763
2032	7	$ 66,857	$ 860,000	$ (793,143)	$ (352,165)
2033	8	$ 66,857		$ 66,857	$ 27,743
2034	9	$ 66,857		$ 66,857	$ 25,928
2035	10	$ 66,857		$ 66,857	$ 24,232
2036	11	$ 66,857		$ 66,857	$ 22,647
2037	12	$ 66,857		$ 66,857	$ 21,165
2038	13	$ 66,857		$ 66,857	$ 19,781
2039	14	$ 66,857	$ 860,000	$ (793,143)	$ (219,311)
2040	15	$ 66,857		$ 66,857	$ 17,277
2041	16	$ 66,857		$ 66,857	$ 19,781
2042	17	$ 66,857		$ 66,857	$ 18,487
2043	18	$ 66,857		$ 66,857	$ 17,277
2044	19	$ 66,857		$ 66,857	$ 16,147
2045	20	$ 66,857		$ 66,857	$ 15,091
Total Benefits		$ 1,337,143	$ 1,720,000	$ (382,857)	$ (98,708)

It is estimated that the Project maintenance cost will cost $1.7 million over the 20 years post construction which will be offset by the reduction of $1.3 million of reduced maintenance on the currently anticipated for the area, for a net maintenance cost will increase of $0.4 million in 2020 dollars or $0.1 million when discounted at 7 percent.

V.4. RESIDUAL VALUE AT YEAR 2045

Exhibit 27: Residual Value

Costs in $2020							
Project Component	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**Total Costs**
BIA 12 Upgrade			$ -	$ -	$ 10,428,191	$ 7,821,143	$ 18,249,334
Estimated Construction Cost		$ -	$ -	$ -	$ 10,428,191	$ 7,821,143	$ 18,249,334
Estimated Engineering, Contingencies and Taro Fee included above							
Estimated Total Project Cost	**$ -**	**$ -**	**$ -**	**$ -**	**$ 10,428,191**	**$ 7,821,143**	**$ 18,249,334**
Estimated Total Project Cost (7% discount)	**$ -**	**$ -**	**$ -**	**$ -**	**$ 7,955,617**	**$ 5,576,367**	**$ 13,531,984**
							$ -

Cost Category	**Initial Capital Costs in Constant Dollars (2020)**	**Factor**	**Remaining Value**	**Remaining Value (2045) 7% discount**
BIA 12 Upgrade	$ 18,249,334	0.50	$ 9,124,667	$ 1,924,820
		-	$ -	$ -
Present Value of Total Remaining Capital Value			**$ 9,124,667**	**$ 1,924,820**

The improvements are estimated to have a varying asset life of 40 years. Hence by year 20 post-construction, it is assumed that the residual value of the assets will equate to 50 percent of the capital investment. Total Residual Value is estimated to be $9.1 million in 2020 dollars or $1.9 million when discounted at 7 percent.

SECTION VI. LONG TERM OUTCOMES

Summary of the Benefit Cost Analysis

A favorable Benefit-Cost Ratio is one that exceeds 1.0, indicating that the 20-year analysis of the benefits post-construction, life cycle cost and residual value of the asset exceed the capital costs expended during the analysis period.

VI.A. RESULTS

Exhibit 28: Summary of the Long- Term Outcome estimated in the BCA.

Summary Matrix

Areas of Evaluation	Description	Inputs (over the life of the project)	Monetized Value 2020 dollars	Monetized Value Discount Rate 7%/3%
Safety	Crash Reduction Savings	• 49% crash reduction for Property Damage Only, Injury crashes	$ 2,144,966	$ 807,804
Environmental Sustainability	Reduced Pollution	• Emission reductions of: 197 metric tons CO2	$ 17,456	$ 5,163
Economic Competitiveness	Travel Time Savings	• Reduction in 58,600 motor vehicle hours traveled (VHT)	$ 1,936,930	$ 735,284
	Vehicle Operation Cost Savings	• Reduction of 22,000 gallons of fuel	$ 73,787	$ 28,010
State of Good Repair		Not calculated other than in Life cycle		
Emergency Response	Reduction in Losses due to delayed response	• 15,100 response minutes saved	$ 28,275,409	$ 10,736,008
Total Benefits before Maint and Residual Value			$ 32,448,547	$ 12,312,270
Maintenance and Residual		Life Cycle Cost and Residual	$ 8,741,810	$ 1,826,112
Total Benefits			$ 41,190,357	$ 14,138,382
Total Costs			$ 18,673,908	$ 13,951,419
Net Present Value			$ 22,516,449	$ 186,963
Benefit Cost Ratio			2.21	1.01

Quantified benefits include improved safety from the reduction of accidents due to the road improvements on BIA 12, reduction in vehicle delay, reduced emissions reduced travel times, reduced vehicle operating costs and improved emergency response. due to reduced use of route detours required when BIA 12 is closed,

A **discount rate of 7 % / 3%** was used, following the Benefit-Cost Analysis Guidance for Discretionary Grant Programs updated March 2022. This rate yields conservative estimates of NPV and benefit cost ratio. Bottom line, the present value (PV) of capital costs in 2020 dollars is $18.7 million and the PV of total benefits is $41.2 million in 2020 dollars. When discounted total costs equal $13.9 million and total benefits are estimated at $14.1 million. This yields a NPV of $0.2 million and a benefit-cost ratio of 1:1. Thus, showing that the project is cost effective.

The improved roadway on BIA 12 will provide a much safer route. This is estimated to reduce the probability of a multitude types of accidents totaling over 33 accidents over the 20 year analysis period post construction including 13 serious injuries and 20 property damages only accidents. This results in a total monetized safety value of $0.8 million at the 7% discount rate.

The improved road conditions should eliminate potential detours and save over 22,000 gallons of fuel used by vehicles in the area. This reduction in fuel usage reduces emissions by 197 MT of CO_2, and limited NOx for an estimated savings of $0.02 million in 2020 dollars or $0.005 million when discounted.

Economic Competitiveness Category generated a discounted saving of $0.07 million in Total Travel Time Value Savings. This is achieved by 58,600 hours saved from reduced time related accident delays. Fuel savings will decrease operating costs by $0.02 in 2020 dollars or $0.03 when discounted.

Emergency Response delays will potentially be reduced by 15,000 hours over the analysis period due to removal of potential detours required due to road closures on BIA 12. This is estimated to generate social benefits totaling $28.3 million in 2020 dollars equivalent to $10.7 million discounted at 7 percent.

Affected Populations and Types of Impacts

The primary populations benefitting from the Project include:

- Residents and visitors to Cheery Creek

Costs include construction and lifecycle costs. Construction costs are best available estimates as of October 2022. This analysis anticipates general operations and maintenance costs.

Unquantified benefits include:

- Lives impacted by delayed emergency response due to road blockages.
- Loss of the ability to locate a mini mart in Cherry Creek to support the residents due to the lack of a paved road. Vendors have stated that without a paved road to access the Cherry Creek Community, they are not interested in locating a mini mart in Cherry Creek due to the inability to reliably serve / support such a store location.