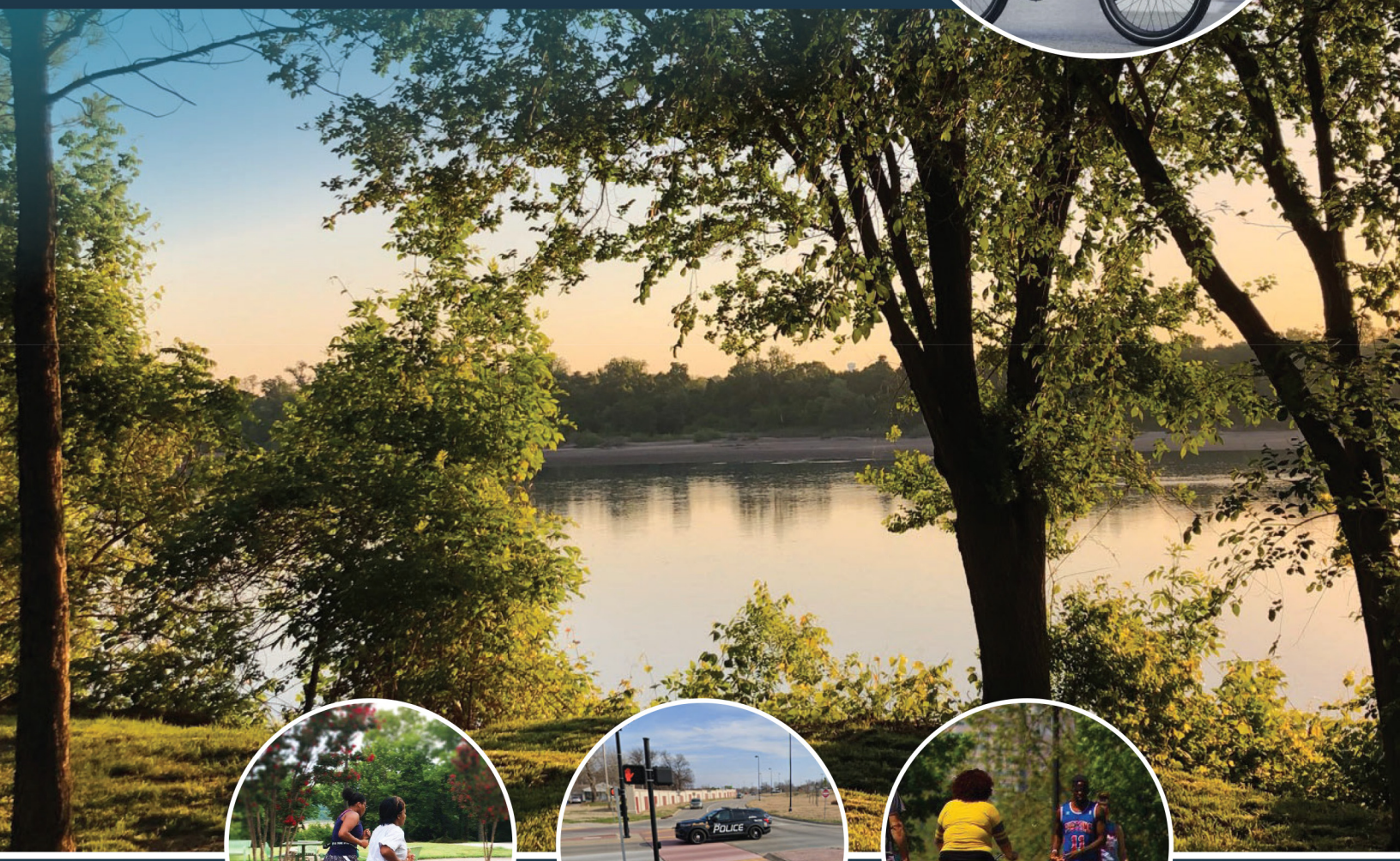
Tulsa-Jenks
Multi-Modal Safety Project

Appendix A:
Benefit Cost Analysis Technical Memorandum



INCOG

THE MUSCOGEE NATION

Submitted by The Indian Nations Council of Governments and the Muscogee Nation

Tulsa-Jenks Multi-Modal Safety Project

BENEFIT-COST ANALYSIS SUPPLEMENTARY DOCUMENTATION

FY2022 RAISE DISCRETIONARY GRANT PROGRAM

PREPARED FOR: INDIAN NATION COUNCIL OF GOVERNMENTS
APRIL 14, 2022

EXECUTIVE SUMMARY

A benefit-cost analysis (BCA) was conducted for **Tulsa-Jenks Multi-Modal Safety Project** (the Project) for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the Fiscal Year (FY) 2022 RAISE Grants program. The analysis was 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. The period of analysis corresponds to 23 years and includes 3 years of construction and 20 years of benefits after operations begin in 2026.

The Tulsa-Jenks Multi-modal Safety Project will increase the safety and quality of life for cyclists, pedestrians, and motorists along the Arkansas River between the cities of Tulsa and Jenks, Oklahoma. The Tulsa Community River Connections Project has dual aspects that are meant to provide safe and impactful outcomes for the surrounding community: Trail Improvements and Riverside Drive Mobility Improvements.

Trail Improvements

1. West Bank Trail (Turkey Mtn. –E 96th Street S.): Construction of west bank multi-use trail connection to and from Turkey Mountain Urban Wilderness at 71st Street to 96th Street;

2. West Bank Trail (E 96th – E 104th Street): Construction of West Bank multi-use trail from the south Tulsa/Jenks pedestrian and low water dam fully connecting Turkey Mountain at 71st Street to the dam at 104th Street;

3. East Bank Connection Trail (86th – 96th Street): Reconstruction of east bank multi-use trail from 86th to 96th; and

4. East Bank Connection Trail (96th – 104th Street): Construction of new multi-use trail on the east bank from 96th St S to 104th St S.

Intersection Improvements

1. Eight arterial intersections have been identified as hazardous for pedestrians.
    a. Improvements include: Adding continuous sidewalks, high-visibility road markings, traffic signal coordination, pedestrian countdown signals, bikeshare stations, Electric Vehicle charging stations

Costs

The capital cost for this Project is expected to be $20.25 million in undiscounted year of expenditure (YOE) dollars through 2027, equating to $16.56 million in undiscounted 2020 dollars. At a 7 percent real discount rate, these costs are $11.10 million in 2020 dollars. The Operations and Maintenance (O&M) costs associated with this project are estimated to be $77,500 annually in 2022 dollars, equating to $71,204 annually in 2020 dollars.

In 2020 dollars, the Project is expected to generate $28.53 million in discounted benefits using a 7 percent discount rate. These monetized benefits are derived from safety benefits of avoided collisions, reduction in travel time for motorists at impacted intersections, and reduced agency R&R costs. This leads to an overall project Net Present Value of $17.43 million in 2020 discounted dollars and a Benefit Cost Ratio (BCR) of 2.57. The overall project benefit matrix can be seen in Table ES-1.

Table ES-1: Project Impacts and Benefits Summary, Monetary Values (Millions, 2020$)

Current Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Impact Type	Monetized Results (at 7% discount rate)	Page Reference in BCA
The Project area consists of intersections that are dangerous for pedestrians and cyclists	Project improvements to eight hazardous intersections will create safer conditions and reduce crashes, including development of pedestrian refuges and high-visibility crosswalks.	Reduction in crashes at these major intersections will reduce total crashes along project extent with new and improved share use paths as well as roadway improvements	$13.12	11
The Project area consists of intersections that cause delay to motorists	Intersection traffic flow improvements such as better traffic signal coordination, flashing left-turn arrows and high-visibility crosswalks (causing fewer crashes), other roadway improvements lead towards safer conditions along a major arterial.	Reduced travel time at these intersections for motorists	$14.79	12
R&R costs associated with aging infrastructure	The Project will rehabilitate existing trail corridor in addition to constructing additional trail mileage	Reduced agency costs	$0.62	13

Source: WSP, 2022

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1 INTRODUCTION

A benefit-cost analysis (BCA) was conducted for **Tulsa-Jenks Multi-modal Safety Project** (the Project) for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the RAISE 2022 program. The following section describes the BCA framework, evaluation metrics, and report contents.

1.1 BCA FRAMEWORK

A BCA is an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of an investment alternative. Benefits and costs are broadly defined and are quantified in monetary terms to the extent possible. The overall goal of a BCA is to assess whether the expected benefits of a project justify the costs from a national perspective. A BCA framework attempts to capture the net welfare change created by a 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 as a result of the proposed project.

The BCA framework involves defining a Base Case or "No Build" Case, which is compared to the "Build" Case, where the grant request is awarded, and the project is built as proposed. The BCA assesses the incremental difference between the Base Case and the Build Case, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare over a project lifecycle. The importance of future welfare changes is determined through discounting, which is meant to reflect both the opportunity cost of capital as well as the societal preference for the present.

The analysis was conducted in accordance with the benefit-cost methodology as recommended by the USDOT in the 2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs. This methodology includes the following analytical assumptions:

- Defining existing and future conditions under a No Build base case as well as under the Build;
- Estimating benefits and costs during project construction and operation, including 20 years of operations beyond the Project completion when benefits accrue;
- Using USDOT recommended monetized values for reduced fatalities, injuries, property damage, travel time savings, and emissions, while relying on best practices for monetization of other benefits;
- Presenting dollar values in real 2020 dollars. In instances where cost estimates and benefits valuations are expressed in historical or future dollar years, using an appropriate inflation rate to adjust the values;
- Discounting future benefits and costs with a real discount rate of 7 percent consistent with USDOT guidance.

1.2 REPORT CONTENTS

Section 2 of this Appendix contains a description of the **Tulsa-Jenks Multi-modal Safety Project** elements, information on the general assumptions made in the analysis, and a description of the base case compared to the

build case. Section 3 provides a summary of the anticipated project costs. Section 4 reviews the expected economic benefits the project would generate, including a review of the assumptions and methodology used to calculate these benefits. Section 5 reports the high-level results of the benefit-cost analysis.

2 PROJECT OVERVIEW

2.1 DESCRIPTION

Tulsa-Jenks Multi-modal Safety Project intends to connect communities in the City of Tulsa and City of Jenks via non-motorized trails to a voter approved, locally funded pedestrian bridge and low water dam across the Arkansas River, fully completing a loop of multi-use trails throughout the project area. Additionally, the project will provide associated roadway and signal infrastructure improvements to connect all transportation system users in the project area, making it easier to access the riverfront for recreation and economic development opportunities and the trail system for bicycle commuters (Figure 1).

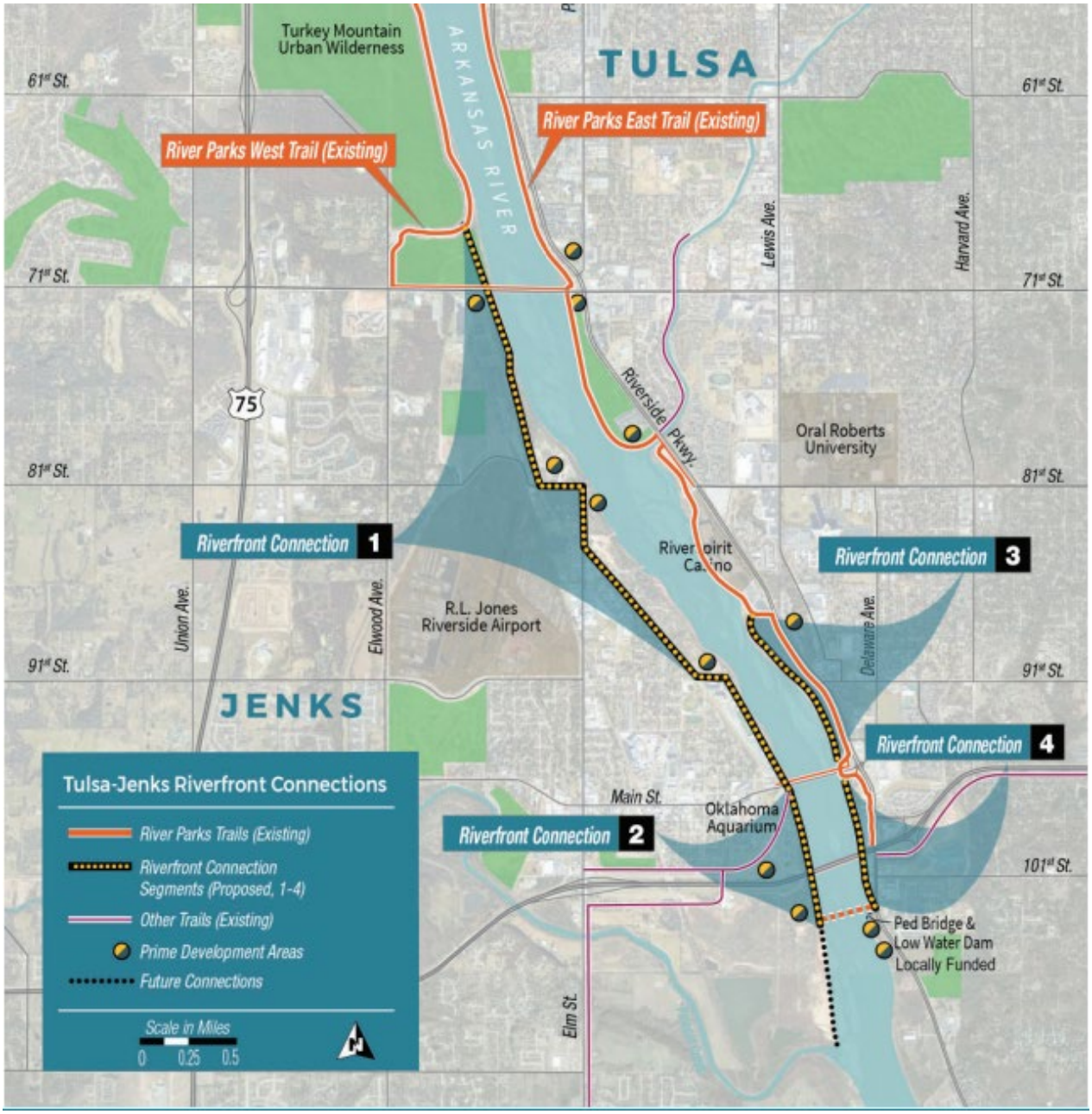
The Project is located along the Arkansas River (Figure 2), a protected natural landmark in Oklahoma, and will impact residents, visitors, and businesses in a positive manner. As it stands, there is no safe way for pedestrians and cyclists to enjoy traveling along this section of the Arkansas River without endangering themselves by traveling on the adjacent roadways without protected sidewalks or trails. Expectedly, the project area experiences higher than normal crash rates within its one-mile radius than the rest of Tulsa or Jenks. The area is also prone to flooding, and the project will make resiliency improvements that will enhance the safety of motor vehicles, pedestrians, and cyclists while making quality of life improvements through new recreational, commercial retail, and transportation access. Without these critical connections made by the new trails system, southern Tulsa and Jenks will be forced to continue to travel unsafely, and critical areas of economic importance will remain disconnected from each other.

The Project will make several substantial improvements to the infrastructure impacting the economy of Tulsa, Jenks, the state of Oklahoma, and the broader region. By addressing critical safety and mobility issues while also capitalizing on the long-term value of the trails, the project will create safe and efficient connections that will support a growing population and regional economy. The Project's safety, residual value, and quality of life benefits will support the investment strategy of INCOG while also improving the lives of cyclists, pedestrians, and motor vehicles throughout the area, including a number of historically disadvantaged communities within the project area.

Figure 1. Project Improvements

Source: City of Tulsa, 2022

Figure 2: Project Map



Source: INCOG, 2022

2.2 GENERAL ASSUMPTIONS

For project investments, dollar figures in this analysis are expressed in constant 2020 dollars (2020$). The real discount rate used for this analysis was 7.0 percent, consistent with USDOT 2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs. For the project, the evaluation period includes the 4 year design/construction period during which capital expenditures are undertaken, plus 20 years of operations beyond the project completion within which to accrue benefits. All benefits and costs are conservatively assumed to occur at the end of each year for purposes of present value discounting. Benefits accruing from the improvements are assumed to begin in the calendar year following construction's completion.

For the purposes of this study, it has been assumed that design and construction of the project begins as early as 2024 and continues through the end of 2027; it is assumed that the project would be fully complete and operational starting in 2028. The analysis period, therefore, begins in 2024 when design begin and continues through 20 years of operations starting 2028, or through 2047.

2.3 BASE CASE AND BUILD CASE

For the purposes of this BCA, the no-build/base case assumes that none of the contemplated trail improvement projects would be completed, and that the existing poor cycling and pedestrian conditions would remain in their current conditions. The no-build/base case would include none of the proposed project enhancements, including roadway enhancements on Riverside Dr., and would only include rehabilitation and repairs to one-mile of existing trails on the eastern side of the Arkansas River in 2025 and 2040, as well as regular annual operations and maintenance costs.

3 PROJECT COSTS

3.1 CAPITAL COSTS

Capital costs for this project (Table 1) are primarily associated with the actual construction. Construction costs will entail the paving and installation of multi-use trails along both the east and west banks of the Arkansas River in the cities of Jenks and Tulsa, OK. They also entail roadway improvements along Riverside Drive which will calm traffic along the heavily trafficked corridor parallel to the trail facilities. The capital costs associated with the Project come out to $20.25 million in YOE dollars.

Table 1: Project Schedule and Costs (Millions, YOE$)

Cost Category	FY 2024	FY 2025	FY 2026	FY 2027	Total
Pre-Construction Costs					
Survey, Design, and Engineering	$1.29	$1.29	$1.29	$0	$3.86
Construction Costs					
Four Trail Segments	$0	$2.06	$5.23	$5.23	$12.52
Riverside Parkway Traffic Safety Improvements	$0	$1.29	$1.29	$1.29	$3.86
Total					
Total Project Cost	**$1.29**	**$4.64**	**$7.81**	**6.52**	**$20.25**

Source: City of Tulsa, 2022

3.2 OPERATING AND MAINTENANCE COSTS

In the no-build/base case scenario, expected regular annual O&M costs for the one-mile of existing trails on the eastern side of the Arkansas River would amount to approximately $10,000 in 2022 dollars (or $9,188 in 2020 dollars).

In the build scenario, the total mileage of the trail system is expected to increase from 1 mile to approximately 7.5 miles. As such, in addition to the intersection improvements proposed, the trail enhancements under this project are expected to increase operating and maintenance costs to an average annual rate of $77,500 in 2022 dollars (or $71,204 in 2020 dollars), scaling relatively evenly with the increased mileage.

4 PROJECT BENEFITS

The benefits of **Tulsa-Jenks Multi-modal Safety Project** include mobility and health improvements, residual value accrued on the assets, and the reduction in damage to property and humans resulting from crash incidents.

The analysis uses standardized factors provided by governmental and industry sources to efficiently determine the monetized value of user and social benefits resulting from the project improvements.
Table 2 shows **Tulsa-Jenks Multi-modal Safety Project** long-term benefits aligned to the benefit categories.

Table 2: Project Benefits by Long-Term Outcome Category

Type of Benefit	Relationship to RAISE Goals	Description	Monetized (Discounted 2020$M)
Safety	Reduction in traffic fatalities/injuries	Reduction in traffic fatalities/injuries, and PDO crashes	$13.12
Travel Time Savings	Less automobile delays due to intersection improvements as well as because of reduced cyclists and pedestrian crash incidents	Improved intersections reducing travel time delay for motorists, reduce pedestrian and cyclists crashes	$14.79
Reduced Agency O&M/R&R Costs	Restoration/promotion of good infrastructure condition, supporting commerce	Increased O&M/R&R costs results in a decrease in benefits	$0.62
Residual Value	Promotion of good infrastructure condition, supporting commerce	Accrued value of trail assets over the analysis period	No residual value expected
Health, Commuter, and Recreation Improvements	Promotion of low-emission transportation, equitable mobility	Health benefits realized from the improved lifestyle of those that switch to bicycle travel rather than automobile and use the new facilities for recreation as well as improved cyclist/pedestrian mobility options	Not Monetized

Source: WSP, 2022

The Project's BCA did not measure the number of trips estimated to shift from automotive trips to bicycle or pedestrian trips. In other words, the reduction in Vehicle Miles Traveled (VMT) was not measured to determine potential emissions reductions as a result of the Project's improvements. Therefore, the Project's benefits may be higher than those that are measured in this BCA because of potential reduced automotive trips and the associated health, mobility, and environmental benefits with added bicycle or pedestrian trips.

4.1 SAFETY

The safety benefits assessed in this analysis include a reduction in fatalities and injuries, as well as a reduction in other property damage crash costs resulting from the project.

Safety benefits are primarily derived from the bicycle and pedestrian crashes that will be avoided from the trail construction efforts that remove cyclists and pedestrians from unsafe roadway travel conditions to a shared path away from oncoming traffic. More specifically, the installation of high-visibility crosswalks at 8 intersections as well as the installation of pedestrian refuges at these intersections are expected to provide significant passenger safety benefits. Some auto crashes are expected to be avoided through the traffic-calming improvements on Riverside Drive, such as the installation of left-turn flashing yellow arrows at high-risk intersections. The recent crash history is shown in
Table 3.

Table 3: Project Area Crash History (2016-2020)

Collision Type	Number of Collisions (2016-2020)	Auto-only crashes	Pedestrian + Bike crashes	Average Annual Crashes (Auto-Only)	Average Annual Crashes (Pedestrian + Bike)
O – Property Damage only	162	162	0	32.4	0
C – Possible Injury	101	101	0	20.2	0
B – Non-incapacitating	43	43	0	8.6	0
A – Incapacitating	30	18	12	3.6	2.4
K - Killed	2	2	0	0.4	0
All Collisions	**338**	**326**	**12**	**65.2**	**2.4**

To estimate the reduction in bike and pedestrian crashes because of the project, the BCA uses a Crash Reduction Factor (CRF) of 0.46 associated with "INSTALL RAISED MEDIAN WITH MARKED CROSSWALK (UNCONTROLLED)" to determine the number of reduced crash types because of the safer intersection conditions (which is where the pedestrian and bike incidents have occurred). The project will likely also remove motor vehicle trips from the road that could result in fewer accidents in crowded local landmarks like the Tulsa Outlet Mall in Jenks and Turkey Mountain Urban Wilderness and improves the resilience of the current Riverside Parkway conditions to prevent flood-related pedestrian, cyclist, and motorist crashes. The installation of trail paths throughout the project area are also expected to increase pedestrian and bike safety by providing clearly marked pathways to traverse the locality. However, these benefits have not been monetized. Only the one CRF of 0.46 associated with the installation of the intersection improvements was employed to measure pedestrian and bike safety benefits. This CRF for pedestrian crashes is believed to be conservative, as while the 46% reduction assumed here is significant, similar improvements in the vicinity of the project area have actually shown to reduce pedestrian crashes by 60-80%.

Two CRF factors were considered to estimate the safety benefits accrued to auto users:

- A CRF of 0.143 associated with "INSTALL LEFT TURN FLASHING YELLOW ARROW SIGNALS AND SUPPLEMENTAL TRAFFIC SIGNS" to measure improvements in left-turn crashes as a result of the installation of left-turn flashing arrows.
- A CRF of 0.19 associated with "INSTALL HIGH-VISIBILITY CROSSWALK" to measure improvements in all crashes at intersections as a result of the installation of high-visibility crosswalks.

Owing to the observed split of left-turn crashes and other vehicular crashes in the project, a blended CRF combining these two individual CRFs would likely yield the correct calculation for expected reduction in crashes. Other project improvements such as better traffic signal coordination and installation of traffic detection cameras would also be reasonably be expected to induce safety benefits at intersections, but these improvements were not considered in the determination of an appropriate CRF as it was not possible to isolate the number of crashes that were directly impacted by the absence of these measures. In order to be conservative, the lower-bound CRF of 0.143 was ultimately chosen to calculate expected reduction in vehicular crashes from project improvements. This 14% reduction in vehicular crashes is conservative and other crash reductions are expected but not monetized.

The annual reductions in crashes are monetized using USDOT values for crashes of different types (shown in Table 4). The project lifecycle's safety benefits are expected to total $39.8 million in 2020 undiscounted dollars, and $13.1 million in 2020 dollars at a 7 percent discounted rate, as shown in Table 5.

Table 4: Safety Benefits Assumptions and Sources

Variable	Unit	Value	Source
Cost per O – No Injury	2020$	$3,900	US DOT Guidance, March 2022
Cost per C – Possible Injury	2020$	$77,200	US DOT Guidance, March 2022
Cost per B – Non-incapacitating	2020$	$151,100	US DOT Guidance, March 2022
Cost per A – Incapacitating	2020$	$554,800	US DOT Guidance, March 2022
Cost per K – Killed	2020$	$11,600,000	US DOT Guidance, March 2022
Cost per U – Injured (Severity Unknown)	2020$	$210,300	US DOT Guidance, March 2022
Cost per Property - Damage Only Crash	2020$	$4,500	US DOT Guidance, March 2022

Table 5: Safety Estimation of Benefits, (Millions, 2020$)

Benefit	Undiscounted	Discounted (7%)
No Injury - O	$0.4	$0.1
Possible Injury - C	$4.5	$1.5
Non-Incapacitating - B	$3.7	$1.2
Incapacitating - A	$18.0	$5.9
Killed - K	$13.3	$4.4
Total Safety Benefits	**$39.8**	**$13.1**

Source: WSP, 2022

4.2 TRAVEL TIME SAVINGS

The intersection improvements, including traffic signal coordination, installation of left-turn flashing yellow arrows, as well as improved markings are all expected to yield small travel-time savings to auto users at each of the intersections impacted (Table 6).

Table 6. Intersections along Riverside Drive

	Intersections along Riverside Drive				
	81st	91st	96th	Creek Tpk	101st
Daily Traffic	66,804	61,626	100,214	56,519	40,805
No-Build Delay at Intersection (minutes) (Blend of AM/PM/Off-peak/Rest-of-day)	1.85	1.85	1.85	1.85	1.85
No-Build Delay at Intersection (minutes) (Blend of AM/PM/Off-peak/Rest-of-day)	1.62	1.62	1.62	1.62	1.62
Average Travel Time Savings per trip (minutes)	0.23	0.23	0.23	0.23	0.23

With a truck traffic share of 4% (auto share of 96%), as well as an observed auto occupancy factor of 1.20, a total of 122,660 person-hours are expected to be saved annually as a result of project improvements, which have been monetized using the auto and truck value of travel time estimates recommended in USDOT Guidance. Table 7 lists the monetized benefits showing that the time savings equates to about $14.8 million (2020 dollars, discounted at seven percent) in benefits through the end of the analysis period.

Table 7: Travel Time Savings Benefits (Millions, 2020$)

Benefit	Undiscounted	Discounted (7%)
Travel Time Savings - Auto	$42.2	$13.9
Travel Time Savings - Truck	$2.6	$0.9
Total	**$44.8**	**$14.8**

The advent of the new trail systems is also expected to not only include new cyclists, but to speed up their movement. According to NCHRP Report 552, cyclists are willing to spend up to 20 minutes more to switch from an unmarked on-road facility with side parking to an off-road bicycle trail, with smaller changes for less dramatic improvements. The report also notes that travel speeds tend to rise on off-road facilities. While such benefits are expected to be accrued to cyclists, they have not been monetized for the BCA.

4.3 STATE OF GOOD REPAIR AND AVOIDED AGENCY COSTS

In the no-build/base case scenario, expected regular annual O&M costs for the one-mile of existing trails on the eastern side of the Arkansas River would amount to approximately $10,000 in 2022 dollars (or $9,188 in 2020 dollars).

In the build scenario, the total mileage of the trail system is expected to increase from 1 mile to approximately 7.5 miles. As such, in addition to the intersection improvements proposed, the trail enhancements under this project are expected to increase operating and maintenance costs to an average annual rate of $77,500 in 2022 dollars (or $71,204 in 2020 dollars), scaling relatively evenly with the increased mileage. Per USDOT guidance, O&M costs are included in the numerator along with other project benefits when calculating the benefit-cost ratio (BCR).

Further, the BUILD scenario would avoid planned R&R costs associated with the current one-mile trail segments mentioned above. These rehabilitation costs were expected to occur in 2025 and 2040, and would equate to $1.50

million in 2022 dollars ($1.38 million in 2020$) in both these years in the NO-BUILD scenario. Instead, some of these R&R costs associated with construction of Project elements would occur in 2042 in the BUILD scenario. Table 8 summarizes the net expected avoided R&R costs as a result of the project.

Table 8. Avoided Agency Costs Benefits (Millions, 2020$)

Benefit	Project Lifecycle	
	Undiscounted	Discounted (7%)
Net O&M Costs (Increased Cost)	($1.24)	($0.41)
Net Avoided R&R Costs (Increased Benefit)	$1.38	$1.03
Total	$0.14	$0.62

Residual Value benefits are derived from the value remaining on each investment's lifecycle value at the end of the analysis period. The design life of the asphalt trails is expected to be 20 years. As the project operations period is also defined as 20 years as part of this BCA, no residual value is expected to be retained at the end of the analysis period. The roadway intersection improvements are also not expected to retain any significant residual value at the end of the analysis period. Therefore, INCOG will realize no additional benefit of the residual value of project elements that would exist at the end of the analysis period (Table 9).

Table 9: Residual Value Estimation of Benefits (Millions, 2020$)

Benefit Associated to the Segment	Expected Lifespan	Capital Cost (Undiscounted)	Value in Final Year	
			Undiscounted	Discounted (7%)
East Bank Dual Purpose Trail: (Rebuild 86th - 96th) PLUS(New 96th - 104th)	20	$4.8	$0	$0
Westbank Dual Purpose Trail: (Turkey Mtn to the new Ped bridge)	20	$5.3	$0	$0
Safety and Traffic Flow Improvements on Riverside Drive	20	$3.2	$0	$0
Total		**$13.3**	**$0**	**$0**

Source: WSP, 2022

4.4 ECONOMIC COMPETITIVENESS

The **Tulsa-Jenks Multi-modal Safety Project** will contribute to economic competitiveness by providing commuter mobility benefits to bicyclists and pedestrians while taking cars off the road, reducing travel times for cars and trucks, and reducing vehicle operating costs. The value of these benefits have not been quantified in the BCA model. The Project will also support several qualitative economic benefits. The trails will provide key connections to the downtown area of Tulsa and Jenks, Turkey Mountain Urban Wilderness, the upcoming Tulsa Outlet Mall in Jenks, and other Arkansas River recreational landmarks and destinations. The Project will also support several river-based recreational activities that will contribute to the local economy positively such as water taxis, water-based sports and travel, and riverside outdoor commercial centers like restaurants, outlet malls, and other gathering places.

4.5 QUALITY OF LIFE

This project will create quality of life benefits including improved health and recreation, however none of these benefits have been monetized as part of this application.

Health benefits are accrued by cyclists and pedestrians, both commuter and recreational, who are shifting routes to or will be using for the first time the new path. The Project improves users' quality of life further through improving aesthetics and natural environment to interact with, but these benefits have not been quantified.

4.5.1 HEALTH BENEFITS

Health benefits apply to cyclists who would otherwise not be able to use a bicycle under existing conditions, and to both pedestrians and cyclists who have access to improved connectivity to the trail system and a larger system by mileage. These pedestrians and cyclists realize benefits by increased daily physical activity, which has been shown to improve health and reduce future medical costs. USDOT BCA guidance from March 2022 identified health benefit monetization values per induced cyclist and pedestrian trip. While there are expected to be new induced trips as a result of project improvements, the project team was unable to quantify the estimated number of induced cyclist and pedestrian trips. Therefore, these benefits were not monetized.

4.5.2 COMMUTER BENEFITS

USDOT BCA guidance from March 2022 identified benefits specifically for new users of bicycle and pedestrian facilities that take advantage of this new infrastructure as part of their commutes. These benefits result from the time spent commuting using active transportation means instead of by transit or motor vehicles, since this represents a revealed preference in how active transportation users choose to travel. The value of time for this benefit is assumed to be greater than the value of time used for recreational users or the population at large. However, as it was not possible to quantify the induced number of new cyclist trips or mode-shift characteristics, this benefit was not monetized.

5 SUMMARY OF RESULTS

5.1 EVALUATION MEASURES

The benefit-cost analysis converts potential gains (benefits) and losses (costs) from the 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 evaluation also estimates the benefit-cost ratio; the present value of incremental benefits is divided by the present value of incremental costs to yield the benefit-cost ratio. 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.

5.2 BCA RESULTS

Table 10 below presents the evaluation results for the project. Results are presented in undiscounted and discounted at 7 percent as prescribed by the USDOT. All benefits and costs were estimated in constant 2020 dollars over an evaluation period extending 20 years beyond system completion in 2027. The total benefits from the project improvements within the analysis period represent $28.53 million when discounted at 7 percent. The total capital costs are calculated to be $11.10 million when discounted at 7 percent. The difference of the discounted benefits and costs equal a net present value of $17.43 million, resulting in a benefit-cost ratio (BCR) of 2.57.

Table 10: Benefit Cost Analysis Results (Millions, 2020$)

BCA Metric	Project Lifecycle	
	Undiscounted	Discounted (7%)
Total Benefits	**$84.74**	**$28.53**
Safety	$39.77	$13.12
Travel Time Savings	$44.83	$14.79
Avoided Agency Costs (Net of O&M and R&R)	$0.14	$0.62
Total Costs	$16.56	$11.10
Net Present Value (NPV)	$68.18	$17.43
Benefit Cost Ratio (BCR)	5.12	2.57
Internal Rate of Return (IRR)	22%	
Payback Period (Years)	7	

Source: WSP, 2022