Benefit-Cost Analysis Report

April 2024

Pine Ridge Indian Reservation Pavement Resiliency and Restoration Project

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Summary of Project Outcomes

Metric	No Build	Build	Net Change	Saving in $ over the 20 years post Construction
i. 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 to delays due to the current closure of the routes				
Projected Accidents 2028-2047				
Collisions- Prop only	229.8	174.3	(55.5)	$ 333,048
Injury Accidents	178.4	135.3	(43.1)	$ 8,894,775
Fatalities	37.8	28.7	(9.1)	$84,530,331
Total Accidents	446.0	338.3	(107.7)	$93,758,154
ii. State of Good Repair				
Lane Miles	2 lanes	2 lanes		
Condition of Road / Road Rating	roadway in fair / poor condition	roadbed refurbished to good condition		
Maintenance Cost of Direct Route	$ 18,646,468	$ 11,948,000		$ 6,698,468
Reduction of VMT due to reduction of potential required detour	1,849,805,207	1,845,335,331	(4,469,877)	$ 536,385
iii. Economic Competitiveness - Reducing Transportation Cost / Travel Delays				
Travel Time Savings (VHT) 2028-2075				
Autos - VHT	511,826	27,370	(484,456)	$ 14,560,198
Trucks - VHT	21,326	1,140	(20,186)	$ 536,672
Total - VHT	533,152	28,510	(504,642)	$ 15,096,869
Vehicle Operating Costs (VMT) 2028-2047				
Autos - VMT	1,785,502,455	1,781,187,960	(4,314,495)	$ 2,243,537
Trucks - VMT	64,302,752	64,147,371	(155,381)	$ 205,103
Total - VMT	1,849,805,207	1,845,335,331	(4,469,877)	$ 2,448,641
Environmental Sustainability- Reduction of Energy Use- Gallons of Fuel Used Gallons of Fuel Saved				
Autos	72,287,549	72,112,873	174,676	$ 576,347
Trucks	10,717,125	10,691,229	25,897	$ 102,303
Total	83,004,674	82,804,101	200,573	$ 678,650
iv. Quality of Life				
2028-2047				
Number of Trips per vehicle per day	2.3	2.3	0	
VMT	1,849,805,207	1,845,335,331	(4,469,877)	$ 15,096,869
Average Trip Length- Direct	103.0	103.0	-	
Percent of trips requiring detour	1.7%	-	-1.7%	

I. BCA SUMMARY

I.A Overview

This report provides detailed documentation of the Benefit-Cost Analysis (BCA) performed to evaluate the public benefits generated by Pine Ridge Indian Reservation Pavement Resiliency and Restoration Project (the Project). The BCA demonstrates the cost and benefits of the Project for which the project sponsor is seeking Federal support, measured in terms of a Benefit-Costs Ratio (BCR) and net present value (NPV). The Project has independent utility with benefits exceeding costs.

The BCA methodology used in this analysis is consistent with the U.S. Department of Transportation, Benefit-cost Analysis Guidance for Discretionary Grant Programs, December 2023. The detailed cost and benefit assumptions are provided in the BCA Spreadsheet Appendix. In addition, Exhibit 1 below describes the Current Status (Baseline or No-Build), the anticipated changes to the baseline (the Build Scenario), types of impacts, population affected, and anticipated societal benefits. References are noted as to where the details can be found in both this technical memo and to which Tab the calculations are found in the Excel Spreadsheet.

The impacts include:

- Addressing Safety related road conditions such as adding guardrails, adding paved shoulders, improved pavement friction.
- Resurfacing pavement for storm resiliency and improved safety.

Overall, the Project will improve safety for all travelers; increase the regional transportation system efficiency and reliability; improve access for residents, businesses, emergency services, and tourists; and increases regional mobility for people and freight.

Affected Populations and Types of Impacts

The primary populations benefitting from Project include companies transporting goods through the region, residents, and tourists. The Project connects residents living and traveling within the area to educational, recreation, economic opportunities, and other essential services.

Exhibit 1: Benefit-Cost Analysis Overview Matrix

Pine Ridge Indian Reservation Pavement Resiliency and Restoration Project Project Matrix					
Current Status/Baseline & Problem to be Addressed	**Change to Baseline/ Alternatives**	**Type of Impacts**	**Population Affected by Impacts**	**Economic Benefits**	**TAB**
Currently, the road users experience accidents due to road conditions, and extended delays due to road closures post storm damage.	This Project will improve travel routes for all motorized to promote connectivity and mobility between critical facilities, economic centers, residential neighborhoods, schools, and recreational areas. The Project would improve safety, the state of good repair, and the quality of life for the community. The Project area consists of 103 miles of BIA roads within the project area.	Multimodal benefits are gained, providing improved mobility	The Reservation residents are anticipated to benefit at-large from these improvements. Freight movements, visitors will also benefit from the improved roadways.	Significant reduction in travel time and reduced fuel consumption and emissions.	Travel Time Savings
				Improved air quality due to a reduction in automobile reliance.	Environmental Savings
		Improves traveler safety. Thus, it is anticipated to reduce collisions and provide space for all travel modes.	All users of Project roadways	Collision costs reduced in terms of property damage, injuries and fatalities.	Safety Savings
		Creates the framework for more effective project maintenance at reduced costs.	Oglala Sioux Tribe	Reduction in maintenance costs, and restoration cost post severe storms	Maintenance
		Reduces wear and tear on detour routes required when closures occur after storm damage	All road users	Reduction in State of Good Repair costs	State of Good Repair

I.B Background

This BCA accompanies a grant application for the Pine Ridge Indian Reservation Pavement Resiliency and Restoration Project (the Project). The Oglala Sioux Tribe (OST) is requesting $37,581,600 for the Project. The RURAL Project encompasses BIA Routes 2, 14, 25, 27, 28, 33, and 41, which are located on the Pine Ridge Indian Reservation and along or adjacent to the Tribally designated Crazy Horse Scenic Byway (CHSB). BIA 2 is an arterial east/west route and BIA 27, and BIA 41 are north/south arterials connecting to the largest Reservation community of Pine Ridge Village and larger cities of Rapid City, SD approximately 40 miles northwest, and Chadron, NE approximately 20 miles southwest. BIA 14, 25, 28, and 33 are essential routes connecting Tribal communities. Sections of BIA 27 and BIA 41 also run adjacent to the Badlands National Park South Unit. This area receives visitors from all over the world, providing a positive impact to the local and regional economy. The OST barely receives enough road maintenance funding to control snow and ice, let alone upgrade or repair roads. The current condition of the roadway is deteriorating, insufficient to meet the traffic needs, and presents safety, accessibility, and sustainability risks. These sections of roadway need to be reconstructed, restored, and made more resilient for the safety of travelers and enjoyment of visitors. The proposed construction project will address these issues and ensure consistent, year-round access for visitors of the Badlands National Park and improve the safety and accessibility of the transportation system within the rural tribal communities, provide opportunity for future economic and tourism development, and connect residents to employment, education, health care, goods and services, and Tribal programs on the Pine Ridge Indian Reservation. The Project directly aligns with the RURAL purpose of improving and expanding infrastructure in rural areas and aligning with USDOT's strategic goals of improving safety, economic strength and global competitiveness, equity, and climate and sustainability.

The Project is located on the Pine Ridge Indian Reservation in rural southwestern South Dakota in Oglala Lakota County. The Reservation encompasses over 2 million acres (3,469 square miles) in Oglala Lakota County, the southern half of Jackson County, and Bennett County. Oglala Lakota County[1] has a population of 13,672 with 50.5 percent of that population living in poverty. Oglala Lakota County, census tracts 9410, 9411, 9412, tribal tract T001, T002, T004, T005, is identified as an Area of Persistent Poverty, Historically Disadvantaged, and Transportation Disadvantaged Community.

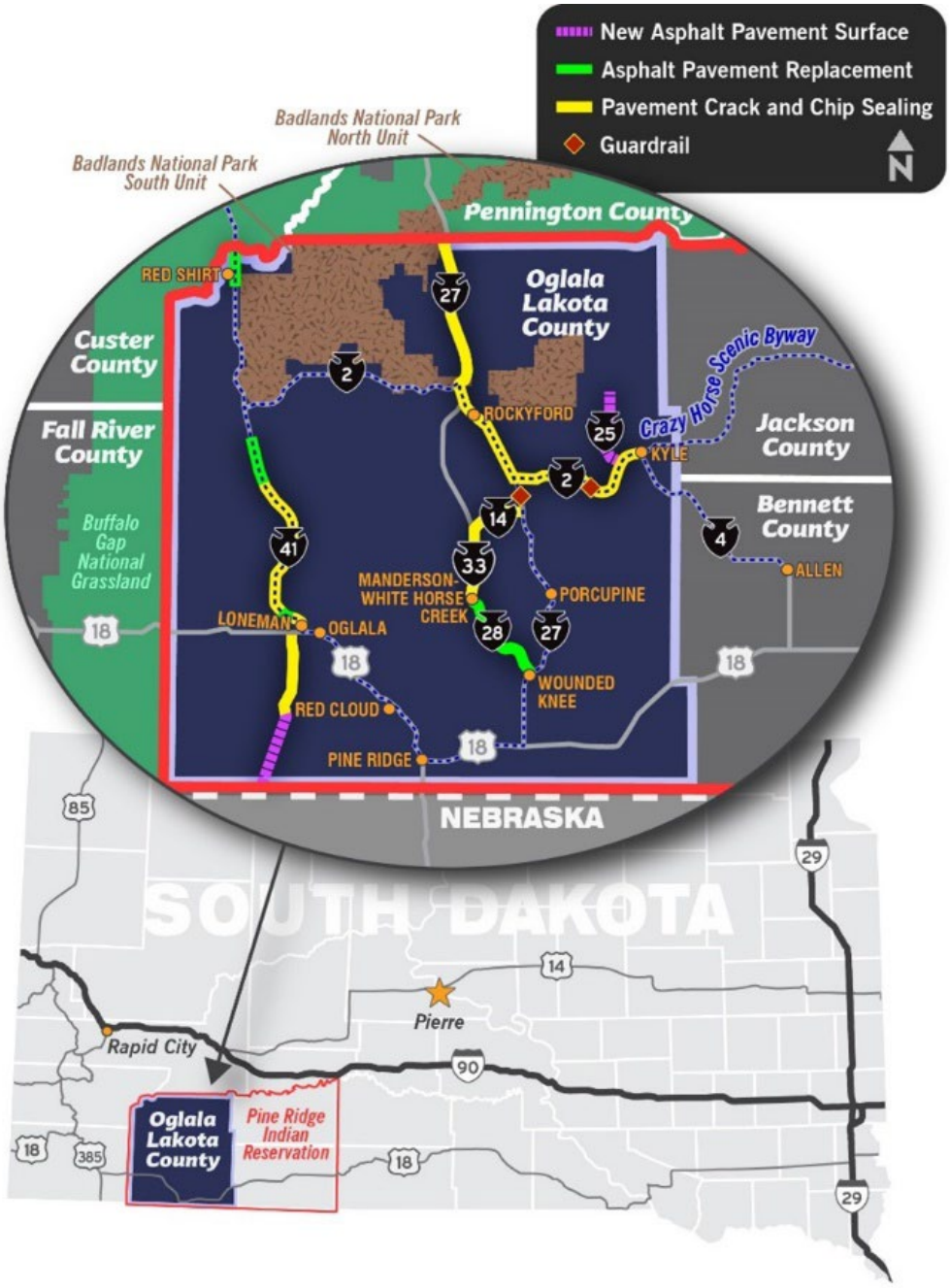
The Reservation is home to many individuals and families in financially sensitive situations. Access to reliable and safe transportation is critical to living sustainably in this impoverished rural area. Pine Ridge Indian Reservation[2] is one of poorest communities in the nation with

[1] Oglala Lakota County, South Dakota - Census Bureau Profile
[2] https://data.census.gov/profile/Pine_Ridge_Reservation,_SD--NE?g=2500000US2810

48.2 percent of people living in poverty and a 12.3 percent unemployment rate compared to the national average of 3.6 percent.

Oglala Lakota County, where the project is centrally located, is a regional hub providing access to goods and services, health care, education centers, employment, childcare, recreation, and other essential tribal services.

Exhibit 2:Project Location



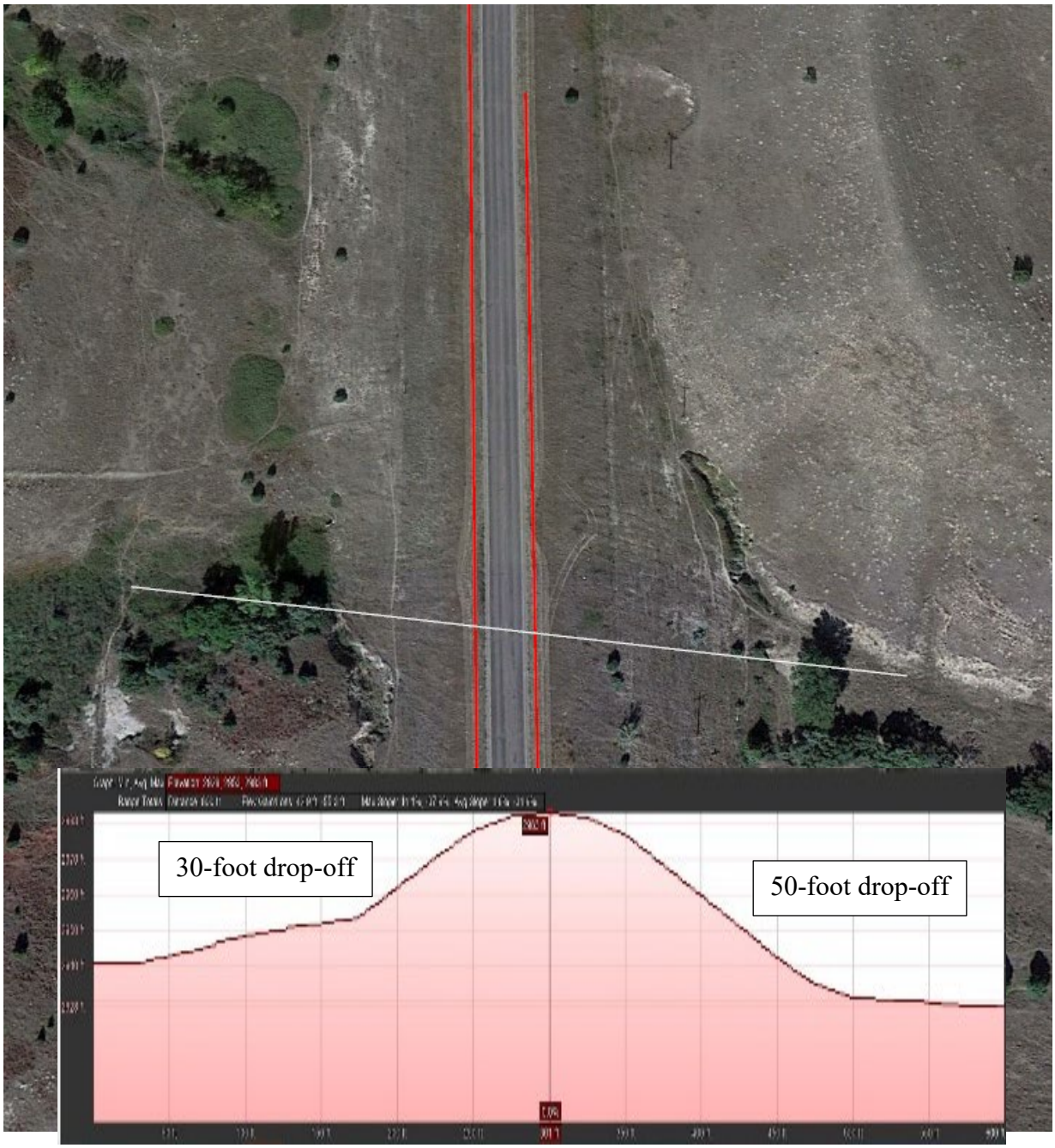
I.B.1. No-Build Scenario

The No-Build alternative represents the base conditions for the project area. This alternative assumes no significant modifications are made to the transportation system besides routine maintenance and storm recovery.

Exhibit 3: Example of current base conditions of roadway in the Project Area



Exhibit 4: Inadequate Guardrails



I.B.2. Build Scenario

The Project includes roadways that pass through several Tribal communities on the Pine Ridge Indian Reservation. Areas include the communities of Red Shirt, Loneman, Oglala, Rockyford, Sharps Corner, Kyle, Manderson, and Wounded Knee. These roadways are the arterial transportation network connecting these smaller tribal communities to the major communities of Pine Ridge, Rapid City and into Nebraska. The roadways are owned by BIA and maintained by the Tribe. Many of them were constructed more than 50 years ago and are now suffering from deteriorating infrastructure that does not meet current design standards. The infrastructure issues are similar throughout the different areas and not only include poor pavement conditions or lack of pavement, but also safety, accessibility, and sustainability concerns. As a result, this project considers the connectivity throughout the Reservation as a whole and would like to address all the individual project areas as one overall Reservation project to resolve the current infrastructure needs.

Asphalt Pavement Replacement



The Project proposes to reconstruct the asphalt pavement structure on BIA 28 and portions of BIA 41. BIA 28 is located between BIA 2 at the community of Wounded Knee and travels 8.8 miles northwest to the community of Manderson where it ends at BIA 33. BIA 28 has large transverse cracks which are difficult to seal and cause a rough ride. BIA 41 stretches between the north Reservation line to the south Reservation/state line. Portions of the highway have deteriorated asphalt pavement with ruts, cracks, and potholes. The most northern 6.5 miles is very narrow, rutted and doesn't drain properly resulting in water, snow and ice remaining on the surface causing dangerous driving conditions. Approximately 16.3 miles south of the Reservation line is another 4-mile section which has severe cracking and potholes. Approximately 2.5 miles north of US18 is a 0.7-mile narrow section which has severe heaving along a horizontal and vertical curve. This is an especially dangerous section due to the road heaving. The Project will reconstruct the asphalt pavement structure and widen the roadway to incorporate at least 2-foot asphalt shoulders to improve safety of the traveling public, maintain usability, and to keep pavement from further deterioration. The existing asphalt will be milled, recycled, and reused in new asphalt concrete pavement. The remaining base course will be salvaged for reuse in the reconstructed road base. The new pavement structure will consist of geotextile separator fabric between the subgrade and base course and tri-axial geogrid between layers of base course.

Route	Location	Length	Improvements
BIA 28	Wounded Knee to Manderson	8.8 miles	Replace asphalt pavement structure with geotextiles, 2-foot shoulders, rumble strips, and pavement striping
BIA 41	North Reservation line to 6.5 miles south	6.5 miles	Replace asphalt pavement structure with geotextiles, add 2-foot shoulders, rumble strips, and pavement striping
BIA 41	16.3 miles south of the north Reservation line to 4 miles south	4 miles	Replace asphalt pavement structure with geotextiles, 4-foot shoulders, rumble strips, and pavement striping
BIA 41	2.5 miles north of US18 to 0.7 miles north	0.7 miles	Replace asphalt pavement structure with geotextiles, add 4-foot shoulders, rumble strips, add High Friction Surface Treatment, and pavement striping

New Asphalt Pavement Surfacing

The Project proposes to construct new asphalt pavement on BIA 25 and the unpaved portion of BIA 41. BIA 25 is located northwest of the community of Kyle from BIA 2 to 5 miles north. BIA 25 was reconstructed in 2013 and although it was designed to have an asphalt paved surface, the Tribe did not have sufficient funding for all of the work needed. It was completed with a base course surfacing ready for asphalt pavement when funding is available. BIA 41 stretches between the north Reservation line to the south Reservation/state line. The most southern 7 miles was paved many years ago but had deteriorated so severely it is a gravel road with chunks of asphalt partially exposed. Because this road connects to Chadron, Nebraska, a resource to Tribal members for goods and services, education, employment, and health care, it is essential the road have a hard surface top. On BIA 25, damaged geotextile separator fabric will be repaired, and base course replenished. On BIA 41 the existing asphalt chunks will be salvaged and used for gravel surfacing on a nearby roadway. New geotextile separator fabric will be placed over reshaped and recompacted subgrade. For both routes, tri-axial geogrid will be installed between base course layers and topped with new asphalt pavement. The Project will construct the asphalt pavement structure and widen the roadway to incorporate at least 2-foot asphalt shoulders to improve safety of the traveling public, maintain usability, and to keep pavement from further deterioration. The existing asphalt will be milled, recycled, and reused in new asphalt concrete pavement. The new pavement structure will consist of geotextile separator fabric between the subgrade and base course and tri-axial geogrid between layers of base course.

Route	Location	Length	Improvements
BIA 25	From BIA 2 to 5 miles north	5 miles	Repair geotextile separator fabric, add base course with tri-axial geogrid between layers, asphalt pavement surface, 4-foot shoulders, rumble strips, and pavement striping
BIA 41	From south Reservation line to 7 miles north	7 miles	Remove asphalt chunks, reshape and recompact subgrade, geotextile separator fabric under base course with tri-axial geogrid between layers, asphalt pavement surface, 2-foot shoulders, rumble strips, and pavement striping

Pavement Crack and Chip Sealing (2, 14, 27, 33, 41)

Asphalt pavement crack and chip sealing and pavement striping will be completed along BIA 2, from Kyle to BIA 27, totaling 14.7 miles, BIA 14 (4.9 miles) between BIA 27 and BIA 33, BIA 27 (22.7 miles) from the north Reservation line to Sharps Corner, and BIA 33 from BIA 14 south to Manderson community (6 miles). Where High Friction Surface Treatment is installed, the road will be crack sealed and chip seal will skip over that area. Existing rumble strips are deep enough to receive the chip seal and will be as effective after the sealing is completed.



Safety Improvements - Shoulder Widening, Guardrails, and High Friction Surface Treatment

Shoulders will be widened 2-feet on BIA 41's 6.5-mile segment and by 4-feet on BIA 41's curve in the 0.7-mile segment. All other routes will maintain the current shoulder width.



Guardrail will be added to BIA 2 along the outside edge of a sharp curve with steep embankment approximately 5.2 miles west of Kyle. Guardrail will also be installed along both sides of BIA 27 2 miles south of Sharps Corner where there is a steep embankment.

High Friction Surface Treatment will be installed on five sharp curves on BIA 2, one sharp reverse curve at the White River bridge on BIA 27, and the curve in the 0.7-mile pavement reconstruction area on BIA 41.

I.B.3. BCA Model Development

An Excel spreadsheet-based BCA model was developed for this analysis. The model utilizes data from KLJ Engineering, and the Oglala Sioux Tribe, and nationally accepted parameters. Many of the national parameters were provided by the United States Department of

Transportation (USDOT) specifically for Discretionary Grant applications such as the MDPG discretionary funding program.

I.B.4. Organization of the BCA Memorandum

Section II describes the Project's No-Build versus Build scenarios.

Section III describes the inputs and results of each of the Benefit components of the BCA model. The project-specific inputs include 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, 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 IV 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 built into the model.

I.C BCA Summary

This Project will reconstruct the roadway and add associated improvements which will:

- Increase efficiency of traffic flow.
- Improve safety by repairing a deteriorated roadway, reducing the probability of accidents.
- Reduce vehicle operations costs.
- Reduce fuel emissions.
- The OST is prepared to move forward with the construction of this Project pending RURAL Discretionary Grant funding, final engineering design, and final environmental clearances. The Project is scheduled over two construction seasons. Construction is to begin in 2025 and be completed by the fall 2027 with project close out Q4 2027.

The benefits analyzed in this report include crash reduction savings, travel time savings, fuel savings, reduced greenhouse gas emissions, and the residual life of the infrastructure at the end of the 20-year analysis period. The estimated costs analyzed include construction and future maintenance costs (which remain the same under the base condition and the preferred alternative).

Following is a summary of the findings for each category at a three.one percent (3.1%) discount rate for non-CO_2 costs and benefits and a two percent (2%) discount rate for CO_2 benefits.

The Benefit-Cost Analysis (BCA) follows guidelines outlined in the Notice of Funding Opportunity for the RURAL Grant Program published in the March 2024 Federal Register. **The resulting benefit-cost ratio is 2.23.**

Exhibit 5: BCA Analysis Summary

PINE RIDGE INDIAN RESERVATION PAVEMENT RESILIENCY AND RESTORATION

Benefit Cost Analysis

Summary Matrix

Areas of Evaluation	Description	Inputs (over the life of the project)	Monetized Value 2022 dollars	Monetized Value Discount Rate 3.1%/2%
Safety	Crash Reduction Savings	•17% crash reduction for Property Damage Only, Injury and Fatality crashes	$ 93,758,154	$ 58,727,087
Environmental Sustainability	Reduced Pollution	• Emission reductions of: 9900 metric tons CO_2	$ 3,076,693	$ 2,232,092
Economic Competitiveness	Travel Time Savings	• Reduction in 460,900 vehicle hours traveled (VHT)	$ 15,098,723	$ 9,457,354
	Vehicle Operation Cost Savings	• Reduction of 1.1 million gallons of fuel	$ 13,297,650	$ 8,329,219
State of Good Repair	Savings due to reduced use of Detour route	• Reduction in 24 million vehicle miles traveled (VMT)	$ 2,912,907	$ 1,824,551
Emergency Response	Reduction in Losses due to delayed response	Not calcuated		
Total Benefits before Maint and Residual Value			$ 128,144,127	$ 80,570,303
Maintenance		Life Cycle Cost	$ 6,698,468	$ 4,365,447
Residual		Residual Value	$ 21,524,790	$ 10,033,958
Total Benefits			$ 156,367,384	$ 94,969,708
Total Costs			$ 45,924,715	$ 42,635,047
Net Present Value			$ 110,442,669	$ 52,334,661
Benefit Cost Ratio			3.40	2.23

I.D Annual Results with the completion of the Build Scenario

Exhibit 6: Total Annual Benefits and Costs

			Annual Public Benefits									
Year Post construction	Project Year	Calendar Year	Annual Traffic Trips Delayed	Total Time Saved	Op Cost Saved	Accidents Reduced	Emergency Response Delay Reductions	State of Good Repair on Detour Route	Non-CO_2 Emission Reductions	CO_2 Emission Reductions	Total Public Benefits
		2020									
		2021									
	1	2022									
	2	2023									
	3	2024									
	4	2025									
	5	2026	21,571								
	6	2027	21,787								
1	7	2028	22,004	$ 685,713	$ 603,917	$ 4,258,056	$ -	$ 132,291	$ 28,620	$ 111,970	$ 5,820,567
2	8	2029	22,224	$ 692,570	$ 609,956	$ 4,300,637	$ -	$ 133,613	$ 29,445	$ 114,447	$ 5,880,668
3	9	2030	22,447	$ 699,496	$ 616,056	$ 4,343,643	$ -	$ 134,950	$ 10,271	$ 117,419	$ 5,921,835
4	10	2031	22,671	$ 706,491	$ 622,216	$ 4,387,079	$ -	$ 136,299	$ 10,374	$ 120,900	$ 5,983,360
5	11	2032	22,898	$ 713,556	$ 628,438	$ 4,430,950	$ -	$ 137,662	$ 10,478	$ 123,508	$ 6,044,592
6	12	2033	23,127	$ 720,692	$ 634,723	$ 4,475,260	$ -	$ 139,039	$ 10,583	$ 127,096	$ 6,107,392
7	13	2034	23,358	$ 727,898	$ 641,070	$ 4,520,012	$ -	$ 140,429	$ 10,688	$ 130,269	$ 6,170,367
8	14	2035	23,592	$ 735,177	$ 647,481	$ 4,565,212	$ -	$ 141,833	$ 10,795	$ 133,492	$ 6,233,992
9	15	2036	23,828	$ 742,529	$ 653,956	$ 4,610,865	$ -	$ 143,252	$ 10,903	$ 136,767	$ 6,298,272
10	16	2037	24,066	$ 749,955	$ 660,495	$ 4,656,973	$ -	$ 144,684	$ 11,012	$ 140,584	$ 6,363,704
11	17	2038	24,307	$ 757,454	$ 667,100	$ 4,703,543	$ -	$ 146,131	$ 11,122	$ 143,474	$ 6,428,825
12	18	2039	24,550	$ 765,029	$ 673,771	$ 4,750,578	$ -	$ 147,592	$ 11,234	$ 146,908	$ 6,495,112
13	19	2040	24,795	$ 772,679	$ 680,509	$ 4,798,084	$ -	$ 149,068	$ 5,756	$ 150,900	$ 6,556,996
14	20	2041	25,043	$ 780,406	$ 687,314	$ 4,846,065	$ -	$ 150,559	$ 5,813	$ 154,448	$ 6,624,605
15	21	2042	25,294	$ 788,210	$ 694,187	$ 4,894,526	$ -	$ 152,065	$ 5,871	$ 158,567	$ 6,693,425
16	22	2043	25,546	$ 796,092	$ 701,129	$ 4,943,471	$ -	$ 153,585	$ 5,930	$ 162,232	$ 6,762,439
17	23	2044	25,802	$ 804,053	$ 708,140	$ 4,992,906	$ -	$ 155,121	$ 5,989	$ 166,480	$ 6,832,689
18	24	2045	26,060	$ 812,093	$ 715,222	$ 5,042,835	$ -	$ 156,672	$ 6,049	$ 170,267	$ 6,903,138
19	25	2046	26,321	$ 820,214	$ 722,374	$ 5,093,263	$ -	$ 158,239	$ 6,110	$ 174,648	$ 6,974,848
20	26	2047	26,584	$ 828,416	$ 729,597	$ 5,144,196	$ -	$ 159,821	$ 6,171	$ 179,100	$ 7,047,302
		Total	527,873	$ 15,098,723	$ 13,297,650	$ 93,758,154	$ -	$ 2,912,907	$ 213,215	$ 2,863,478	$ 128,144,127

II. PROJECT DESCRIPTION

II.A. No-Build Scenario

Without RURAL funding, the OST will struggle to find funds to reconstruct the Project in the timeframe needed to substantially impact safety and state-of-good repair. The condition of the roadway already presents a safety hazard. Under the No-Build Scenario, no significant modifications will be made to the transportation system besides routine maintenance and is subject to storm damage.

II.B. Build Scenario

The Project will improve the pavement resiliency and restore the project roads by improving poor pavement conditions and addressing unsafe conditions that increase the severity of accidents when they occur. Details of the applications that will be applied to the route are detailed in Section I.B.2.: Build Scenario above. The infrastructure issues are similar throughout the different areas and not only include poor pavement conditions or lack of pavement, but also safety, accessibility, and sustainability concerns. As a result, this project considers the connectivity throughout the Reservation as a whole and would like to address all the individual project areas as one overall Reservation project to resolve the current infrastructure needs.

III. PROJECT BENEFITS

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

The BCA was conducted within the parameters of the December 2023- Discretionary BCA Guidance. A standard 20-year project life-cycle (post-construction) was used with all costs and benefits using 2022 as a base year, recognizing 2023 through 2027 as planning, design, and construction years, and running a 20-year project post-construction analysis period from 2028-2047. Full-year benefits were counted starting in 2028, as it was the first year of the operation of the reconstructed corridor. The discount rate of seven percent was used for all non-CO_2 benefits and costs, and a three percent discount rate was used for CO_2 emissions as directed by the RURAL Discretionary Grant guidelines.

Various sources of information were gathered to determine the economic benefits including information from the OST Departments of Transportation traffic counts and traffic types, highway safety records, emergency services accident records, US Federal Highway Administration safety statistics, and US Environmental Protection Agency statistics.

The total cumulative benefits were compared to the total cumulative costs. Future benefits and costs are discounted to present values using a real discount rate of seven percent. Project costs include construction, project administration, and future maintenance. Life-cycle as reflected in Maintenance costs have been estimated based upon the No-Build scenario versus the Build scenario.

III.A Summary of Detailed Benefits

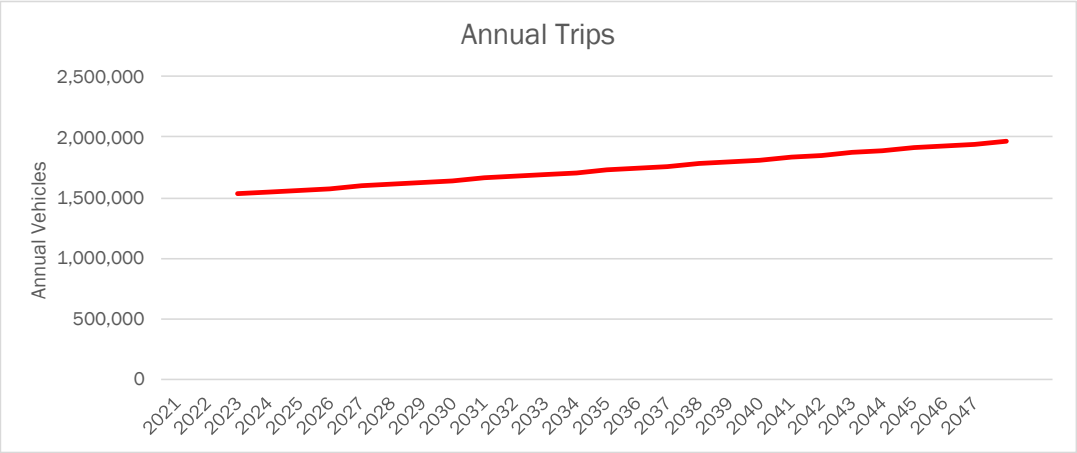
Exhibit 7: Annual Benefits by year

			Benefits											
Year Post construction	Project Year	Calendar Year	Maintenance	Residual	Maint and Residual	Total Time Saved	Op Cost Saved	Accidents Reduced	Emission Reductions	State of Good Repair Savings on Detour Route	Emergency Response Savings	Total Benefits before Maint and Residual	Total Benefits with Maint and Residual
		2018											
		2019											
		2020											
		2021											
	1	2022											
	2	2023											
	3	2024											
	4	2025											
	5	2026											
	6	2027											
1	7	2028	$ -		$ -	$ 685,713	$ 603,917	$ 4,258,056	$ 140,590	$ 132,291	$ -	$ 5,820,567	$ 5,820,567
2	8	2029	$ 1,674,617		$ 1,674,617	$ 692,570	$ 609,956	$ 4,300,637	$ 143,892	$ 133,613	$ -	$ 5,880,668	$ 7,555,285
3	9	2030	$ -		$ -	$ 699,496	$ 616,056	$ 4,343,643	$ 127,690	$ 134,950	$ -	$ 5,921,835	$ 5,921,835
4	10	2031	$ -		$ -	$ 706,491	$ 622,216	$ 4,387,079	$ 131,274	$ 136,299	$ -	$ 5,983,360	$ 5,983,360
5	11	2032	$ -		$ -	$ 713,556	$ 628,438	$ 4,430,950	$ 133,985	$ 137,662	$ -	$ 6,044,592	$ 6,044,592
6	12	2033	$ -		$ -	$ 720,692	$ 634,723	$ 4,475,260	$ 137,679	$ 139,039	$ -	$ 6,107,392	$ 6,107,392
7	13	2034	$ 1,674,617		$ 1,674,617	$ 727,898	$ 641,070	$ 4,520,012	$ 140,957	$ 140,429	$ -	$ 6,170,367	$ 7,844,984
8	14	2035	$ -		$ -	$ 735,177	$ 647,481	$ 4,565,212	$ 144,288	$ 141,833	$ -	$ 6,233,992	$ 6,233,992
9	15	2036	$ -		$ -	$ 742,529	$ 653,956	$ 4,610,865	$ 147,671	$ 143,252	$ -	$ 6,298,272	$ 6,298,272
10	16	2037	$ -		$ -	$ 749,955	$ 660,495	$ 4,656,973	$ 151,596	$ 144,684	$ -	$ 6,363,704	$ 6,363,704
11	17	2038	$ -		$ -	$ 757,454	$ 667,100	$ 4,703,543	$ 154,597	$ 146,131	$ -	$ 6,428,825	$ 6,428,825
12	18	2039	$ 1,674,617		$ 1,674,617	$ 765,029	$ 673,771	$ 4,750,578	$ 158,141	$ 147,592	$ -	$ 6,495,112	$ 8,169,729
13	19	2040	$ -		$ -	$ 772,679	$ 680,509	$ 4,798,084	$ 156,656	$ 149,068	$ -	$ 6,556,996	$ 6,556,996
14	20	2041	$ -		$ -	$ 780,406	$ 687,314	$ 4,846,065	$ 160,261	$ 150,559	$ -	$ 6,624,605	$ 6,624,605
15	21	2042	$ -		$ -	$ 788,210	$ 694,187	$ 4,894,526	$ 164,438	$ 152,065	$ -	$ 6,693,425	$ 6,693,425
16	22	2043	$ -		$ -	$ 796,092	$ 701,129	$ 4,943,471	$ 168,162	$ 153,585	$ -	$ 6,762,439	$ 6,762,439
17	23	2044	$ 1,674,617		$ 1,674,617	$ 804,053	$ 708,140	$ 4,992,906	$ 172,470	$ 155,121	$ -	$ 6,832,689	$ 8,507,306
18	24	2045	$ -		$ -	$ 812,093	$ 715,222	$ 5,042,835	$ 176,316	$ 156,672	$ -	$ 6,903,138	$ 6,903,138
19	25	2046	$ -		$ -	$ 820,214	$ 722,374	$ 5,093,263	$ 180,758	$ 158,239	$ -	$ 6,974,848	$ 6,974,848
20	26	2047	$ -	$ 21,524,790	$ 21,524,790	$ 828,416	$ 729,597	$ 5,144,196	$ 185,271	$ 159,821	$ -	$ 7,047,302	$ 28,572,092
		Total	$ 6,698,468	$21,524,790	$ 28,223,258	$ 15,098,723	$ 13,297,650	$ 93,758,154	$ 3,076,693	$ 2,912,907	$ -	$ 128,144,127	$ 156,367,384

The Benefits summarized in Exhibit 7 are based upon starting in 2028 following completion of the Project. It is estimated by 2047 when the Project opens, volume will have grown by 1 percent per year from 4200 AADT in 2022 to 4458 AADT in 2028 and to 5386 by 2047.

Over the 20-year post-construction analysis period, it is estimated that Public Benefits will exceed $128 million and Total Benefits exceed $156 million when Maintenance and Residual are added in 2022 dollars.

Exhibit 8: Average Annual Daily Trips



Average Daily Traffic (ADT) Assumptions

Existing traffic flow data for the project area was gathered from SDDOT/ ArcGIS traffic counts showing trips per day in 2022. The 20-year growth factor of 1 percent was estimated per project engineers to conservatively project traffic growth on the Project Corridor. As noted above, OST traffic records indicate that 96.5 percent of travel in the project area is passenger vehicles, and 3.5 percent is commercial truck traffic.

III.A.1. Economic Competitiveness

Economic Competitiveness can be defined as the combination of Travel Time Savings and Vehicle Operating Cost Savings generated by this Project. This benefit category totals over $32.5 million in 2022 dollars which is equivalent to over $14.9 million when discounted at 3.1 percent.

III.A.1.i Travel Time Savings

Travel Time Value Savings Benefit captures the net value saved by vehicle occupants using the Project. Utilizing the Trip volume projections, total auto occupant hours are calculated and multiplied by the Hourly Auto Vehicle Time Value rate of $32.73/hour based upon the All-Purpose auto rate of $19.60 times the 1.67 occupancy rate per auto. The Truck hours are multiplied by the Truck time value of $33.60/ hour.

OST traffic records indicate that 96.5 percent of travel in the project area is passenger vehicles, and 3.5 percent is commercial truck traffic. The 103-mile Project route was evaluated for current travel delays. It is estimated that delays are caused by two types of events: Accident induced delays and Road Closures due to slides and floods. Based upon the data provided it is estimated that the implementation of this Project will reduce the delay along the route by approximately 95 percent. Based on data for 2021, the No-Build delays for accidents were estimated to be 1557 hours for that year and the closure due to storms were estimated to be 19165 hours of delay per year for the same year (2021) for a net of 20729 hours of delay in 2021.

The project will enhance the local, regional, and national economic competitiveness by providing more efficient travel and transportation of goods and people through the project corridor.

Exhibit 9: Assumptions for Travel Times Value Saved

Travel Time Savings							
	Red Shirt to Pine Ridge BIA 2/41	Pine Ridge to Kyle BIA 27	Total/ Average				
Vehicles per day	2000	2200	2096	2023 average counts on BIA 2/.41 and BIA 27	**Days per year**	365	
Annual	730,000	803,000	1,533,000				
Cars/Personal	96.0%	97.0%	96.5%	Tribal data	**Annual growth rate**	1.00%	engineer's estimate
Trucks	4.0%	3.0%	3.5%	Tribal data	**Accident induced delay**	1567	hours/year
					Road Closure delays due to slides / floods	19163	hours/year
					Direct Build - no delay	0	hours/year
					Net Delay	20729	hours/year
Passengers per vehicle (All purposes)	1.67			USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Dec 2023	**Hourly Value of Travel Time (all purposes)**	$ 19.60	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Dec 2023
Passengers per truck	1			USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Dec 2023	**Hourly Value of Travel Time (truck drivers)**	$ 33.50	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Dec 2023

Exhibit 10: 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	Disc at 3.1%
		Estimated flood and accident delay	Reduced flood and accident delay		96.5%	3.5%		
2020			-	-				
2021		20,729	-					
2022		20,936	-					
2023		21,146	-					
2024		21,357	-					
2025		21,571						
2026		21,787						
2027		22,004						
2028	1	22,224	1,295	20,930	$ 661,256	$ 24,373	$ 685,713	$ 570,940.12
2029	2	22,447	1,308	21,139	$ 667,869	$ 24,617	$ 692,570	$ 559,310.88
2030	3	22,671	1,321	21,350	$ 674,547	$ 24,863	$ 699,496	$ 547,918.52
2031	4	22,898	1,334	21,564	$ 681,293	$ 25,112	$ 706,491	$ 536,758.20
2032	5	23,127	1,347	21,780	$ 688,106	$ 25,363	$ 713,556	$ 525,825.20
2033	6	23,358	1,361	21,997	$ 694,987	$ 25,616	$ 720,692	$ 515,114.89
2034	7	23,592	1,374	22,217	$ 701,937	$ 25,873	$ 727,898	$ 504,622.73
2035	8	23,828	1,388	22,439	$ 708,956	$ 26,131	$ 735,177	$ 494,344.29
2036	9	24,066	1,402	22,664	$ 716,045	$ 26,393	$ 742,529	$ 484,275.20
2037	10	24,307	1,416	22,890	$ 723,206	$ 26,657	$ 749,955	$ 474,411.20
2038	11	24,550	1,430	23,119	$ 730,438	$ 26,923	$ 757,454	$ 464,748.12
2039	12	24,795	1,445	23,351	$ 737,742	$ 27,192	$ 765,029	$ 455,281.87
2040	13	25,043	1,459	23,584	$ 745,120	$ 27,464	$ 772,679	$ 446,008.42
2041	14	25,294	1,474	23,820	$ 752,571	$ 27,739	$ 780,406	$ 436,923.87
2042	15	25,546	1,488	24,058	$ 760,097	$ 28,016	$ 788,210	$ 428,024.35
2043	16	25,802	1,503	24,299	$ 767,698	$ 28,296	$ 796,092	$ 419,306.11
2044	17	26,060	1,518	24,542	$ 775,375	$ 28,579	$ 804,053	$ 410,765.44
2045	18	26,321	1,533	24,787	$ 783,128	$ 28,865	$ 812,093	$ 402,398.73
2046	19	26,584	1,549	25,035	$ 790,960	$ 29,154	$ 820,214	$ 394,202.44
2047	20	26,850	1,564	25,285	$ 798,869	$ 29,445	$ 828,416	$ 386,173.10
Total Benefits 2028-2047		489,361	28,510	460,851	$ 14,560,198	$ 536,672	$ 15,098,723	$ 9,457,354

In total, travel time savings for this Project is estimated to be just over $15 million in 2022 dollars and slightly less than $9.5 million when discounted at 3.1 percent.

III.A.1.ii Vehicle Operating Cost Savings

Additionally, economic improvements are recognized through vehicle operation costs because of reduced fuel usage from both passenger vehicles and truck traffic. Due to the reduced potential closures due to accidents and storm damage caused by the current conditions of the Project area, potential detours will be reduced if not eliminated, accidents will be reduced due the safety improvements implemented along the route. Thus, average travel miles per trip along the direct route will be increased when the Project is completed, and delays will be reduced throughout the area. The best method to monetize Vehicle Operating Cost savings is the use vehicle cost per mile as recommended in the BCA guidance.

Exhibit 11: Assumptions for Operating Cost Savings

Vehicle Use Assumptions								
Light duty vehicle operating costs	$ 0.52						per mile	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Dec 2023
Commercial trucks	$ 1.32						per mile	
						Red Shirt to Pine Ridge	Pine Ridge to Kyle	Wt Average Daily VMT
AADT						2000	2200	4200
Net delay, miles reduced per trip, shortest detour route								
Direct route in miles						53.7	49.5	103
Shortest detour route						80.5	62.55	143
Days per year								365
Trips per day in 2022								4,200
Direct route during No Build								98.3%
Detour route during No Build								1.7%
Cars/Personal								96.5%
Trucks								3.5%
Annual Growth Rate								1.00%

The Operating Cost savings achieved within the 20-years post construction is just under 24 million hours for a savings of $13.3 million in operating costs in 2022 dollars reducing the operation cost of the vehicles traveling on the roads in the project area. Auto trips are estimated to be reduced by over 23.4 million miles equaling $12.2 million in 2022 dollars saved at $0.52 per mile. Commercial vehicles are modeled to save 0.8 million miles at $1.32 per mile in 2022 dollars equating to a savings of $1.1 million in operating costs once the Project is completed. The economic benefit realized from saved operation costs totals $13.3 million in 2022 dollars equaling $8.3 million when discounted at 3.1 percent.

Exhibit 12: Vehicle Operating Cost Savings as demonstrated by the reduction in fuel usage

Calendar Year	Project Year	AADT	Annual Trips	Direct Trips	Detoured Trips	Base Case VMT	BUILD VMT	Net Savings VMT	Annual Savings in Miles Traveled (cars/personal)	Annual Savings in Miles Traveled (trucks)	Annual Savings (cars/personal)	Annual Savings (trucks)	Annual Savings in Constant Dollars	Present Value of Savings (dollars) (3.1% discount rate)
											$0.52 per mile	$1.32 per mile	($2022)	
2016														
2017														
2018														
2019														
2020														
2021														
2022		4200	1,533,000	1,507,450	25,550									
2023		4242	1,548,330	1,522,525	25,806									
2024		4284	1,563,813	1,537,750	26,064									
2025		4327	1,579,451	1,553,127	26,324									
2026		4371	1,595,246	1,568,659	26,587									
2027		4414	1,611,198	1,584,345	26,853									
2028	1	4458	1,627,310	1,600,189	27,122	169,040,854	167,938,432	1,102,421	1,064,099	38,322	$ 553,332	$ 50,585	$ 603,917	$ 502,835
2029	2	4503	1,643,583	1,616,190	27,393	170,731,262	169,617,817	1,113,446	1,074,740	38,705	$ 558,865	$ 51,091	$ 609,956	$ 492,593
2030	3	4548	1,660,019	1,632,352	27,667	172,438,575	171,313,995	1,124,580	1,085,488	39,093	$ 564,454	$ 51,602	$ 616,056	$ 482,559
2031	4	4593	1,676,620	1,648,676	27,944	174,162,961	173,027,135	1,135,826	1,096,342	39,483	$ 570,098	$ 52,118	$ 622,216	$ 472,730
2032	5	4639	1,693,386	1,665,163	28,223	175,904,590	174,757,406	1,147,184	1,107,306	39,878	$ 575,799	$ 52,639	$ 628,438	$ 463,101
2033	6	4686	1,710,320	1,681,814	28,505	177,663,636	176,504,980	1,158,656	1,118,379	40,277	$ 581,557	$ 53,166	$ 634,723	$ 453,669
2034	7	4733	1,727,423	1,698,632	28,790	179,440,273	178,270,030	1,170,243	1,129,563	40,680	$ 587,373	$ 53,697	$ 641,070	$ 444,428
2035	8	4780	1,744,697	1,715,619	29,078	181,234,675	180,052,730	1,181,945	1,140,858	41,087	$ 593,246	$ 54,234	$ 647,481	$ 435,376
2036	9	4828	1,762,144	1,732,775	29,369	183,047,022	181,853,258	1,193,764	1,152,267	41,498	$ 599,179	$ 54,777	$ 653,956	$ 426,508
2037	10	4876	1,779,765	1,750,103	29,663	184,877,492	183,671,790	1,205,702	1,163,790	41,913	$ 605,171	$ 55,325	$ 660,495	$ 417,820
2038	11	4925	1,797,563	1,767,604	29,959	186,726,267	185,508,508	1,217,759	1,175,427	42,332	$ 611,222	$ 55,878	$ 667,100	$ 409,310
2039	12	4974	1,815,539	1,785,280	30,259	188,593,530	187,363,593	1,229,937	1,187,182	42,755	$ 617,335	$ 56,437	$ 673,771	$ 400,973
2040	13	5024	1,833,694	1,803,133	30,562	190,479,465	189,237,229	1,242,236	1,199,054	43,182	$ 623,508	$ 57,001	$ 680,509	$ 392,806
2041	14	5074	1,852,031	1,821,164	30,867	192,384,260	191,129,601	1,254,658	1,211,044	43,614	$ 629,743	$ 57,571	$ 687,314	$ 384,805
2042	15	5125	1,870,551	1,839,375	31,176	194,308,102	193,040,897	1,267,205	1,223,155	44,050	$ 636,040	$ 58,147	$ 694,187	$ 376,967
2043	16	5176	1,889,257	1,857,769	31,488	196,251,183	194,971,306	1,279,877	1,235,386	44,491	$ 642,401	$ 58,728	$ 701,129	$ 369,289
2044	17	5228	1,908,149	1,876,347	31,802	198,213,695	196,921,019	1,292,676	1,247,740	44,936	$ 648,825	$ 59,315	$ 708,140	$ 361,767
2045	18	5280	1,927,231	1,895,110	32,121	200,195,832	198,890,230	1,305,603	1,260,217	45,385	$ 655,313	$ 59,909	$ 715,222	$ 354,398
2046	19	5333	1,946,503	1,914,061	32,442	202,197,791	200,879,132	1,318,659	1,272,820	45,839	$ 661,866	$ 60,508	$ 722,374	$ 347,179
2047	20	5386	1,965,968	1,933,202	32,766	204,219,768	202,887,923	1,331,845	1,285,548	46,297	$ 668,485	$ 61,113	$ 729,597	$ 340,108
Total Benefits 2028-2047			**35,831,754**	**35,234,558**	**597,196**	**3,722,111,234**	**3,697,837,013**	**24,274,222**	**23,430,404**	**843,818**	**12,183,810**	**1,113,840**	**13,297,650**	**8,329,219**

III.A.2. Safety

Accident Reduction Savings

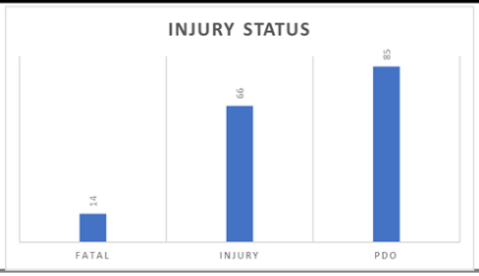
The 2024 BCA Guidance uses the KABCO level values. This analysis includes accidents occurring ratings Property Damage Only to and Incapacitated injury accidents. Per the BCA guidance on page 39. The accident reduction factor used in this analysis was calculated using US Department of Transportation's Desktop Reference for Crash Reduction Factors.

When examining accidents in the project area, it is anticipated that based upon the designed safety improvements will be reduced by an average of 17 percent following the implementation of the Project in the area. The ten-year historical data from 2013-2022 indicates there have been an average of 85 property damage only collisions, an average of 66 injury crashes and 14 crash where fatal injuries were sustained. Over the 20-year post construction analysis period of the project, accident reduction savings is projected to be $93.8 million in 2022 dollars or just under $58.7 million when discounted at 3.1 percent.

Exhibit 13: Assumptions for Safety Improvements

Project Area Crashes

		Total per Injury Type- 2013-2022	Per Dec 2023 BCA guidance, pg. 39 Value per Injury Type	Value of Injuries	No Build Annual Average	Build Annual Average
PDO	Property Damage Only	85	$ 9,100	$ 773,500	8.50	7.02
	Injury Crashes	66	$ 313,000	$ 20,658,000	6.60	5.45
K	Killed	14	$ 14,022,900	$ 196,320,600	1.40	1.16
	Total Crashes	165			16.50	13.64
				$ 2,712,233	CRF	17%
					CRM	83%



Years Analyzed 2013-2022	
Average Prop Damage Only	8.50
Average annual value of injuries	6.60
Average Fatalities	1.40

Crash Modification Factor Example: Average Crashes (after CM implementation) – (CMF × Avg. Crashes (Before CM Implementation)) = Crash Reduction
Crash modification factors (CMFs) and crash reduction factors (CRFs) are both terms used to express the effectiveness of countermeasures installed to improve highway safety. The main difference is that CMFs are used to compute the expected number of crashes after implementing certain improvements, while CRFs provide estimates of the percentage reduction in crashes. A CRF of 46, for example, represents a 46 percent reduction in crashes at a particular site. CMFs and CRFs are related by a simple mathematical function: CMF = 1 - (CRF/100). Using the previous example, a CRF of 46 would yield a CMF of 0.54. Because both terms are widely used in the field of traffic safety, both are available in the clearinghouse.

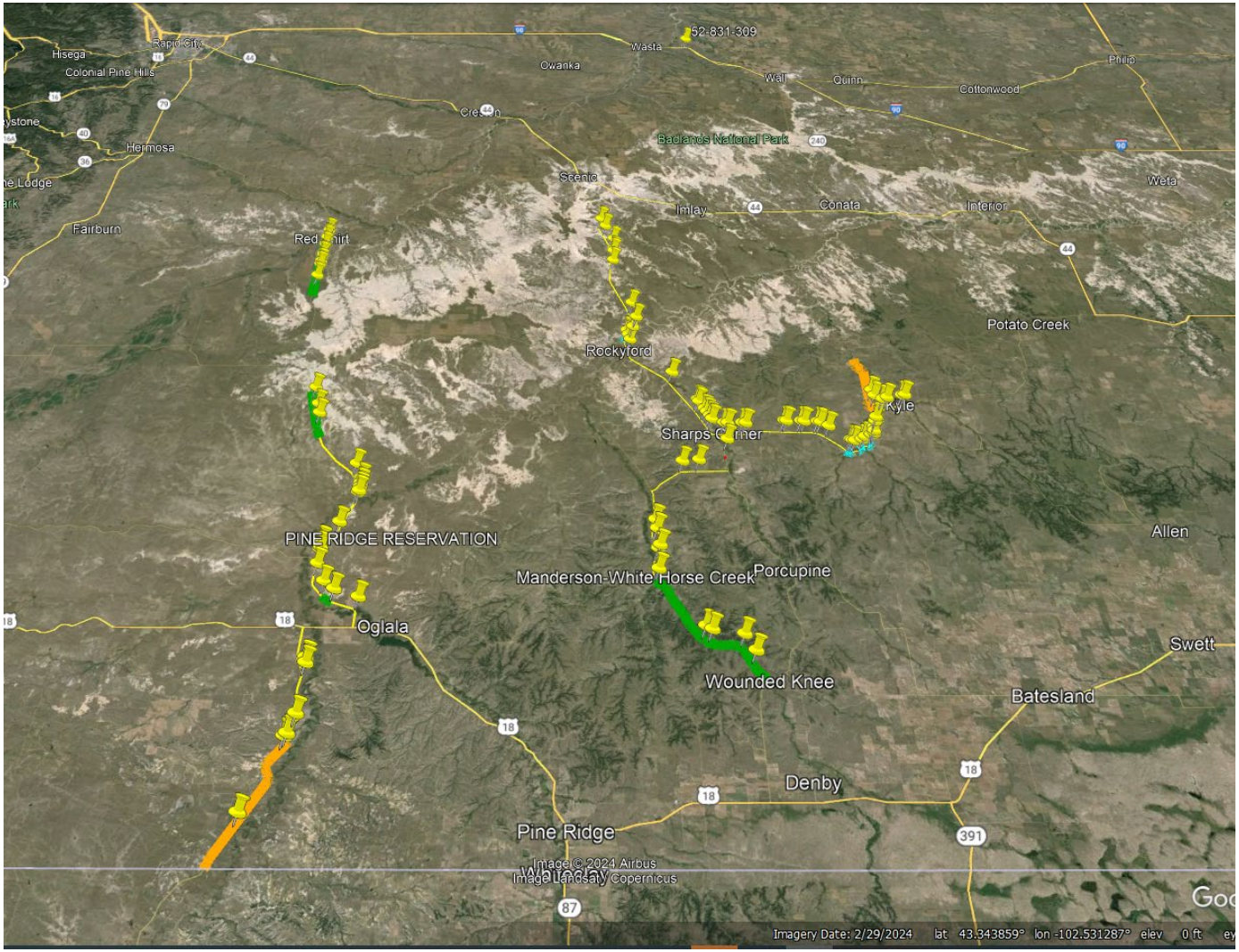
Exhibit 14: Crash Modification Factors for the Project

Source: https://www.cmfclearinghouse.org/index.php										
	Crash Modification Factor Description	CMF	Segment Length	% of Route	Route Weighted CMF	CMF ID #	ADT	% of Traffic	Weighted CMF	Weighted Crash Reduction Factor (CRF)
BIA 2 - CRACK & CHIP SEAL - FROM BIA 27 TO KYLE, SD &	Improve Pavement Friction (Chip Seal)	0.892	12.3	83.67%	0.822	7312	2000	19.1%	0.157	
	New Guardrail Along Embankment	0.433	0.2	1.36%						
	Install High Friction Surface	0.466	2.2	14.97%		11437				
BIA 14 - CRACK & CHIP SEAL - FRM BIA 33 TO BIA 27	Improve Pavement Friction (Chip Seal)	0.892	4.9	100.00%	0.892	7312	300	2.9%	0.026	
BIA 25 - NEW ASPHALT PAVEMENT - FRM BIA 2	Change Roadway Surface From Gravel or Dirt to Asphalt	0.921	5.0	100.00%	0.580	2978	650	6.2%	0.036	
	Install Paved Shoulder and Rumble Strips	0.630	5.0	100.00%		2831				
BIA 27 - CRACK & CHIP SEAL - FROM THE	Improve Pavement Friction (Chip Seal)	0.892	21.9	96.48%	0.877	7312	830	7.9%	0.070	
	Install High Friction Surface	0.466	0.8	3.52%		11437				
BIA 27 - GUARDRAIL - 2 MILES SOUTH OF SHARPS CORNER	New Guardrail Along Embankment	0.930	0.1	100.00%	0.930	39	2200	21.0%	0.196	
BIA 28 - ASPHALT PAVEMENT	Resurface Pavement	0.787	8.8	100.00%	0.702	10282	1300	12.4%	0.087	
	Install Safety Edge Treatment	0.892	8.8	100.00%		7312				
BIA 33 - CRACK AND CHIP SEAL - FROM MANDERSON, SD NORTH TO BIA 14	Improve Pavement Friction (Chip Seal)	0.892	6.0	100.00%	0.892	7312	600	5.7%	0.051	
BIA 41 - ASPHALT PAVEMENT REPLACEMENT - FROM RESERVATION	Resurface Pavement	0.787	6.5	38.46%	0.787	10282	750	7.2%	0.056	
	Provide 2-ft Paved Shoulder (both sides) - Tangent Sections	0.880	6.2			10398				
	Provide 2-ft Paved Shoulder (both sides) - Curves	0.660	0.3			10415				
BIA 41 - ASPHALT PAVEMENT REPLACEMENT - FRM 16.3 MI. S. OF THE RESERVATION LINE TO 4 MI. S.	Resurface Pavement	0.787	4.0	23.67%		10282				
BIA 41 - CRACK & CHIP SEAL - FRM 9.9 MILES NORTH OF US HWY 18 TO 6.4 MILES NORTH	Improve Pavement Friction (Chip Seal)	0.892	6.4	37.87%		7312				
BIA 41 - ASPHALT PAVEMENT	Provide 4-ft Paved Shoulder (both sides) - Curves	0.700	0.7	7.07%	0.852		1550	14.8%	0.126	
	Install High Friction Surface	0.466	0.7			11437				
BIA 41 - CRACK & CHIP SEAL - FRM BIA US18 TO 9.9 MILES NORTH LESS 0.7 MILE RECONSTRUCT	Improve Pavement Friction (Chip Seal)	0.892	9.2	92.93%		7312				
BIA 41 - CRACK & CHIP SEAL - FRM US 18 SOUTH TO BIA 32	Improve Pavement Friction (Chip Seal)	0.892	6.9	49.64%	0.798	7312	280	2.7%	0.021	
BIA 41 - NEW ASPHALT PAVEMENT - FRM	Change Roadway Surface From Gravel or Dirt to Asphalt	1.119	7.0	50.36%		2978				
	Install Paved Shoulder and Rumble Strips	0.630	7.0			2831				
Total Crash Modification (Weighted) Factor Benefits									0.826	0.17

Exhibit 15: Savings from Accident Prevention on the Roads

No Build			BUILD			Net Reduction in Accidents							
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 3.1% discount
1.00%	1.00%	1.00%	1.00%	1.00%	1.00%								
8.6	6.7	1.4											
8.7	6.7	1.4											
8.8	6.8	1.4											
8.8	6.9	1.5											
8.9	6.9	1.5											
9.0	7.0	1.5											
9.1	7.1	1.5											
9.2	7.1	1.5											
9.3	7.2	1.5											
9.4	7.3	1.5											
9.5	7.4	1.6											
9.6	7.4	1.6	7.92	6.15	1.30	(1.66)	(1.29)	(0.27)	$ (15,125)	$ (403,959)	$ (3,838,972)	$ 4,258,056	$ 3,545,352
9.7	7.5	1.6	8.00	6.21	1.32	(1.68)	(1.30)	(0.28)	$ (15,277)	$ (407,999)	$ (3,877,361)	$ 4,300,637	$ 3,473,138
9.8	7.6	1.6	8.07	6.27	1.33	(1.70)	(1.32)	(0.28)	$ (15,430)	$ (412,079)	$ (3,916,135)	$ 4,343,643	$ 3,402,396
9.9	7.7	1.6	8.16	6.33	1.34	(1.71)	(1.33)	(0.28)	$ (15,584)	$ (416,199)	$ (3,955,296)	$ 4,387,079	$ 3,333,094
10.0	7.7	1.6	8.24	6.40	1.36	(1.73)	(1.34)	(0.28)	$ (15,740)	$ (420,361)	$ (3,994,849)	$ 4,430,950	$ 3,265,203
10.1	7.8	1.7	8.32	6.46	1.37	(1.75)	(1.36)	(0.29)	$ (15,897)	$ (424,565)	$ (4,034,798)	$ 4,475,260	$ 3,198,696
10.2	7.9	1.7	8.40	6.52	1.38	(1.76)	(1.37)	(0.29)	$ (16,056)	$ (428,811)	$ (4,075,146)	$ 4,520,012	$ 3,133,543
10.3	8.0	1.7	8.49	6.59	1.40	(1.78)	(1.38)	(0.29)	$ (16,217)	$ (433,099)	$ (4,115,897)	$ 4,565,212	$ 3,069,717
10.4	8.1	1.7	8.57	6.66	1.41	(1.80)	(1.40)	(0.30)	$ (16,379)	$ (437,430)	$ (4,157,056)	$ 4,610,865	$ 3,007,191
10.5	8.1	1.7	8.66	6.72	1.43	(1.82)	(1.41)	(0.30)	$ (16,543)	$ (441,804)	$ (4,198,627)	$ 4,656,973	$ 2,945,939
10.6	8.2	1.7	8.74	6.79	1.44	(1.84)	(1.43)	(0.30)	$ (16,708)	$ (446,222)	$ (4,240,613)	$ 4,703,543	$ 2,885,935
10.7	8.3	1.8	8.83	6.86	1.45	(1.85)	(1.44)	(0.31)	$ (16,875)	$ (450,684)	$ (4,283,019)	$ 4,750,578	$ 2,827,152
10.8	8.4	1.8	8.92	6.93	1.47	(1.87)	(1.45)	(0.31)	$ (17,044)	$ (455,191)	$ (4,325,849)	$ 4,798,084	$ 2,769,567
10.9	8.5	1.8	9.01	7.00	1.48	(1.89)	(1.47)	(0.31)	$ (17,214)	$ (459,743)	$ (4,369,108)	$ 4,846,065	$ 2,713,155
11.0	8.5	1.8	9.10	7.07	1.50	(1.91)	(1.48)	(0.31)	$ (17,386)	$ (464,340)	$ (4,412,799)	$ 4,894,526	$ 2,657,892
11.1	8.6	1.8	9.19	7.14	1.51	(1.93)	(1.50)	(0.32)	$ (17,560)	$ (468,984)	$ (4,456,927)	$ 4,943,471	$ 2,603,754
11.2	8.7	1.8	9.28	7.21	1.53	(1.95)	(1.51)	(0.32)	$ (17,736)	$ (473,674)	$ (4,501,496)	$ 4,992,906	$ 2,550,720
11.3	8.8	1.9	9.37	7.28	1.54	(1.97)	(1.53)	(0.32)	$ (17,913)	$ (478,410)	$ (4,546,511)	$ 5,042,835	$ 2,498,765
11.5	8.9	1.9	9.47	7.35	1.56	(1.99)	(1.54)	(0.33)	$ (18,092)	$ (483,195)	$ (4,591,976)	$ 5,093,263	$ 2,447,869
11.6	9.0	1.9	9.56	7.43	1.58	(2.01)	(1.56)	(0.33)	$ (18,273)	$ (488,026)	$ (4,637,896)	$ 5,144,196	$ 2,398,009
229.771	178.410	37.845	174.300	135.339	28.708	(37)	(28)	(6)	(333,048)	(8,894,775)	(84,530,331)	$ 93,758,154	$ 58,727,087

Exhibit 16: Crash History 2013-2022



III.A.4. Environmental Sustainability

The primary focus on environmental sustainability is the reduction of fuel consumption and greenhouse gas emissions. Reduced travel distance will result in decreased fuel consumption and greenhouse gas emission.

Exhibit 17: Assumptions for calculating Emission Pollutant Savings

Assumptions and Factors	2020	2030	2040	Source
SOX kg/mile produced at 60 mph Rural Unrestricted (light-duty gasoline-fueled vehicles - up to 6000lbs GVW gasoline fueled passenger cars.)	0.0000021357	0.0000016919	0.0000015216	MOVES and Other Mobile Source Emissions Models https://www.epa.gov/moves Note: EPA MOVES3.0.3 project-level runs were used to determine running exhaust emission rates at different speeds across varying road types for this tool. The BCA Bridge tool runs include speeds of zero to seventy miles per hour (mph) on ten-mph intervals. Project-level links were created to correspond to the road type and speed. As such, 3-digit MOVES linkIDs were formed by concatenating roadTypeID (first digit) and speed in mph (next two digits). For more details about the EPA MOVES3.0.3 runs, please see the attached Emission Documentation.
SOX produced kg/mile at 60 mph Rural Unrestricted (heavy-duty diesel vehicles - trucks)	0.0000044235	0.0000038767	0.0000034852	
NOx kg/mile produced at 60 mph Rural Unrestricted (light-duty gasoline-fueled vehicles - up to 6000lbs GVW gasoline fueled passenger cars.)	0.000405692	0.000075164	0.000012145	
NOx produced kg/mile at 60 mph Rural Unrestricted (heavy-duty diesel vehicles - trucks)	0.005383187	0.001941788	0.001010937	
$PM_{2.5}$ produced kg/mile 60mph Rural Unrestricted (light-duty gasoline-fueled vehicles - up to 6000lbs GVW gasoline fueled passenger cars.)	0.000006895	0.000003800	0.000002827	
$PM_{2.5}$ produced kg/mile 60 mph Rural unrestricted (heavy-duty diesel vehicles - trucks)	0.000185502	0.000054439	0.000016002	
CO2 produced grams/gallon (gasoline)	8,887		USDOT BCA Guidance Table A-6 pg.43, References and Notes https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references	
CO2 produced grams/gallon (diesel)	10,180		USDOT BCA Guidance Table A-6 pg.43, References and Notes https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references	
1 kilo gram = 1000 grams	0.001			
1 kilo gram = .001 metric tons	0.001			
1 kilo gram = .0011 short tons	0.0011			
1 metric ton = 1.1023 short tons	1.1023		USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Dec 2023, pg. 43	
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 Analysis period (years)	20			
ADT % passenger vehicles	96.5%		Engineer's report	
ADT % trucks	3.5%		Engineer's report	
Days per year	365			
VOC $/short ton	see annual costs		USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, Dec 2023, Table A-6: Damage Cost for Pollutant Emissions per MT pg. 43	
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		Maritime Transportation Research and Education Center A Modal Comparison of Domestic Freight Transportation Effects on the General Public. Jan 2021 https://rosap.ntl.bts.gov/view/dot/60644	
Fuel usage - Trucks mpg	6			

This project will reduce 9862 metric tons CO_2, 3.41 metric tons NOx, 0.041 SOx, and 0.128 metric tons PM2.5s. This equates to $21,208 in savings over the 20-year analysis period of the project when discounted at 2.0 percent for CO_2 savings and 3.1 percent for NOx and PM2.5s that corresponds to $3.1 million in 2022 dollars and $2.2 million when discounted.

Exhibit 18: Emission Pollutant Savings

Calendar Year	Project Year	No-BUILD VMT	BUILD VMT	VMT Savings (annual)	Percent of VMT - All Purpose	Percent of VMT - Truck	Gasoline Savings - All Purpose	Diesel Savings - Trucks
		VMT			96.5%	3.5%	**Gallons** based upon 24.7 miles per gallon	**Gallons** based upon 6 miles per gallon
2026								
2027								
2028	1	169,040,854	167,938,432	1,102,421	1,064,099	38,322	43,081	6,387
2029	2	170,731,262	169,617,817	1,113,446	1,074,740	38,705	43,512	6,451
2030	3	172,438,575	171,313,995	1,124,580	1,085,488	39,093	43,947	6,515
2031	4	174,162,961	173,027,135	1,135,826	1,096,342	39,483	44,386	6,581
2032	5	175,904,590	174,757,406	1,147,184	1,107,306	39,878	44,830	6,646
2033	6	177,663,636	176,504,980	1,158,656	1,118,379	40,277	45,278	6,713
2034	7	179,440,273	178,270,030	1,170,243	1,129,563	40,680	45,731	6,780
2035	8	181,234,675	180,052,730	1,181,945	1,140,858	41,087	46,189	6,848
2036	9	183,047,022	181,853,258	1,193,764	1,152,267	41,498	46,650	6,916
2037	10	184,877,492	183,671,790	1,205,702	1,163,790	41,913	47,117	6,985
2038	11	186,726,267	185,508,508	1,217,759	1,175,427	42,332	47,588	7,055
2039	12	188,593,530	187,363,593	1,229,937	1,187,182	42,755	48,064	7,126
2040	13	190,479,465	189,237,229	1,242,236	1,199,054	43,182	48,545	7,197
2041	14	192,384,260	191,129,601	1,254,658	1,211,044	43,614	49,030	7,269
2042	15	194,308,102	193,040,897	1,267,205	1,223,155	44,050	49,520	7,342
2043	16	196,251,183	194,971,306	1,279,877	1,235,386	44,491	50,016	7,415
2044	17	198,213,695	196,921,019	1,292,676	1,247,740	44,936	50,516	7,489
2045	18	200,195,832	198,890,230	1,305,603	1,260,217	45,385	51,021	7,564
2046	19	202,197,791	200,879,132	1,318,659	1,272,820	45,839	51,531	7,640
2047	20	204,219,768	202,887,923	1,331,845	1,285,548	46,297	52,046	7,716
During 20 year Analysis Period		**3,722,111,234**	**3,697,837,013**	**24,274,222**	**23,430,404**	**843,818**	**948,599**	**140,636**
								1,089,236

Exhibit 19: Environmental Sustainability Savings

Calendar Year	SOX Savings	CO2 savings	NOx Savings	$PM_{2.5}$ Savings	VOC Savings	CO_2 savings	SOX Savings	NOx Savings	$PM_{2.5}$ Savings	Monetized value of SOX savings	Monetized value of NOx savings	Monetized value of PMs savings	Total Savings Non-CO_2	Discounted 3.1%	Monetized value of CO2 savings	Total Savings CO_2	Discounted 2%
	kg/mile	kg/mile	kg/mile	kg/mile	metric ton	metric ton	metric ton	metric ton	metric ton								
2026																	
2027																	
2028	2.4421	447,880	638	14	0.0	448	0.0024	0.638	0.014446	$ 143	$ 13,589	$ 14,888	$ 28,620	$ 23,830	$ 111,970	$ 111,970	$ 99,426
2029	2.4665	452,359	644	15	0.0	452	0.0025	0.644	0.014590	$ 148	$ 13,983	$ 15,314	$ 29,445	$ 23,779	$ 114,447	$ 114,447	$ 99,633
2030	1.9881	456,883	157	6	0.0	457	0.0020	0.157	0.006253	$ 122	$ 3,465	$ 6,684	$ 10,271	$ 8,046	$ 117,419	$ 117,419	$ 100,216
2031	2.0080	461,452	159	6	0.0	461	0.0020	0.159	0.006315	$ 123	$ 3,500	$ 6,751	$ 10,374	$ 7,882	$ 120,900	$ 120,900	$ 101,164
2032	2.0281	466,066	161	6	0.0	466	0.0020	0.161	0.006378	$ 125	$ 3,535	$ 6,819	$ 10,478	$ 7,721	$ 123,508	$ 123,508	$ 101,319
2033	2.0483	470,727	162	6	0.0	471	0.0020	0.162	0.006442	$ 126	$ 3,570	$ 6,887	$ 10,583	$ 7,564	$ 127,096	$ 127,096	$ 102,219
2034	2.0688	475,434	164	7	0.0	475	0.0021	0.164	0.006507	$ 127	$ 3,606	$ 6,956	$ 10,688	$ 7,410	$ 130,269	$ 130,269	$ 102,716
2035	2.0895	480,188	166	7	0.0	480	0.0021	0.166	0.006572	$ 129	$ 3,642	$ 7,025	$ 10,795	$ 7,259	$ 133,492	$ 133,492	$ 103,194
2036	2.1104	484,990	167	7	0.0	485	0.0021	0.167	0.006637	$ 130	$ 3,678	$ 7,095	$ 10,903	$ 7,111	$ 136,767	$ 136,767	$ 103,652
2037	2.1315	489,840	169	7	0.0	490	0.0021	0.169	0.006704	$ 131	$ 3,715	$ 7,166	$ 11,012	$ 6,966	$ 140,584	$ 140,584	$ 104,456
2038	2.1528	494,739	171	7	0.0	495	0.0022	0.171	0.006771	$ 132	$ 3,752	$ 7,238	$ 11,122	$ 6,824	$ 143,474	$ 143,474	$ 104,513
2039	2.1744	499,686	172	7	0.0	500	0.0022	0.172	0.006839	$ 134	$ 3,790	$ 7,310	$ 11,234	$ 6,685	$ 146,908	$ 146,908	$ 104,916
2040	1.8244	504,683	58	4	0.0	505	0.0018	0.058	0.004081	$ 112	$ 1,281	$ 4,363	$ 5,756	$ 3,322	$ 150,900	$ 150,900	$ 105,654
2041	1.8427	509,730	59	4	0.0	510	0.0018	0.059	0.004122	$ 113	$ 1,294	$ 4,406	$ 5,813	$ 3,255	$ 154,448	$ 154,448	$ 106,018
2042	1.8611	514,827	59	4	0.0	515	0.0019	0.059	0.004163	$ 114	$ 1,307	$ 4,450	$ 5,871	$ 3,188	$ 158,567	$ 158,567	$ 106,711
2043	1.8797	519,975	60	4	0.0	520	0.0019	0.060	0.004205	$ 116	$ 1,320	$ 4,495	$ 5,930	$ 3,123	$ 162,232	$ 162,232	$ 107,037
2044	1.8985	525,175	61	4	0.0	525	0.0019	0.061	0.004247	$ 117	$ 1,333	$ 4,540	$ 5,989	$ 3,060	$ 166,480	$ 166,480	$ 107,686
2045	1.9175	530,427	61	4	0.0	530	0.0019	0.061	0.004289	$ 118	$ 1,346	$ 4,585	$ 6,049	$ 2,997	$ 170,267	$ 170,267	$ 107,976
2046	1.9367	535,731	62	4	0.0	536	0.0019	0.062	0.004332	$ 119	$ 1,360	$ 4,631	$ 6,110	$ 2,936	$ 174,648	$ 174,648	$ 108,583
2047	1.9560	541,088	62	4	0.0	541	0.0020	0.062	0.004375	$ 120	$ 1,373	$ 4,677	$ 6,171	$ 2,877	$ 179,100	$ 179,100	$ 109,167
Benefits	**41**	**9,861,880**	**3,413**	**128**	**0**	**9,862**	**0.041**	**3.41**	**0.128**	**$ 2,500**	**$ 74,436**	**$ 136,279**	**$ 213,215**	**$ 145,836**	**$2,863,478**	**$ 2,863,478**	**$ 2,086,256**

III.A.5. State of Good Repair

State of Good Repair has been calculated based on the reduction of VMT on the Detour route upon the completion of these improvements.

Life-Cycle costs for the No-Build and Build scenarios have been calculated and included into the Maintenance and Residual amount on the Summary Matrix. To be conservative in the development of this analysis, Maintenance estimates were obtained from OST.

Exhibit 20: Assumption for State of Good Repair

Assumption	Assumption Value	Unit	Source:
Pavement Maintenance Cost	$0.12	per VMT saved	WSDOT
This Tab measures the roadway maintenance and preservation costs saved by reducing the need for a detour.			

For the calculation of State of Good Repair, it is assumed that the reduced VMT on the detour routes will save the OST approximately $0.12 per mile. This is estimated to save the OST $2.9 million in 2022 dollars and $1.8 million when discounted at 3.1 percent.

Exhibit 21: State of Good Repair

Decreased road maintenance on the detour route due to removing the need for a detour due to floods and slides						
Year	No-Build Road Miles	Build Road Miles	Miles saved	Maintenance rate/ mile	Total savings	Discounted 3.1%
2026	-	-	-	$0.12		$ -
2027	-	-	-	$0.12		$ -
2028	169,040,854	167,938,432	1,102,421	$0.12	$132,291	$ 110,148
2029	170,731,262	169,617,817	1,113,446	$0.12	$133,613	$ 107,905
2030	172,438,575	171,313,995	1,124,580	$0.12	$134,950	$ 105,707
2031	174,162,961	173,027,135	1,135,826	$0.12	$136,299	$ 103,554
2032	175,904,590	174,757,406	1,147,184	$0.12	$137,662	$ 101,444
2033	177,663,636	176,504,980	1,158,656	$0.12	$139,039	$ 99,378
2034	179,440,273	178,270,030	1,170,243	$0.12	$140,429	$ 97,354
2035	181,234,675	180,052,730	1,181,945	$0.12	$141,833	$ 95,371
2036	183,047,022	181,853,258	1,193,764	$0.12	$143,252	$ 93,428
2037	184,877,492	183,671,790	1,205,702	$0.12	$144,684	$ 91,525
2038	186,726,267	185,508,508	1,217,759	$0.12	$146,131	$ 89,661
2039	188,593,530	187,363,593	1,229,937	$0.12	$147,592	$ 87,835
2040	190,479,465	189,237,229	1,242,236	$0.12	$149,068	$ 86,046
2041	192,384,260	191,129,601	1,254,658	$0.12	$150,559	$ 84,293
2042	194,308,102	193,040,897	1,267,205	$0.12	$152,065	$ 82,576
2043	196,251,183	194,971,306	1,279,877	$0.12	$153,585	$ 80,894
2044	198,213,695	196,921,019	1,292,676	$0.12	$155,121	$ 79,247
2045	200,195,832	198,890,230	1,305,603	$0.12	$156,672	$ 77,632
2046	202,197,791	200,879,132	1,318,659	$0.12	$158,239	$ 76,051
2047	204,219,768	202,887,923	1,331,845	$0.12	$159,821	$ 74,502
	3,722,111,234	3,697,837,013	24,274,222		$ 2,912,907	**$ 1,824,551**

III.B. Qualitative Benefits

III.B.1. Quality of Life

The Pine Ridge Indian Reservation Pavement Resiliency and Restoration Project will increase transportation access to jobs, healthcare, education, and other essential destinations throughout the rural region as well as visitor activities which are vital the economic vitality of the region.

In addition to the primary benefits that are quantified by this BCA, there would also be added benefits that have not been included in the Benefit Cost Ratio (BCR) at this time. Such secondary benefits include:

- Benefits received from the visits to the White River Visitors Center. Exhibit 22 below shows the history of the number of visitors since 2000. From 2000 to 2023, the number of visitors has more than doubled. From 2013 to 2023, the number of visitors is up 75 percent.
- Benefits from visits and stays at the Badland National Park which is accessed by the roads in this Project. Exhibit 23
- Wildfire danger for the area is in the 88-90 national percentile. See Exhibit 25: Wildfire Risk below. The potential losses of life and services caused by a wildfire have not been calculated in this analysis.

Exhibit 22: Visitation Statistics to White River Visitor Center 2000-2023

White River Visitor Center Visitation Statistics			
Year	Visitors	Percent Increase/Decrease From Prior Year	
2023	16,518	-0.56%	Compared to 2019
2022	2276		Open 1 month (not evaluated)
2021	0		Closed due to COVID
2000	0		Closed due to COVID
2019	16,611	14.54%	
2018	14,502	23.90%	
2017	11,705	6.75%	
2016	10,965	103.85%	
2015	5,379	-9.58%	
2014	5,949	-36.95%	
2013	9,435	-13.33%	
2012	10,886	-19.93%	
2011	13,595	27.39%	
2010	10,672	-27.63%	
2009	14,746	38.17%	
2008	10,672	-9.74%	
2007	11,824	57.03%	
2006	7,530	-37.08%	
2005	11,967	76.77%	
2004	6,770	33.56%	
2003	5,069	-35.37%	
2002	7,843	-2.28%	
2001	8,026	-1.16%	
2000	8,120		
Since 2000, Visitation to White River Visitor Center has more than doubled (+203%) From 2013 to 2023 Visitors have increased by 75%			

Exhibit 23: Visitor Statistics for the Badlands National Park

Badlands National Park

Report Date: Sept 2023

Current calendar year data are preliminary and subject to change. Data will be finalized by the end of the first quarter of

	This Month	Same Month Last Year	% Change	This Year YTD	Last Year YTD	% Change YTD	Fiscal YTD
Total Recreation Visitors	142,610	121,571	17.3	966,171	919,707	5.1	1,053,272
Northeast Entrance	62,633	44,878	39.6	459,721	391,698	17.4	492,805
Pinnacles Entrance	47,429	47,772	-0.7	295,103	333,654	-11.6	328,194
Interior Road	26,935	24,132	11.6	192,799	176,815	9.0	211,985
Tour Bus Passengers	5,613	4,789	17.2	18,548	17,540	5.7	20,289
Overnight Stays							
Total Overnight Stays	4,782	4,978	-3.9	25,636	28,292	-9.4	28,267
Cedar Pass - Group Camping	59	70	-15.7	232	336	-31.0	239
Cedar Pass Conc - Tent O/N's	206	2,032	-89.9	1,115	10,017	-88.9	1,734
Cedar Pass - RV O/N's	2,132	656	225.0	9,323	3,524	164.6	9,749
Sage Creek - Tent O/N Stays	476	352	35.2	3,129	2,620	19.4	3,219
Sage Creek - RV O/N Stays	184	94	95.7	822	511	60.9	901
Cedar Pass Lodge O/N Stays	1,601	1,506	6.3	9,729	9,256	5.1	10,848
Backcountry	124	268	-53.7	1,286	2,028	-36.6	1,577
Bus Information							
Northeast - Buses	114	97	17.5	402	352	14.2	431
Northeast - Bus Passengers	3,412	2,733	24.8	11,762	9,997	17.7	12,549
Pinnacles - Buses	53	57	-7.0	157	194	-19.1	179
Pinnacles - Bus Passengers	1,893	1,865	1.5	5,361	6,499	-17.5	6,184
Cedar Pass Visitor Center - Buses	12	7	71.4	73	33	121.2	78
Cedar Pass VC - Bus Passengers	308	191	61.3	1,425	1,044	36.5	1,556
Visitor Centers							
Cedar Pass	60,643	44,585	36.0	341,742	284,504	20.1	363,840
White River	2,528	0	0.0	15,871	2,274	597.9	15,871
Sage Creek Horses	0	4	-100.0	14	7	100.0	14

Exhibit 24: 100 Year Floodplain within the Pine Ridge Reservation and Badlands National Park

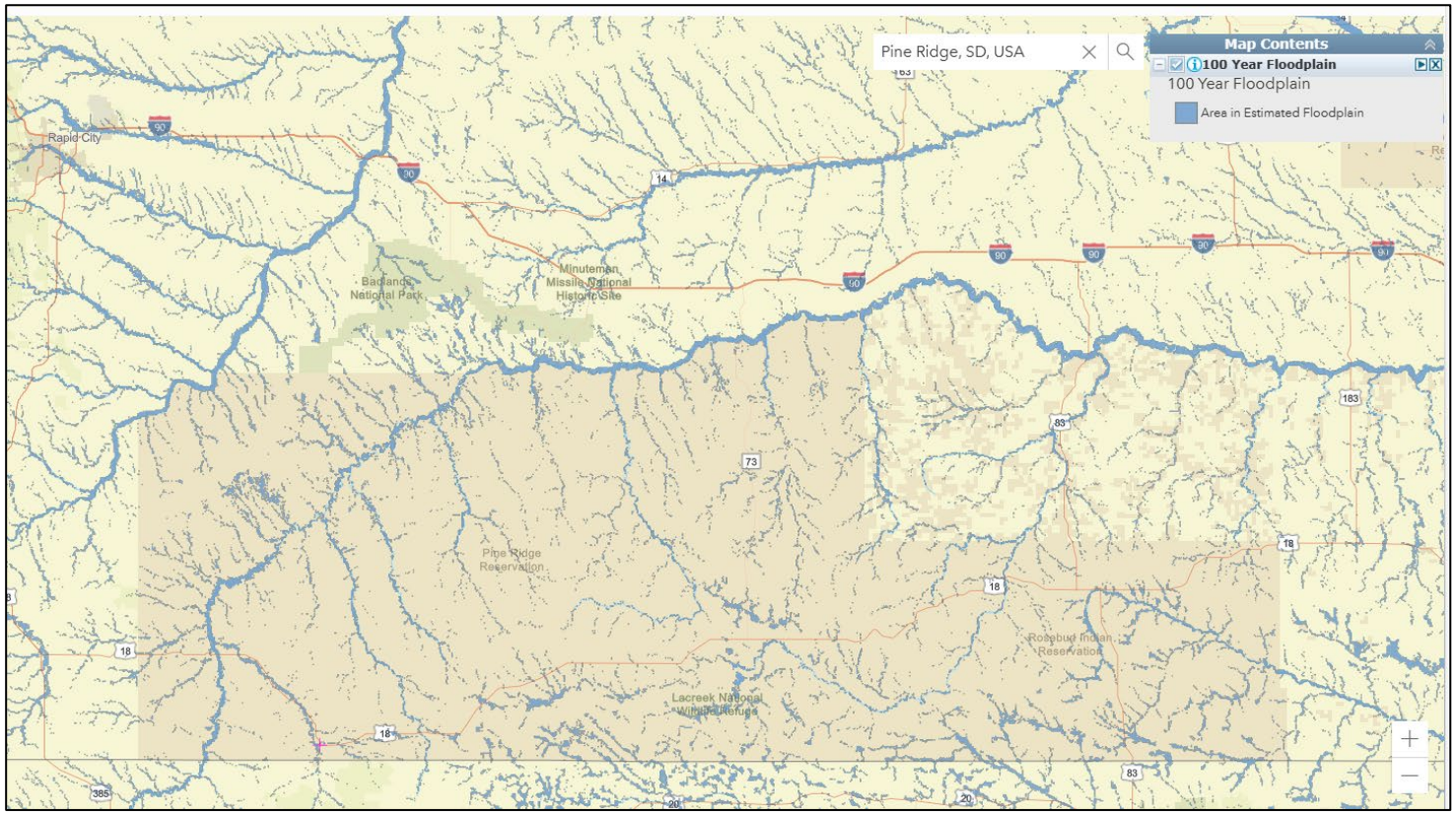
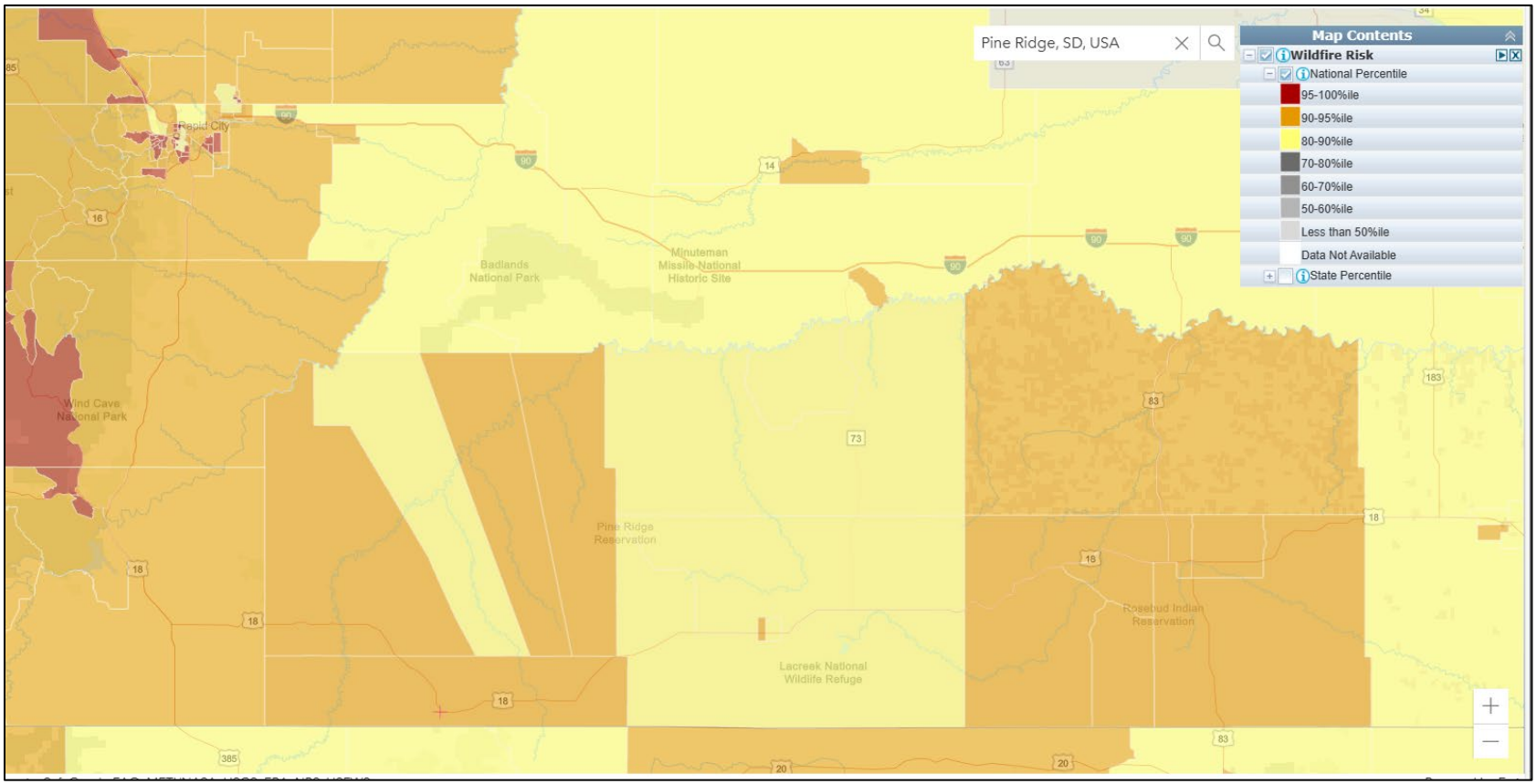


Exhibit 25: Wildfire Risk



Percent of properties at risk from Wildfires: In 2023, the risk 88-percentile and above dropping to 84 percentile and above by 2054.

IV. PROJECT COSTS

IV.A. Construction Costs

It is anticipated that the OST will finalize their engineering, environmental documents and acquisition of Right of Way (ROW) in 2023-2024 and be able to go to construction in Fall 2025. The Project will take two construction seasons to complete. Thus, a completion date of late 2027 is anticipated if funded in this round of RURAL.

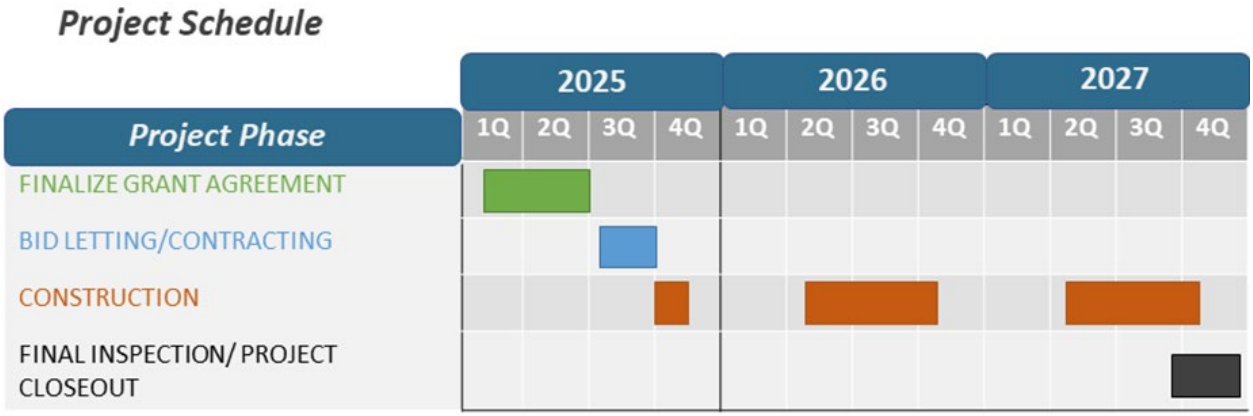
Exhibit 26: Capital Costs

Costs in $2022										
Project Component	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total Costs
Pine Ridge Indian Reservation Pavement Resiliency and Restoration	$0	$ -	$ -	$ -			$ 5,519,798	$ 22,079,190	$ 16,559,393	$ 44,158,380
										$ -
										$ -
Estimated Construction Cost	$0	$0	$ -	$ -	$ -	$ -	$ 5,519,798	$ 22,079,190	$ 16,559,393	$ 44,158,380
Estimated Engineering (Contingencies and Taro Fee are included above)					$ 883,167.6	$ 883,167.6				$ 1,766,335
Estimated Total Project Cost	$0	$ -	$ -	$ -	$ 883,168	$ 883,168	$ 5,519,798	$ 22,079,190	$ 16,559,393	$ 45,924,715
Estimated Total Project Cost (3.1% discount)	$0			$ -	$ 856,613	$ 830,856	$ 5,036,712	$ 20,788,379	$ 15,122,487	$ 42,635,047

The engineer's preliminary opinion of cost, completed by the Tribe and their consulting engineers, projects the cost of the project to be $45.2 million in 2022 dollars which equates to $42.6 million when discounted at 3.1 percent.

IV.B. Schedule

Exhibit 27 Project Schedule



IV.C. Life Cycle Costs (Maintenance Expense)

Operating and maintenance costs over the life of the project have been estimated for the No-Build and Build scenarios. It is anticipated that based upon the current asset management policies of the OST Department of Transportation, the roadway will be maintained under the N0-Build scenario. When the Roadway is reconstructed under this Project, then the life-cycle costs will be recalculated upon the date of the Corridor opening. Below Exhibit 29, is the current estimate of the savings in maintenance costs that will occur on the Corridor upon completion of the Project and the 20-year post-construction period.

Presently, the No-Build maintenance costs are recognized in the OST's transportation budget. It is planned that upon completion the old assets will be removed from the OST's asset management plan, and the new assets added, and maintenance expenses will be covered respectively budgeted accordingly. In this analysis it is estimated that the Project will save the OST $6.7 million in 2022 dollars over the 20-year post-construction or a little under than $4.4 million when discounted at 3.1 percent.

Exhibit 28: Assumption for Maintenance Costs

Assumption for Maintenance of the Corridor						
No Build	Facility			Annual Maintenance	life	in service
			Unit	Cost per Year		
	Roadway		Annual	$ 185,400		2028
	Roadway	Chip and seal	Every 7 years	$ 4,120,000		2029
	Roadway	Storm Damage	Every 5 years	$ 1,674,617		2029
Build	Facility		Unit	Annual Maintenance	life	in service
				Cost per Year		
	Roadway		Annual	$ 185,400		2028
	Roadway	Chip and seal	Every 7 years	$ 4,120,000		2028

Exhibit 29: Life-Cycle Cost Savings

Calendar Year	Project Year	$2022 No Build	$2022 Build	Total Maintenance Savings	Discounted at 3.1%
2019		Storm			
2020					
2021					
2022					
2023					
2024		storm			
2025					
2026					
2027					
2028	1	$ 185,400	$ 185,400	$ -	$ -
2029	2	$ 1,860,017	$ 185,400	$ 1,674,617	$ 1,352,399
2030	3	$ 185,400	$ 185,400	$ -	$ -
2031	4	$ 185,400	$ 185,400	$ -	$ -
2032	5	$ 185,400	$ 185,400	$ -	$ -
2033	6	$ 185,400	$ 185,400	$ -	$ -
2034	7	$ 5,980,017	$ 4,305,400	$ 1,674,617	$ 1,160,945
2035	8	$ 185,400	$ 185,400	$ -	$ -
2036	9	$ 185,400	$ 185,400	$ -	$ -
2037	10	$ 185,400	$ 185,400	$ -	$ -
2038	11	$ 185,400	$ 185,400	$ -	$ -
2039	12	$ 1,860,017	$ 185,400	$ 1,674,617	$ 996,594
2040	13	$ 185,400	$ 185,400	$ -	$ -
2041	14	$ 4,305,400	$ 4,305,400	$ -	$ -
2042	15	$ 185,400	$ 185,400	$ -	$ -
2043	16	$ 185,400	$ 185,400	$ -	$ -
2044	17	$ 1,860,017	$ 185,400	$ 1,674,617	$ 855,509
2045	18	$ 185,400	$ 185,400	$ -	$ -
2046	19	$ 185,400	$ 185,400	$ -	$ -
2047	20	$ 185,400	$ 185,400	$ -	$ -
Total Benefits		$ 18,646,468	$ 11,948,000	$ 6,698,468	$ 4,365,447

IV.D. Residual Value at Year 2047

The value of the project's Residual Value is based on the remaining value of the infrastructure after the 20-year analysis period, which equals $21.5 million in 2022 dollars or just over $10 million when discounted at 3.1 percent. The assets were depreciated on a straight line of 40-year life for the roadway and accompanying improvements.

Exhibit 30: Residual Value in Year 2047

Cost Category	Initial Capital Costs in Constant Dollars (2022)	Factor	Remaining Value	Remaining Value (2048) 3.1% discount
Pine Ridge Indian Reservation Pavement Resiliency and Restoration	$ 43,049,580	0.50	$ 21,524,790	$ 10,033,958
		-	$ -	$ -
Present Value of Total Remaining Capital Value			**$ 21,524,790**	**$ 10,033,958**

Asset Life	Years
Road Construction	40
Road Construction with the geotextiles	50

The project will incorporate an innovative use of geotextiles within the pavement structure, which resists the movement of the badland geological clays. The use of separation fabric under the pavement structure maintains separation of soil and base course and prevents soil from pumping up into the base course and intermixing which would weaken the pavement structure over time. The use of triaxial geogrid between layers of base course increases the base course strength, prevents rutting, and reduces movement to the asphalt pavement which will reduce cracking. The geotextile integrated pavement structure replacement planned will be stronger, more resilient, and have a longer life span than a standard pavement structure with asphalt over base course. This use of this innovative technique and materials extends the asset life for the roads with this treatment from the traditional 40 years to 50 years. To be conservative, the Analysis uses 40 years as the Asset Life of the Project.

V. BENEFIT COST SUMMARY

As Exhibit 31 shows, the Project, when discounted at 3.1 percent /2 percent, generates $80.6 million in public benefits before life-cycle costs savings of $4.3 million and a residual value of just over $10 million, for a total benefit of $95 million. Project costs are $42.6 million when discounted at 3.1 percent. The Benefit Cost Ratio is estimated to be 2.23 with a Net Present Value of $52.3 million.

Safety Benefits of consists of reduction of accidents within the Project area. The completed Project is estimated to reduce accidents by 17 percent due to the safety elements designed into the Project for a savings of $58.7-million when discounted at 3.1 percent. Safety accounts for 73 percent of the Project's public benefits.

Environmental Sustainability of reducing vehicle delay hours with the completion of the Project accounts for less than 2 percent of the public benefits or $2.2 million when discounted at 3.1/2 percent respectively.

Economic Competitiveness contributes $17.8 million consisting of $8.3 million from Operating cost savings (10 percent of total public benefits) and mobility is increased by $9.5 million in Travel Time Value savings (12 percent of the public benefits).

State of Good Repair due to the reduction in the use of the detour contributes $1.8 million to the public benefits when discounted at 3.1 percent (2 percent)

V.A. Results

Exhibit 31: Summary of Benefit-Cost Analysis, Preferred Alternative

PINE RIDGE INDIAN RESERVATION PAVEMENT RESILIENCY AND RESTORATION

Benefit Cost Analysis

Summary Matrix

Areas of Evaluation	Description	Inputs (over the life of the project)	Monetized Value 2022 dollars	Monetized Value Discount Rate 3.1%/2%
Safety	Crash Reduction Savings	•17% crash reduction for Property Damage Only, Injury and Fatality crashes	$ 93,758,154	$ 58,727,087
Environmental Sustainability	Reduced Pollution	• Emission reductions of: 9900 metric tons CO_2	$ 3,076,693	$ 2,232,092
Economic Competitiveness	Travel Time Savings	• Reduction in 460,900 vehicle hours traveled (VHT)	$ 15,098,723	$ 9,457,354
	Vehicle Operation Cost Savings	• Reduction of 1.1 million gallons of fuel	$ 13,297,650	$ 8,329,219
State of Good Repair	Savings due to reduced use of Detour route	• Reduction in 24 million vehicle miles traveled (VMT)	$ 2,912,907	$ 1,824,551
Emergency Response	Reduction in Losses due to delayed response	Not calcuated		
Total Benefits before Maint and Residual Value			$ 128,144,127	$ 80,570,303
Maintenance		Life Cycle Cost	$ 6,698,468	$ 4,365,447
Residual		Residual Value	$ 21,524,790	$ 10,033,958
Total Benefits			$ 156,367,384	$ 94,969,708
Total Costs			$ 45,924,715	$ 42,635,047
Net Present Value			$ 110,442,669	$ 52,334,661
Benefit Cost Ratio			3.40	2.23