# Bridging the Gap: Multimodal Connections on I-35 over the Oklahoma River

Oklahoma Department of Transportation

Bridge Investment Program

Fiscal Year 2023 and 2024 Large Bridge Grant Application

November 27, 2023

## *Benefit Cost Narrative*

OKLAHOMA Transportation

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# Executive Summary

This Benefit Cost Analysis (BCA) supports Oklahoma Department of Transportation (ODOT) request of $81 million in Fiscal Year (FY) 2023 and 2024 Bridge Investment Program (BIP) Large Bridge funds to replace the I-35 NB and SB bridges, construct a new I-35 ramp NB bridge, and rehabilitate the I-35 bridge over the Stillwater railroad (the Project). The new I-35 bridges would provide six 12-foot lanes in each direction, and a minimum of 12-foot inside and outside shoulders. Currently, the I-35 bridges have five lanes in each direction, but the shoulder widths are inadequate, causing both bridges to be considered functionally obsolete. The Project will provide new, safer, and geometrically improved bridges over the Oklahoma River. The main vehicular bridge replacement will deliver major safety benefits to a high crash-prone river crossing, while adding vehicular capacity through travel lane expansion and the provision of safety lanes in both directions, which are currently functionally obsolete on the existing bridge.

The BCA captures and monetizes three categories of benefits arising from the vehicular bridge project: life cycle cost savings (maintenance and residual value), travel time savings, and crash reduction benefits. The BCA captures and monetizes three categories of benefits arising from the vehicular bridge project: life cycle cost savings (capital costs, maintenance costs, and residual value), travel time savings, and crash reduction benefits. Other benefits that have not been monetized (but are discussed below) include resilience, emissions, and other environmental benefits. Economic benefits such as enhanced labor and business productivity (over and above those embodied in travel time savings) are also not included. However, the overall improvements in regional accessibility may generate benefits.

**Results**: The Project yields an overall Benefit-Cost Ratio (BCR) of 3.2 and a Net Present Value of $215.1 million. The preponderance of benefits is from crash reductions and vehicular travel time savings, with smaller but still significant shares due to life cycle cost savings arising from the Project.

# Overview

The BCA has been conducted following the USDOT's Benefit-Cost Analysis Guidance for Discretionary Grant Programs (January 2023) and the Bridge Investment Program (BIP) BCA tool. The following general parameters and assumptions were used in the BCA:

# Project Description

For the purposes of this analysis, a No-Build and Build Alternative were under consideration.

## No-Build Alternative

The No-Build Alternative included leaving the existing bridges and their geometry as is with no modifications or restrictions to current access.

## Build Alternative

The Project, centrally located in downtown Oklahoma City, will provide a new, safer, and geometrically improved bridge over the Oklahoma River. The Project includes replacing two mainline bridges on I-35 (National Bridge Inventory (NBI) 21356 and 21723), rehabilitating the two I-35 ramp bridges over the BNSF Railway (NBI 21335 and 21708), constructing a new I-35 ramp bridge spanning the Oklahoma River, and lengthening an existing box structure (NBI 14239) that traverses underneath the I-35. The Project also includes a separate "shared use" multimodal bridge that will be constructed west of the I-35 southbound (SB) bridge, and it will connect to the recently constructed Oklahoma River Trail system on both sides of the river. Due to Bridge Investment Program (BIP) eligibility requirements, the multimodal bridge is not included in this grant application. The bridge width will be approximately 96 feet for I-35 SB to accommodate six lanes with 12-foot shoulders. I-35 NB will be approximately 72 feet wide (four-lanes with shoulders) and the two-lane ramp bridge approximately 42 feet wide. The three bridges will be approximately 820 feet long with a primary span extending at least 360 feet. The Project will deliver major safety benefits to a high crash-prone crossing while adding vehicular capacity through travel lane expansion and the provision of safety lanes in both directions, which are currently functionally obsolete on the existing bridge. The bridge is an essential connecting link along I-35, a major north-south interstate route that provides passenger and truck freight connectivity from the Texas-Mexico border through the Dallas metro area, to Oklahoma City, and on to points north.

# BCA Methodology

Methodology and assumptions largely follow the processes outlined by FHWA and USDOT for using the BIP BCA Tool and standard BCA assumptions. Specific details regarding the values used in the accompanying BCA Tool are outlined in the sections below:

## Main Components

The main components analyzed included:

- Initial capital costs
- Remaining Capital Value: The remaining capital value (value of improvement beyond the analysis period) was considered a benefit and was added to other user benefits.
- Maintenance and lifecycle costs
- Traving time/delay (vehicle hours traveled – VHT)
- Crashes by severity

## Analysis Years

This analysis assumed that the Build Alternative would be constructed over a four-year period, starting in 2026 with completion in 2029. Therefore, the year 2030 was assumed to be the first full year that benefits will be accrued from the Project. The Project costs also account for costs already incurred and expected to be incurred between 2023 and 2025. The annual cost burden for each bridge was based on the payout schedule in **Table 1**.

*Table 1: Payout Schedule*

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | Total |
|---|---|---|---|---|---|---|---|---|
| Construction Cost Percentage | 2% | 4% | 6% | 15% | 30% | 30% | 13% | 100% |

The analysis focused on the estimated daily benefits. For the two river crossing bridges an analysis period of 30 years was used as the bridges are being reconstructed. For the railroad crossing bridges and box culvert extension, an analysis period of 20 years was used as these are rehabilitation projects. The present value of all benefits and costs was calculated using 2021 as the year of current dollars.

## Economic Assumptions

The value of time, occupancy, and cost of crashes were obtained from the *Benefit Cost Analysis Guidance for Discretionary Grant Programs*, dated January 2023 and are consistent with the default values provided in the BIP BCA Tool. A user value was provided for average bus occupancy by EMBARK who operates the lone route crossing the bridges in the Project area. This is based on 2023 ridership to date, and for purposes of this analysis was not expected to grow over time, which should be considered a conservative estimate.

## Construction Costs

ODOT estimated costs based on estimated quantities and recent similar projects. The costs developed by ODOT were originally estimated in 2023 dollars. The estimates for both the roadway and bridge portions of the Project include a 30 percent contingency. For purposes of this analysis these were converted to 2021 dollars using the GDP price deflator by obtaining the quarterly factor for 2023 Q3 (122.817) and the average annual factor for 2021 (110.185). Costs are not developed in year of expenditure dollars.

As the BIP BCA Tool is set up to conduct the analysis by bridge and it is anticipated that there will be contingency costs and additional roadway and traffic costs associated with the Project, these costs were distributed to each bridge based on the bridges proportion of the total bridge costs. Original 2023 costs, 2021 converted costs for the analysis, and distribution of additional non-bridge costs are provided in **Table 2**. This table also contains the proportional breakout of bridge versus roadway costs for the purpose of calculating the remaining capital value of the Project. **Table 3** shows the distribution of roadway and contingency costs to each individual bridge based on the cost proportion in **Table 2**.

*Table 2: Project Cost and Bridge Cost Proportion*

| Item and Component (NBI #) | Cost (2023 $) | Cost (2021 $) | Proportion |
|---|---|---|---|
| **Roadway** | | | |
| Construction | $27.5M | $24.67M | |
| Other Items | $4.0M | $3.59M | |
| Roadway Contingency (30%) | $9.45M | $8.48M | |
| **I-35 Bridges** | | | |
| I-35 SB over River (21723) | $42.66M | $38.27M | .451 |
| I-35 NB over River (21356) | $30.51M | $27.37M | .323 |
| I-35 NB New Ramp (# TBD) | $18.63M | $16.71M | .197 |
| Box Culvert Extension (14239) | $0.27M | $0.24M | .003 |
| I-35 over RR Bridge (21708 and 21335) | $2.52M | $2.26M | .027 |
| Contingency (30%) | $28.377M | $25.46M | |
| **Total** | **$163.917M** | **$147.06M** | |

*Table 3: Cost Distribution to Individual Bridges*

| Item and component (NBI #) | Cost (2021 $) | Proportion | Bridge Contingency | Total Bridge | Roadway | Bridge and Roadway |
|---|---|---|---|---|---|---|
| **I-35 Bridges** | | | | | | |
| I-35 SB over River (21723) | $38.27M | .451 | $11.48M | $49.75M | $16.57M | $66.32M |
| I-35 NB over River (21356) | $27.37M | .323 | $8.21M | $35.58M | $11.85M | $47.43M |
| I-35 NB New Ramp (# TBD) | $16.71M | .197 | $5.01M | $21.73M | $7.24M | $28.97M |
| Box Culvert Extension (14239) | $0.24M | .003 | $0.73M | $0.31M | $0.10M | $0.42M |
| I-35 over RR Bridge (21708 and 21335) | $2.26M | .027 | $0.68M | $2.94M | $0.98M | $3.92M |
| **Total** | | | | | | **$147.06M** |

Additional detail on **Table 3** is provided in the below:

- The bridge contingency column distributes the $25.46M bridge contingency (in **Table 2**) across each bridge based on the proportion.
- The 2021 cost column and bridge contingency columns sum to obtain the total bridge cost.
- The roadway column distributes the sum of the roadway cost items in **Table 2** ($24.67M + $3.59M + $8.48M) across each bridge based on proportion.
- The bridge plus the roadway column sums the total bridge and roadway columns. The sum of this column equals the total 2021 dollars Project cost of $147.06M.

## Residual Value

Residual value for the BIP BCA Tool was split into two categories. Seventy-five percent of the Project capital costs were assigned an asset life of 60 years, and the other 25 percent were assigned an asset life of 40 years. Project components in each cost category were assumed a service life based on recommendations provided by MnDOT Office of Transportation System Management (https://www.dot.state.mn.us/planning/program/benefitcost.html - Table 5). Cost proportions were based on percentage of total bridge to bridge + roadway costs from **Table 3**. Forty years was selected for the roadway portion based on the significant work associated with those components, which is more commensurate with sub-base/base and grading and drainage activities outlined in the guidance.

# Operating and Maintenance (O&M) Costs

It is expected that reconstructing the Project bridges will reduce the required future rehabilitation and maintenance activities to keep the roadway serviceable. Future maintenance activities were obtained for the No-Build and Build scenarios from project planning staff. The provided rehabilitation and maintenance schedules for each scenario are listed below in **Table 4**. All dollar amounts are provided in 2021 dollars.

*Table 4: Operations &Maintenance Cost Schedules*

| Bridge | No-Build Routine Costs | No-Build Large Maintenance Costs | Build Routine Costs | Build Large Maintenance Costs |
|---|---|---|---|---|
| I-35 SB over River (21723) | $1,000 | $1.0M (2026)<br>$1.5M (2040)<br>$1.5M (2054) | $1,000 | $0.5M (2050) |
| I-35 NB over River (21356) | $1,000 | $1.0M (2026)<br>$1.5M (2040)<br>$1.5M (2054) | $1,000 | $0.5M (2050) |
| I-35 NB New Ramp (# TBD) | None | None | $1,000 | $0.5M (2050) |
| Box Culvert Extension (14239) | $1,000 | None | $1,000 | None |
| I-35 over RR Bridge (21708 and 21335) | $1,000 | $0.5M (2040) | $1,000 | $0.5M (2040) |

The routine repair costs are expected to occur every other year for both the No-Build and Build and largely cancel out except for those occurring before the construction of the Build Alternative.

# Development of AADT and Travel Time Savings

This analysis assumed the NBI AADT values for all bridges with only one small exception. All bridges assumed a bus AADT of 9 trips per day and subtracted this amount from the provided passenger AADT value. The bus trip count obtained by local transit provider EMBARK. No growth was assumed for this transit route into the future. All bridges in the BIP BCA Tool are directional (e.g., only northbound, or only southbound) except for the box culvert. For this reason, the box culvert assumes 18 bus trips per day as both inbound and outbound trips cross this structure.

## Travel Time Savings

To compute travel time savings the BIP BCA Tool breaks out the travel time benefit and construction disbenefit by bridge. In actuality, the bridges included in the Project work as a system. That is savings to vehicles traveling across one bridge in each direction travel across all the bridges in that direction (e.g., southbound vehicles travel across the river bridge, the box culvert, and the railroad bridge). It is for this reason that all travel time savings for a given direction are assigned to the river crossing bridges. This methodology was selected as to not triple count the benefits by applying travel time savings to all bridges in each direction. It was selected to not have to break out the benefits for all bridges in each direction, which implies that a given bridge accounts for a certain proportion of the directional benefits. If one directional bridge is down, it does not matter if the other two bridges in that direction are in service, vehicles will not be able to access that bridge.

To compute the travel time savings, this analysis used assumed travel speeds through the 2-mile Project area in each direction. The assumed travel speeds and resultant travel times, and travel time savings are included in **Table 5**.

*Table 5: Travel Speed, Travel Time, and Travel Time Savings Assumptions*

| Year | No-Build Speed (mph) | No-Build Travel Time (min.) | Build Travel Speed (mph) | Build Travel Time (min.) | Travel Time Savings (min.) | Travel Time Savings Used (min.) |
|---|---|---|---|---|---|---|
| 2030 | 35 | 3.43 | 55 | 2.18 | 1.25 | .623 |
| 2040 | 30 | 4 | 55 | 2.18 | 1.82 | .910 |
| 2059 | 23.6 | 5.09 | 55 | 2.18 | 2.90 | .145 |

The No-Build speed in 2059 was based off the trend in travel time between 2030 and 2040. The travel speeds are assumptions based on existing peak period data from the NPMRDS.

Although ODOT also recognizes that although the Project includes an increase in capacity, no induced demand is included. This has to do with where the Project is in the planning process and when future year forecasts are developed using traditional travel demand forecasting techniques. Often the influence of induced demand as it relates to travel time savings 'cancels out'. That is, the additional traffic added to the facility under an induced demand scenario, which reduces the facility speeds for existing users, is offset by the travel time savings observed by those users transferring to the facility. Without any additional information regarding induced demand, the analysis used this as a reasonable and conservative assumption.

Additionally, the assumed travel time savings were reduced by 50 percent (**Table 5** 'Travel Time Savings Used' column). This assumption was made since it is not expected that all vehicles will realize this benefit. Only those traveling during peak periods when speeds are depressed will realize improved travel time benefits.

For the I-35 northbound river crossing bridges (mainline and new ramp bridge), the travel time benefits were split 60 percent to the mainline bridge and 40 percent to the new ramp bridge based on the proportion of total travel lanes.

It should also be noted that the free flow speed assumed for the build condition is lower than the posted speed limit and free flow speed and should also be considered conservative.

### Construction Disbenefits

Similar assumptions were used to calculate construction disbenefits. All disbenefits were attributed to the river bridges, and NBI AADT values were used with adjustments for bus trips. For the construction of the I-35 NB and SB river bridges it is expected that two lanes in each direction will be always maintained during construction. It is also assumed that this condition will be in place for all 365 days for all four years for the purpose of the BCA analysis.

The analysis assumes a delay of 1 minute per vehicle. This is equivalent to a reduction in speed from 60 mph to 30 mph for 1 mile of the construction zone. This would also be equivalent to 20 percent of vehicles (e.g., those at the peaks) experiencing a 5-minute delay, or traveling at 10 mph.

The crash increase is based on CMF ID: 520 (Active work zone with temporary lane closure compared to no work zone – all areas and severities) and is associated with a 66 percent increase in crashes during construction.

## Safety Analysis

### Project Area Crash Data

ODOT uses crash data from the Oklahoma Highway Safety Office (OHSO) because it provides in-depth crash data for specific project locations. OSHO produces publications and problem identification data including in-depth analysis of crash numbers, rates, and locations. The OHSO crash data is used by highway safety professionals across Oklahoma to evaluate traffic safety priority areas and propose potential solutions.

Crash data were obtained from the OHSO to determine the nature and frequency of collisions along the interstates and ramps. Collision history was evaluated for the entire interchange area, extending 2 miles north of the bridges and 1.5 miles south of the bridges along I-35, 0.75 miles north of the interchange along I-235, 1.25 miles west of the interchange along I-40, and 1 mile west of the interchange along Oklahoma City Boulevard. The collision information was collected and analyzed over a 10-year period 1/1/2012 to 12/31/2021, which is the latest available data.

As shown in **Table 6**, a total of 4,371 collisions were recorded involving 1,686 injured persons and 24 fatalities. This is the equivalent of 1.2 collisions per day over 10 years. Of those injuries, 110 were of sufficient severity that the injured person was incapacitated.

*Table 6: Interchange Crashes*

| Type of Collision | Fatality | Injury | Property Damage | Total |
|---|---|---|---|---|
| Rear-End | 3 | 646 | 1,656 | 2,305 |
| Head-On | 4 | 4 | 1 | 9 |
| Right Angle | 1 | 64 | 81 | 146 |
| Angle Turning | 1 | 54 | 149 | 204 |
| Other Angle | | 1 | 3 | 4 |
| Sideswipe Same Direction | 1 | 137 | 934 | 1,072 |
| Sideswipe Opposite Direction | 1 | 5 | 4 | 10 |
| Fixed Object | 6 | 143 | 226 | 375 |
| Pedestrian | 2 | 6 | | 8 |
| Pedal Cycle | | 1 | | 1 |
| Animal | | | 1 | 1 |
| Overturn/Rollover | 1 | 38 | 23 | 62 |
| Other Single Vehicle Crash | | 7 | 29 | 36 |
| Other | | 24 | 114 | 138 |
| **Total** | **20** | **1,130** | **3,221** | **4,371** |

SOURCE: OKLAHOMA HIGHWAY SAFETY OFFICE

The most prevalent collision type within the interchange was rear-end (front to rear) collisions, accounting for over half (2,305 of the 4,371 total) of all collisions. These types of crashes are commonly observed with congested roadways where stopped traffic occurs in the driving lanes and sudden deceleration from vehicles traveling at higher rates of speed is required. The limited bridge travel lane capacity, reduced shoulders, and merging of travel lanes directly south lead to conditions that cause traffic stopping and weaving.

The replacement bridges for I-35 NB and SB would have six lanes each as well as adequate shoulder widths. This would allow for the I-35 NB bridge to have a dedicated lane for I-40 WB and the I-35 SB bridge to have an additional lane from I-40 WB. South of the I-35 SB bridge, the proposed roadway would narrow to four lanes instead of three; this is an additional lane from the current configuration. The additional lane should help reduce the number of rear-end collisions by reducing the backup at the interchange during peak hours which, in turn, increases the capacity of the interchange. The addition of a SB through-lane would lessen the weave movements which occur today.

The next most common collision type found was sideswipe same direction at nearly 25 percent. The reduction of the five-lane bridge to three lanes south of the bridge causes a weaving movement on both sides of the roadway for I-35 SB and causes a considerable number of sideswipe collisions as drivers seek to merge. The I-35 bridge replacement would provide an additional lane and would eliminate the weaving movement on the inside of the roadway and help reduce the number of sideswipe collisions.

Additionally, the I-35 bridge replacement would restore the inside and outside shoulders to adequate widths. Full shoulders are important for the safety of a bridge because they allow for broken-down cars to pull off to the shoulder rather than blocking a lane of traffic. The shoulders also permit emergency vehicles to bypass stopped traffic to access the scene of a crash or incident more quickly, allowing injured persons to receive medical attention sooner.

For this analysis and to facilitate use of the BIP BCA Tool, the interchange crashes were distributed to each of the individual project bridges proportional to the construction cost relative to the total bridge costs.

### Crash Reduction Factors

To compute the expected crash reduction associated with the infrastructure improvements, this analysis leverages CMFs from the CMF Clearing house.

***Lane Increase***: The analysis uses CMF ID: 8335 to estimate the expected crash reduction associated with the additional lane. The CMF is .75 for an additional lane in an urban area, which indicates an expected crash decrease of 25 percent. This reduction is applicable to all crash types and for all severities except for property damage only (PDO) crashes. Given the amount of PDO crashes on these facilities, and the nature of the crashes, this should be considered a conservative estimate for included no benefit is applied to 74 percent of the crashes.

## Factors not Quantified

### Additional Safety Benefits

The Project includes additional shoulder widening to be consistent with modern design practice. For this improvement, the CRF Desktop Reference Manual has a crash reduction factor (CRF) of .20 (or a CMF of .80) for upgrading facilities with less than 4-foot shoulder to over 8 foot. Traditional practice for combining CMFs as prescribed by the Highway Safety Manual is that CMFs be multiplied together. In this Projects case, that would equate to a combined CMF of (.75*.8) 0.6 to account for both geometric improvements. This was not included in the BCA to ensure a conservative estimate of benefits.

### Bridge Condition and Closures

The BIP BCA Tool leverages this section to calculate benefits for the bridge as closures are avoided. These include additional vehicle operating costs, emissions, and other environmental impacts associated with rerouted traffic. For all Project bridges except for the new NB I-35 ramp bridge, it was assumed that the detour would route vehicles on a similar facility (I-240 and I-44 to the west of I-35) to complete a similar NB/SB through trip that can currently be completed using I-35 through the Project area. This detour is 7.7 miles longer (18 miles compared to 10.3 miles) than a trip completed using the Project bridges. Based on Google Maps, this trip would take 17 minutes (travel speed of 63.5 mph) to complete, or an additional 7.3 minutes than using the Project bridges. The new I-35 NB ramp bridge has an equidistant but slower local route that could be used to make the movement. Based on Google Maps, this would take an additional .2 minutes, but this does not include any congestion that would be associated with the local road system handling freeway level volumes.

It was determined that while the Project will improve or preserve the bridges condition in a way that reduces the risk of closure and/or road posting (especially related to potential bridge scour impacts), there was no data or analysis available to complete this section of the BIP BCA Tool.

Excluding these benefits is a conservative estimate, particularly because even a 10 percent reduction in future traffic starting in 2040, escalating to a 20 percent reduction in 2050 could result in another approximately $26M in benefits per direction.

### Resiliency to weather, seismic or other extreme events

Like the approach for bridge conditions and closures, the analysis does not account for these benefits as there was no data or analysis available to complete this section of the BIP BCA Tool. It is expected that there will be benefits from the Project for this category, and not including them should be considered a conservative estimate.

### Wildlife, Noise, and Water Run Off

Like the approach for bridge conditions and closures, the analysis does not account for these benefits as there was no data or analysis available to complete this section of the BIP BCA Tool. It is expected that there will be benefits from the Project associated with noise and water run-off improvements, and not including them should be considered a conservative estimate.

### Pedestrian and Bicycle Benefits

It is planned that this Project will include a multimodal pedestrian and bicycle bridge adjacent to the vehicular river bridges. However, this bridge is not included in the Project costs and benefits of this element were not included in the benefit-cost analysis.

# BCA Results

The benefit-cost analysis provides an indication of the economic desirability of a scenario, but results must be weighed by decision-makers along with the assessment of other effects and impacts. Projects are considered cost-effective if the benefit-cost ratio is greater than 1.0. The larger the ratio number, the greater the benefits per unit cost. Results of the benefit-cost analysis for the Project in provided in **Table 7**.

*Table 7: BCA Results*

| Category | New I-35 Ramp | I-35 Box Culvert | I-35 NB RR | I-35 SB RR | I-35 SB | I-35 NB | Total |
|---|---|---|---|---|---|---|---|
| Safety | $27.58M | $0.31M | $1.46M | $1.46M | $29.68M | $21.22M | **$81.71M** |
| Travel Time | $60.83M | | | | $112.74M | $51.17M | **$224.74M** |
| Maintenance | $0M | $0M | $0.14M | $0.14M | $0.51M | $0.51M | **$1.29M** |
| Residual Value | $0.97M | $0.04M | $0.18M | $0.18M | $2.22M | $1.59M | **$5.18M** |
| Total Benefits | $89.38M | $0.35M | $1.78M | $1.78M | $145.14M | $74.49M | **$312.92M** |
| Total Discounted Costs | $19.27M | $0.28M | $1.3M | $1.3M | $44.12M | $31.55M | **$97.83M** |
| **BCR** | **4.64** | **1.26** | **1.37** | **1.37** | **3.29** | **2.36** | **3.20** |
| **Net Present Value** | **$70.11M** | **$0.07M** | **$0.48M** | **$0.48M** | **$101.02M** | **$42.93M** | **$215.1M** |

## Sensitivity Testing

As part of the BCA, a sensitivity analysis was conducted to calculate the BCR in the following scenarios:

- **No Safety Benefit**: completely removes the benefits of reduced crashes from safety improvements.

- **Reduced Travel Time Benefit**: decreases the percentage of AADT benefitting from expanded capacity from 50 percent to 20 percent.
- **A combination of the Reduced Travel Time Benefit with a smaller safety benefit** of 61 percent.
    - The 61 percent value was developed by starting with the Reduced Travel Time Benefit sensitivity test, and proportionally reducing the project crash counts across all bridges until a B/C ratio of 1.0 was reached.

As shown in **Table 8**, in all the scenarios the NPV is positive, with a BCA of at least 1.0. Reducing both crashes related to the bridge congestion through the influence area by 39 percent and reducing peak hour AADT from 50 percent to 20 percent results in a BCA of 1.0.

*Table 8: Sensitivity Analyses and Results*

| Scenario | BCR | NPV |
|---|---|---|
| Baseline | 3.20 | $215,095,393 |
| No Safety Benefit | 1.78 | $75,976,549 |
| Reduced Travel Time Benefit | 1.33 | $31,967,900 |
| Reduced Travel Time Benefit and Reduced Safety Benefit | 1.00 | $102,048 |

The sensitivity analysis results indicate that even if the expected project travel time benefits only applied to 20 percent of users and existing project area crashes were reduced by 39 percent a BCR of 1.0 would be achieved.