APPENDIX A: BENEFIT-COST ANALYSIS

EXECUTIVE SUMMARY

This benefit-cost analysis (BCA) conducted for the Oklahoma Department of Transportation's (ODOT) Safety Improvements on Oklahoma Rural Roadways Project, for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the 2022 Rural Grant Program is conducted in accordance with the benefit-cost methodology as outlined by USDOT in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs, released in March 2022 (revised). The period of analysis corresponds to 30 years of benefits after operations begin in 2026, reflective of the significant reconstruction of the roadway segments including bridge construction.

The project will create a safer roadway environment for Oklahoma drivers as they travel along the state's rural roadway network. ODOT is requesting $58 million of Rural Surface Transportation Grant funding to support the completion of this $136.9 million ($108.2 million in 2020 dollars) project including $20.3 million in previously incurred costs. Table ES-1 provides an overview of the cost of the proposed improvements.

Table ES-1 Overview of the Safety Improvements on Oklahoma Rural Roadways Project (Construction Costs)

County	Highway	Total Length	Project Total	Work Type
Atoka	SH 7	5.40	$17,682,597	Grade, Drain, Bridge & Surface
Beckham	SH 34	2.30	$17,440,124	Grade, Drain, Bridge & Surface
Cimarron	US 56	7.96	$17,400,000	Widen, Resurface & Bridge
Ellis	SH 15	3.20	$8,468,000	Widen, Resurface & Bridge
Grady	SH 19	5.87	$24,838,588	Grade, Drain, Bridge & Surface
Johnston	SH 48	6.00	$12,664,880	Widen & Resurface
Roger Mills	SH 152	3.83	$9,821,017	Widen & Resurface
Washita	SH 152	5.00	$8,112,463	Widen, Resurface & Bridge
Total		**39.56**	**$116,607,669**	

The project will reduce crashes, resulting in avoided crash costs of $240.0 million undiscounted and $65.1 million in 2020 discounted dollars.

The Project will incur operations and maintenance (O&M) costs. Compared to the "No Build" scenario savings in O&M costs will be $65.0 million in undiscounted dollars or $27.0 million when discounted at seven percent.

At the end of 30-years operating period, the assets will retain a residual value of $3.3 million in undiscounted dollars and $0.6 million in discounted dollars. The residual value is included in the total benefits of the project per USDOT guidance.

The Project will generate $92.9 million in discounted net benefits using a seven percent discount rate (not including residual value) through 2055. The Project will reduce crash incidents and operations and maintenance costs. Using a seven percent discount rate, this leads to an overall project Net Present Value (including residual value of assets) of -$15.3 million and a **Benefit Cost Ratio (BCR) of 0.9**.[1] The overall project benefit matrix is in **Table ES-2**.

Table ES-2: Safety Improvements on Oklahoma Rural Roadways Project Impacts and Benefits Summary, Monetary Values in Millions of Discounted 2020 dollars

Current Status/Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Economic Benefit	Monetized Benefits, 2026-2055 (at 7% discount rate)	Page Reference in BCA
Crashes due to current configurations	Safer roadway design	Reduction in crash incidents: Reduction in costs associated with fatality, injury, and property damage crashes	$65.1	A-15
Residual Asset Values	Value of remaining useful life on Project assets	75-year useful life for new bridges, 50 years for refurbished bridges, with 45 and 20 years of remaining life value for new and refurbished bridges, respectively.	0.8	A-25

[1] Per USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (March 2022, Revised), savings in operations and maintenance costs are included in the numerator along with other project benefits when calculating the benefit-cost ratio.

Current Status/Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Economic Benefit	Monetized Benefits, 2026-2055 (at 7% discount rate)	Page Reference in BCA
Aging infrastructure resulting in higher O&M costs	Newer and better designed infrastructure and better materials reduce O&M costs	Reduced O&M costs	$27.0	A-25

Source: Cambridge Systematics, Inc.

The overall **Safety Improvements on Oklahoma Rural Roadways Project** impacts are in Table ES-3, which shows the magnitude of the various metrics used in this analysis to quantify the Project benefits.[2]

Table ES-3: Impacts for the Safety Improvements on Oklahoma Rural Roadways Project, **Cumulative 2026-2055**

Metric	Cumulative Savings
Fatal Accidents Avoided	14 fatal crashes
Injury Accidents Avoided	214 injury crashes
Property Damage Only (PDO) Accidents Avoided	276 PDO crashes
Reduced Operations and Maintenance Costs	$27.0 million discounted to $2020

Source: Cambridge Systematics, Inc.

[2] Crash reduction impacts include bicycle and pedestrian-involved incidents.

1. INTRODUCTION

A benefit-cost analysis (BCA) was conducted for **the Safety Improvements on Oklahoma Rural Roadways Project**, for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the 2022 Rural Grant program. This appendix is organized as follows:

- Section 2 contains the Project description.
- Section 3 documents the BCA methodology, including key methodological components, assumptions, and the study scenarios.
- Section 4 contains a detailed explanation and calculation of the Project benefits.
- Section 5 contains a detailed explanation and calculation of the Project costs.
- Section 6 contains the detailed results of the BCA.

2. PROJECT DESCRIPTION

The $136.9 million Safety Improvements on Oklahoma Rural Roadways project is located on a network of roadways throughout the state with the intent to address high fatality and serious industry rates in the rural areas of Oklahoma. The project is located along seven (7) different roadways in eight (8) different counties (**Figure 1**). The project will create a safer roadway environment for Oklahoma drivers as they travel along the state's rural roadway network. It will address serious safety issues along 39.56 miles of state highways, such as a lack of adequate roadway shoulders and run-off road warning treatments, poor roadway geometry limiting down-road visibility, and deteriorating pavement and bridge conditions (Table A-1). These current conditions contribute to over $8.6 million per year in crash-related costs at a rate of 0.46 crashes per route mile per year.

The project will address the roadway deficiencies by:

This project will do the following to improve roadways:

This project will do the following to improve roadways:

- Construct shoulders on the roadways, which is shown to reduce head-on crashes, sideswipe crashes, fixed object crashes, and pedestrian crashes.
- Correct vertical curves where thresholds exceed design standards.
- Install rumble strips to decrease accidental lane departure.
- Improve roadway surface condition, thereby reducing vehicle damage and erratic driving patterns due to avoiding poor pavement areas.
- Install high-friction surface treatment, which has been shown to reduce head-on and sideswipe crashes

These treatments will not only improve the pavement of the roadways, but also significantly reduce the number and severity of crashes.

Figure 1: Safety Improvements on Oklahoma Rural Roadways Project Location

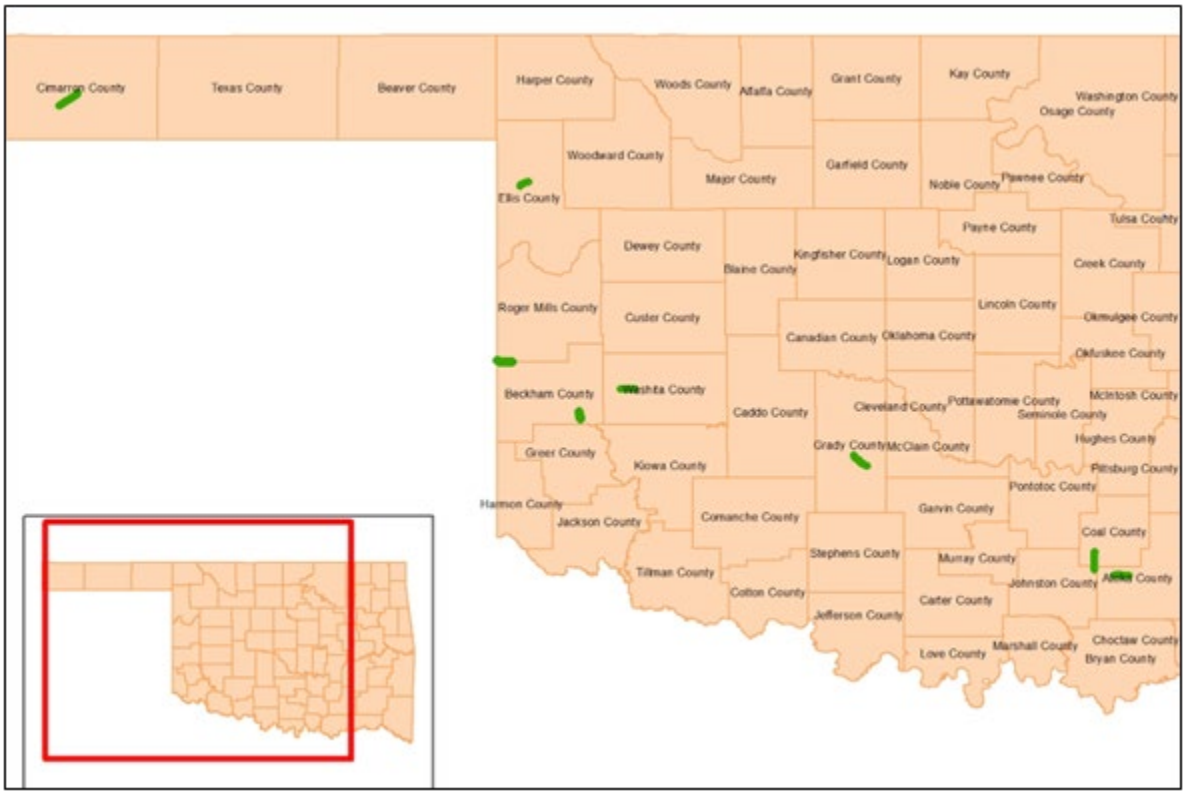

Table A-2: Overview of the Safety Improvement Construction on Oklahoma Rural Roadways Project

County	Highway	Total Length	Project Total	Work Type
Atoka	SH 7	5.40	$17,682,597	Grade, Drain, Bridge & Surface
Beckham	SH 34	2.30	$17,440,124	Grade, Drain, Bridge & Surface
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Roger Mills	SH 152	3.83	$9,821,017	Widen & Resurface
Washita	SH 152	5.00	$8,112,463	Widen, Resurface & Bridge
Total		**39.56**	**$116,607,669**	

3. BENEFIT COST ANALYSIS FRAMEWORK

The BCA provides an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of a potential infrastructure project. Project benefits and costs are broadly defined and are quantified in monetary terms to the extent possible. The overall goal of the project BCA is to assess whether the expected benefits of the project justify the costs from a national perspective. The BCA framework attempts to capture the net welfare change created by the project, including cost savings and increases in welfare (benefits), as well as disbenefits where costs can be identified (e.g., project capital costs), and welfare reductions where some groups are expected to be made worse off because of the proposed project.

The BCA framework involves defining a Base or "No Build" scenario, which is compared to the "Build" scenario. The BCA assesses the incremental difference between the "Build" scenario and the "No Build" scenario, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare over a project life cycle. The importance of future changes is determined through discounting, which is meant to reflect the time value of money.

KEY METHODOLOGICAL COMPONENTS

The project BCA is conducted in accordance with the benefit-cost methodology recommended by the USDOT.[3] The methodology includes the following key components:

- Defining existing and future conditions under the "No Build" (Base) scenario as well as under the "Build" scenario;
- Assessing the project benefits over the 30 years of operations beyond the Project completion when benefits accrue and using USDOT recommended values to monetize traffic crashes by severity while relying on best practices for monetization of any other benefits or disbenefits;
- Estimating the project capital costs during Project construction and Project operation and maintenance costs over the 30 years of operations beyond the Project completion when benefits accrue; and
- Discounting Project benefits and costs to 2020 dollars using a real discount rate of 7 percent consistent with USDOT guidance.

KEY ASSUMPTIONS

The assessment of the Project benefits and costs associated with the **Safety Improvements on Oklahoma Rural Roadways project** involve the following key assumptions:

[3] U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised).

- The evaluation period includes the design and engineering, right of way acquisitions, and construction during which capital expenditures are undertaken, plus 30 years of operations beyond the Project completion within which to evaluate ongoing benefits and costs.

- The construction phase of the Project will begin in 2024 ending in 2025, at which point the Project will be deemed complete.

- The Project will be opened in 2026 and the 30-year operational period will conclude in 2055. Although, segments of the project will be completed early, benefits are assumed to begin accruing when all the project segments are completed.

- All Project benefits and costs are conservatively assumed to occur at the end of each calendar year for purposes of present value discounting.

- Monetary values of Project costs and benefits are expressed in constant, year-end 2020 dollars.

"BUILD" AND "NO BUILD" SCENARIOS

The analysis of the **Safety Improvements on Oklahoma Rural Roadways project** considered how the balance of costs and benefits resulting from the construction of the Project would result in long-term benefits. This is accomplished by comparing the "Build" scenario relative to the "No-Build" scenario.

- The "No Build" (Base) scenario would consist of leaving the roadway segments as they currently stand with routine operational and maintenance costs to maintain current levels of service.

- The "Build" scenario would rehabilitate the roadways and bridges, adding wide paved shoulders with rumble strips to the roadways and bridges, improving roadway geometries to improve line of sight distances, and other minor treatments. This scenario would entail the capital costs associated with the construction until the Project has been completed, and then routine operational and maintenance costs once the Project is in use over the 30-year evaluation period. A residual value of the assets of $8.3 million (undiscounted) is calculated based on remaining useful life.

4. PROJECT BENEFITS

ECONOMIC COMPETITIVENESS – QUALITATIVE ASSESSMENT

This project will help Oklahoma support its rural economy which is heavy in agriculture and energy production, two vital areas of the economy made even more important in the wake of international conflict driving up food and energy costs. Economic activity will be supported in the following ways:

- Energy sector equipment, such as oil rig materials or large wind turbine towers, must move on these narrow roadways. Adding shoulders, smoothing vertical curves, and other geometric design improvements to the roadways will allow for faster movement of this equipment and therefore reduce shipping costs.

- The addition of shoulders will reduce conflicts between large agricultural equipment such as combines and personal vehicles which are able to travel at higher speeds. Sightlines will improve and shoulders will allow for easier passing of the equipment.

- The smoother roadway surface will facilitate faster travel time for all users of the roadway, allowing for greater freight mobility and travel time reductions.

CLIMATE CHANGE, RESILIENCY, AND ENVIRONMENT VOC COST SAVINGS - QUALITATIVE ASSESSMENT

While this project is primarily a safety and state of good repair project, it will improve environmental-related outcomes. ODOT routinely uses warm mix asphalt instead of hot mix asphalt, which is estimated to reduce between 25% and 50% of the emissions related to asphalt production.

There are also six bridges to be replaced, nine modified, and one removed. Based on available data, bridges in at least three counties (Grady, Roger Mills, and Washita) are in or adjacent to a 100-year floodplain. The new bridges constructed as a part of this project will have updated hydraulic designs to better handle extreme weather events. These designs can include widened drainage areas, raised bridge profiles to allow water and debris to clear the structure, stronger bridge foundation elements to withstand water flowing at fast speeds, and use of construction materials better suited to withstand extreme heat and precipitation events.

This project will also support public transportation operations. The following public transportation operators use the roadways that will have safety and state of good repair improvements:

- MAGB Transportation (Cimarron County)

- Red River Transit (Beckham County, Roger Mills County, Washita County, Ellis County)

- Washita Valley Transit (Grady County)

- JAMM Transit (Johnston County, Akota County)

The proposed improvements will allow for faster, safer travel and will result in less wear and tear on the transit vehicles. Because these rural transportation agencies primarily provide demand response service, there is no coordination on bus stop placement along the segments slated for upgrade. However, in those instances where passengers are discharged on upgraded street segments, the shoulders will provide for a safer walking path than the current design with no or insufficient shoulders.

CRASH COST SAVINGS – QUANTITATIVE ASSESSMENT

The safety benefits assessed in this analysis are based on a reduction in automotive (car and truck) crashes resulting directly from the **Safety Improvements on Oklahoma Rural Roadways project**.

Safety benefits result from the reduction in the number of predicted annual crashes from the “Build” scenario relative to the “No-Build” scenario. The estimation of these benefits involved the following:

- Historical crashes for the project roadway segment, over five-year timeframe was analyzed to estimate the average number of annual crashes and their severity.[4] These crashes represent the "No Build" scenario.

- The types of crashes from the "No Build" scenario was reviewed and compared to the efficacy of safety treatments envisioned for the "Build" scenario. The efficacy (crash reduction) estimates were developed using the Crash Modification Factors Clearinghouse compilation[5] of research on the crash modification/reduction capabilities of various safety treatments. These are documented in the accompanying BCA spreadsheet. In most cases, the primary treatment is "UPGRADE NARROW UNPAVED SHOULDER (< 5 FT) TO WIDE PAVED SHOULDER (> 5 FT)" which for this project reduces many of the crashes by 77 percent.[6] In concert with the wider, paved shoulder treatment is "INSTALL EDGELINE RUMBLE STRIPS ON ROADWAYS WITH A SHOULDER WIDTH OF 5 FEET OR GREATER which has an average crash reduction factor of 38 percent.[7] In addition to these treatments, the project includes vertical curve correction and wet reflective treatments, For the combination of the treatments (shoulder and rumble strips) the following formula was used:

  Crash Reduction % = 1-((1-Treatment #1)*(1-(Treatment #2))

  In this case:

  Crash Reduction % = 1-((1-.77)*(1-.38)) = 86%

- The crash reduction factors were applied to the "No Build" crashes to calculate the "Build" crashes. The reduction in crashes, monetized represent the baseline annual safety benefits of the proposed treatment.

- The average annual crash figures and costs were grown annually to reflect the overall growth in Oklahoma's rural State Highways vehicle miles travelled (VMT). The growth rate used is 1.735 percent per year.[8]

- Then, the number of reduced crashes by severity was multiplied by the corresponding comprehensive unit cost of motor vehicle crashes by crash severity (**Table A-2**), to determine the total safety cost reduction. All property damage only (PDO) crashes are assumed to involve 1.748 vehicles, based on crash data presented by U.S. Department of Transportation, National Highway Traffic Safety Administration.[9]

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[4] Source: Oklahoma Department of Transportation
[5] https://www.cmfclearinghouse.org/
[6] http://www.cmfclearinghouse.org/detail.cfm?facid=5411
[7] http://www.cmfclearinghouse.org/study_detail.cfm?stid=206
[8] 2014-2019 DVMT on rural Oklahoma State Highways increased an average compound rate of 1.735% per year. https://www.fhwa.dot.gov/policyinformation/statistics/20**XX**/hm81.cfm
[9] U.S. Department of Transportation, National Highway Traffic Safety Administration, *The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised),* May 2015.

- The cost reductions for each crash type were then summed to generate the total safety benefit.

Table A-2: Comprehensive Unit Costs of Motor Vehicle Crashes by Crash Severity

Variable	Unit	Value	Source
Fatal Crash	$/Crash	**$12,837,400**	U.S. Department of Transportation, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, (March 2022 - Revised)
Injury Crash	$Crash	**$302,600**	U.S. Department of Transportation, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, (March 2022 - Revised); DOT VSL Guidance - 2021 Update.pdf (transportation.gov)
Property Damage Only Accident (No Injury)	$/Crash	$4,600 per vehicle x 1.748 vehicles per crash = **$8,041** per PDO crash	U.S. Department of Transportation, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, (March 2022 - Revised) U.S. Department of Transportation, National Highway Traffic Safety Administration, *The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised),* May 2015[10]

Table A-3 presents the motor vehicle crash reduction benefits. In total, the reduction in automobile and truck crashes reduces crash costs by **$240.0 million** and **$65.1 million** discounted to 2020 dollars.

Table A-3: Crash Reduction Benefits Resulting from the Safety Improvements on Oklahoma Rural Roadways Project, 2026-2055

Year	Total Crash Savings	
	Nominal $	Discounted $2020
2026	$6,166,554	$4,109,035
2027	$6,273,543	$3,906,848
2028	$6,382,389	$3,714,609
2029	$6,493,124	$3,531,829
2030	$6,605,780	$3,358,043
2031	$6,720,390	$3,192,809
2032	$6,836,989	$3,035,705
2033	$6,955,610	$2,886,331
2034	$7,076,290	$2,744,307
2035	$7,199,064	$2,609,272
2036	$7,323,968	$2,480,881
2037	$7,451,038	$2,358,808
2038	$7,580,314	$2,242,741

[10] https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812013

Year	Total Crash Savings	
	Nominal $	Discounted $2020
2039	$7,711,832	$2,132,386
2040	$7,845,633	$2,027,461
2041	$7,981,754	$1,927,698
2042	$8,120,238	$1,832,845
2043	$8,261,124	$1,742,658
2044	$8,404,454	$1,656,910
2045	$8,550,272	$1,575,381
2046	$8,698,619	$1,497,863
2047	$8,849,540	$1,424,160
2048	$9,003,080	$1,354,083
2049	$9,159,283	$1,287,455
2050	$9,318,197	$1,224,105
2051	$9,479,867	$1,163,872
2052	$9,644,343	$1,106,603
2053	$9,811,672	$1,052,152
2054	$9,981,905	$1,000,380
2055	$10,155,091	$951,156
TOTAL	**$240,041,956**	**$65,128,383**

Source: Cambridge Systematics, Inc.

OPERATIONS AND MAINTENANCE COST SAVINGS – QUANTITATIVE ASSESSMENT

Based on data provided by ODOT, the Operations and Maintenance costs (O&M) for the assets constructed under this project will be significantly less than the O&M costs for the"No Build" scenario. This is due to the infrastructure being newer, made from more advanced and durable materials. The "Build" versus "No-Build" O&M costs are:

30-year O&M Costs under the "No Build' scenario:

- Resurface every 10 years - 10 miles at a time ($6.0 million per year over 4 years, each time)
- Rehab work on various bridges - $1.0 million every 4 years
- Total 30-year "No Build" O&M = $89.0 million

30-year O&M Costs under the "Build" Scenario:

- Resurface after 15 years - 10 miles at a time (Silane on bridge surfaces.
- Total 30-year "Build" O&M = $24.0 million

Table A-4 summarizes the "Build" versus "No Build" project costs. Building the project will save $65.0 million in undiscounted O&M costs and $27.0 million in discounted O&M.

Table A-4: Safety Improvements on Safety Improvements on Oklahoma Rural Roadways Project – Life Cycle Project Costs

Year	Build O&M Costs		No Build O&M Costs		Build O&M Cost Savings	Build O&M Cost Savings
	Undiscounted	Discounted	Undiscounted	Discounted	Un-Discounted	Discounted
2023	$0	$0	$0	$0	$0	$0
2024	$0	$0	$6,000,000	$4,577,371	$6,000,000	$4,577,371
2025	$0	$0	$6,000,000	$4,277,917	$6,000,000	$4,277,917
2026	$0	$0	$6,000,000	$3,998,053	$6,000,000	$3,998,053
2027	$0	$0	$6,000,000	$3,736,498	$6,000,000	$3,736,498
2028	$0	$0	$1,000,000	$582,009	$1,000,000	$582,009
2029	$0	$0	$0	$0	$0	$0
2030	$0	$0	$0	$0	$0	$0
2031	$0	$0	$0	$0	$0	$0
2032	$0	$0	$1,000,000	$444,012	$1,000,000	$444,012
2033	$0	$0	$0	$0	$0	$0
2034	$0	$0	$6,000,000	$2,326,903	$6,000,000	$2,326,903
2035	$0	$0	$6,000,000	$2,174,676	$6,000,000	$2,174,676
2036	$0	$0	$7,000,000	$2,371,142	$7,000,000	$2,371,142
2037	$0	$0	$6,000,000	$1,899,446	$6,000,000	$1,899,446
2038	$0	$0	$0	$0	$0	$0
2039	$0	$0	$0	$0	$0	$0
2040	$0	$0	$1,000,000	$258,419	$1,000,000	$258,419
2041	$6,000,000	$1,449,079	$0	$0	$6,000,000	$1,449,079
2042	$6,000,000	$1,354,279	$0	$0	$6,000,000	$1,354,279
2043	$6,000,000	$1,265,681	$0	$0	$6,000,000	$1,265,681
2044	$6,000,000	$1,182,880	$6,000,000	$1,182,880	$0	$0
2045	$0	$0	$6,000,000	$1,105,495	$6,000,000	$1,105,495
2046	$0	$0	$6,000,000	$1,033,173	$6,000,000	$1,033,173
2047	$0	$0	$6,000,000	$965,582	$6,000,000	$965,582
2048	$0	$0	$0	$0	$0	$0
2049	$0	$0	$0	$0	$0	$0
2050	$0	$0	$1,000,000	$131,367	$1,000,000	$131,367
2051	$0	$0	$0	$0	$0	$0
2052	$0	$0	$0	$0	$0	$0
2053	$0	$0	$0	$0	$0	$0
2054	$0	$0	$6,000,000	$601,316	$6,000,000	$601,316
2055	$0	$0	$6,000,000	$561,978	$6,000,000	$561,978
TOTAL	**$24,000,000**	**$5,251,919**	**$89,000,000**	**$32,228,239**	-$65,000,000	-$26,976,321

Source: Cambridge Systematics, Inc.

RESIDUAL VALUE OF ASSETS – QUANTITATIVE ASSESSMENT

Some of the assets built under this project will have a useful life exceeding the 30-year Benefit-Cost study time horizon. Therefore, per USDOT guidance[11], assets with useful lives beyond 30 years are valued for the remaining useful life and discounted at the 30-year discount value. According to ODOT, new bridges will have a useful life of 75 years, with 60 percent value remaining in year 30. Modified/refurbished bridges will have a useful life of 50 years with 40 percent of value remaining at year 30. The calculated residual value of the bridges is **$8.3** million (undiscounted) and **$0.8** million when discounted at seven percent. Table A-5.

Table A-5: Safety Improvements on Oklahoma Rural Roadways Project Bridges Residual Value

County	New Bridges (75 Year Life)	Bridge Modification (50 Year Life)	Totals
	$	$	$
Atoka	$0	$318,200	$318,200
Johnston	$0	$0	$0
Beckham	$7,589,323	$0	$7,589,323
Roger Mills	$0	$1,020,545	$1,020,545
Washita	$0	$252,545	$252,545
Cimarron	$0	$460,891	$460,891
Ellis	$0	$1,333,017	$1,333,017
Grady	$3,973,618	$0	$3,973,618
Total	$11,562,941	$3,385,198	$14,948,139
Residual at 30 years	**$6,937,765**	**$1,354,079**	**$8,291,844**
Residual Discounted 7% to $2020	**$649,811**	**$126,827**	**$776,638**

Source: Cambridge Systematics, Inc.

PROJECT BENEFITS SUMMARY

Table A-6 shows **the Safety Improvements on Oklahoma Rural Roadways Project** long-term benefits aligning the benefit categories - with the merit criteria of the BUILD Grants program.

[11] U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020.

Table A-6: Project Benefits by Long-Term Outcome Category, Millions of Dollars

Long-Term Outcome	Benefit Category	Benefit Description	Benefits (Millions of $)	Benefits 7% Discount (Millions of $2020)
Safety	Reduced Crash Incidents	Reduction in traffic fatalities/injuries and PDO crashes and pedestrian and bicycle crashes	$240.0	$65.1
Reduced O&M Costs	Economic Competitiveness	Lower costs to maintain facilities	$65.0	$27.0
Residual Asset Life	State of Good Repair	Improved health and reduced costs	$8.3	$0.8
Total			**$313.3**	**$92.9**

Source: Cambridge Systematics, Inc.

5. PROJECT COSTS

CAPITAL COSTS

The capital costs associated with the **Safety Improvements on Oklahoma Rural Roadways** Project (**Table A-7**) are primarily associated with the actual construction. Construction costs will total of $116.6 million in nominal dollars. Previously incurred costs of $20.3 million, assigned to 2020, were for right of way purchase, NEPA and engineering.

Table A-7: Project Schedule and Costs

Variable	Value	Unit
Construction Start	2023	year
Construction End	2025	year
Construction Duration	3	years
Project Opening	2026	year
Capital Cost – Construction	$116.6	Millions of $
Previously Incurred Costs (2020)	$20.3	Millions of $
Total Project Cost	$136.9	Millions of $

Source: ODOT, 2022

6. SUMMARY OF RESULTS

EVALUATION MEASURES

The BCA converts potential gains (benefits) and losses (costs) from the **Safety Improvements on Oklahoma Rural Roadways Project** into monetary units and compares them. The following common benefit-cost evaluation measures are included in this BCA:

- Net Present Value (NPV): NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.

- Benefit Cost Ratio (BCR): The present value of incremental benefits is divided by the present value of incremental costs to yield the BCR. The BCR expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of the costs.

BCA RESULTS

Table A-8 presents the evaluation results for the **Safety Improvements on Oklahoma Rural Roadways Project**. Results are presented in undiscounted and discounted at seven percent (3 percent for CO_2 emissions). All benefits and costs are estimated over an evaluation period extending 30 years beyond system completion in 2025 (starting in 2026). The total net benefits from the Project improvements within the analysis period represent **$92.9 million** (including the crash reduction cost savings, O&M cost savings, and asset residual value) when discounted at seven percent. The total capital costs, including engineering and construction, etc. are calculated to be **$108.2 million** when discounted at seven percent. The difference of the discounted benefits and costs equal a NPV of **-$15.3 million**, resulting in a BCR of **0.9:1.**

Table A-9 summarizes the results of the BCA by year. The full spreadsheet model is attached with the application.

Table A-8: Safety Improvements on Oklahoma Rural Roadways Project – Evaluation Measures

BCA Metric	Project Lifecycle	
	Undiscounted (Millions of $)	7% Discount (Millions of $2020)
Benefits:		
Safety Crash Cost Reductions	$240,041,956	$65,128,383
Maintenance & Operations Savings	$65,000,000	$26,976,321
Residual Asset Value	$8,291,844	$776,638
Total Benefits	**$313,333,800**	**$92,881,342**
Total Costs	**$136,865,665**	**$108,161,471**
Benefit/Cost Ratio	**2.3**	**0.9**
Net Present Value	**$176,468,135**	**-$15,280,129**

Source: Cambridge Systematics, Inc.

Table A-9: Safety Improvements on Oklahoma Rural Roadways Project – Life-Cycle Benefit-Cost Analysis

Year	Undiscounted Costs and Benefits		Discounted Costs and Benefits	
	Undiscounted Costs	Undiscounted Benefits	Costs (7% Discount) ($2020)	Benefits (7% Discount) ($2020)
2020 Previously Incurred	$20,257,996	$0	$20,257,996	$0
2023	$19,361,859	$0	$15,805,044	$0
2024	$55,370,982	$6,000,000	$42,242,257	$4,577,371
2025	$41,874,828	$6,000,000	$29,856,174	$4,277,917
2026	$0	$12,166,554	$0	$8,107,088
2027	$0	$12,273,543	$0	$7,643,346
2028	$0	$7,382,389	$0	$4,296,618
2029	$0	$6,493,124	$0	$3,531,829
2030	$0	$6,605,780	$0	$3,358,043
2031	$0	$6,720,390	$0	$3,192,809
2032	$0	$7,836,989	$0	$3,479,717
2033	$0	$6,955,610	$0	$2,886,331
2034	$0	$13,076,290	$0	$5,071,211
2035	$0	$13,199,064	$0	$4,783,948
2036	$0	$14,323,968	$0	$4,852,023
2037	$0	$13,451,038	$0	$4,258,254
2038	$0	$7,580,314	$0	$2,242,741
2039	$0	$7,711,832	$0	$2,132,386
2040	$0	$8,845,633	$0	$2,285,880
2041	$0	$1,981,754	$0	$478,620
2042	$0	$2,120,238	$0	$478,566
2043	$0	$2,261,124	$0	$476,977
2044	$0	$8,404,454	$0	$1,656,910
2045	$0	$14,550,272	$0	$2,680,876
2046	$0	$14,698,619	$0	$2,531,036
2047	$0	$14,849,540	$0	$2,389,742
2048	$0	$9,003,080	$0	$1,354,083
2049	$0	$9,159,283	$0	$1,287,455
2050	$0	$10,318,197	$0	$1,355,472
2051	$0	$9,479,867	$0	$1,163,872
2052	$0	$9,644,343	$0	$1,106,603
2053	$0	$9,811,672	$0	$1,052,152
2054	$0	$15,981,905	$0	$1,601,696
2055	$0	$24,446,935	$0	$2,289,772
TOTAL	**$136,865,665**	**$313,333,800**	**$108,161,471**	**$92,881,342**

Source: Cambridge Systematics, Inc.