# Appendix E: BENEFIT-COST ANALYSIS TECHNICAL MEMORANDUM

# Benefit-Cost Analysis Technical Memorandum

This benefit-cost analysis (BCA) was conducted for the development of the ***California Avenue Bridge project*** for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the Bridge Investment Program (BIP). 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 December 2023. The period of analysis corresponds to 30 years and includes 2 years of construction and 30 years of benefits after operations (replacement bridge) begin in 2028.

The Chicago Department of Transportation (CDOT) is seeking grant funding for the rehabilitation of the ***California Avenue Bridge***, located over the Chicago Sanitary and Ship Canal in Cook County, Illinois. This application seeks funding to rehabilitate and preserve this bridge, which is currently in poor condition and would need to be decommissioned by 2027 without intervention. The California Ave Bridge project will improve the structural integrity, mobility, and safety of the California Avenue Bridge, bringing it to current design standards.

The capital cost for this project (2024 dollar estimate) is expected to be **$78 million** or $73.6 million in 2022 dollars). At a 3.1 percent discount rate, the discounted capital costs are **$64.1 million** in 2022 dollars. With a service life of 60 years, at the end of 30 years, the assets will retain 50 percent of their original value with a residual value of **$44.1 million** in undiscounted dollars and **$15.1 million** in 2022 discounted dollars. The residual value is added to the total benefits of the project as per USDOT guidance.

The project benefits are derived from avoided detour in the “Build” scenario. Table 1 presents a summary of the project impacts, benefits and costs The discounted benefits include safety benefits (**$24.9 million** discounted), Travel Time Savings (**$284.9 million** discounted) Vehicle Operating Costs Savings (**$125 million** discounted) reduced CO2 emissions costs (**$40.4 million** discounted), non-CO2 emissions costs (**$11.8 million** discounted), and other environmental benefits (**$1.9 million** discounted), and Operations and Maintenance (O&M) cost savings ($1.2 million).

Using a 3.1 percent discount rate (2 percent for Carbon emissions), this leads to an overall discounted Net Present Value (including residual value of assets) of **$438.7 million** and a Benefit Cost Ratio (BCR) of **7.84**.

*Table 1. California Avenue Bridge Project Impacts and Benefits & Costs Summary*

| Benefits and Costs | Discounted Value (2022$) |
|---|---|
| Safety Crash Cost Savings (Avoided Crashes) | 24,865,518 |
| Travel Time Savings (Avoided Detours) | 284,931,663 |
| Vehicle Operating Cost Savings (Avoided Detours) | 125,031,485 |
| CO2 Emissions Cost Reduction | $ 40,371,972 |
| Non- CO2 Emissions Cost Reduction | 11,832,941 |
| Other Environmental Benefits | 1,886,489 |
| Residual Asset Value | 15,166,547 |
| O&M Cost Savings | $(1,245,769) |
| **Total Benefits** | **502,840,846** |
| Capital Costs | $64,146,851 |
| **Benefit/Cost Ratio** | **7.84** |
| **Net Present Value** | **$438,693,995** |

Source: Cambridge Systematics

## 1. Introduction

This appendix summarizes the approach used to conduct benefit-cost analysis (BCA) for the development of the ***California Avenue Bridge project*** for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the Bridge Investment Program (BIP). 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[1], released in December 2023. The period of analysis corresponds to 30 years and includes 2 years of construction and 30 years of benefits after operations (replacement bridge) begin in 2028. The appendix is structured as follows:

- Section 2 contains the **Project Description**.
- Section 3 describes the **BCA Framework** including the methodology, its components and assumptions, and the study scenarios.
- Section 4 includes a detailed explanation and calculation of the **Project Benefits**.
- Section 5 contains a detailed explanation and calculation of the **Project Costs**.
- Section 6 contains a **Summary of Results** of the BCA.
- Section 7 documents the results of **Sensitivity Analyses** of critical variables' impacts on the Benefit Cost Ratio (BCR).

## 2. Project Description

The Chicago Department of Transportation (CDOT) is requesting funding to replace the ***California Avenue Bridge*** (Structure Number 016600500000000), which is currently in poor condition and will be decommissioned by 2027 under the "No Build" scenario. The project will rehabilitate and preserve a 98-year-old bascule bridge while improving the structural integrity, mobility, and safety of it.

The project is designed to tackle key transportation challenges:

- The current bridge's condition is rated as Poor according to the National Bridge Inventory (NBI). The bridge deck is in *satisfactory* condition; the substructure is in *fair* condition, but the superstructure is in *serious* condition.
- The project will include the replacing of the bridge deck, and designated members of the roadway stingers, lateral and diagonal bracing members, various gusset plates, sidewalk brackets replacing the existing handrail, and replacing pedestrian lighting and other mechanical and electrical components.
- The bridge is part of the Illinois Priority Freight Network and is a vital regional connector for freight traffic and for access to local jobs. The historic bridge carries two lanes of vehicular traffic and sidewalks along each side.

[1] U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2023.

If the bridge is not reconstructed ("No Build" scenario), no capital investments will be made to improve the bridge's condition. CDOT expects annual partial lane closures for emergency repairs, but then the bridge will be decommissioned in 2027. This closure would require truck traffic to detour 1.65 miles around the bridge and incur significant Travel Time and Operating Costs.

The replacement bridge will be constructed off-alignment with the old bridge; therefore, no construction-related detours are expected.

## 3. Benefit Cost Analysis Framework

The main objective of the BCA summarized here was to compare the expected contributions (benefits) and costs of the project to determine whether its contributions to the region's economic, as well as to the impacted communities, justify the costs from a national perspective. This BCA followed the USDOT's Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2023. As per USDOT's Guidance, a BCA should define the baseline or "No-Build" scenario (the bridge is not rehabilitated, it will be closed to commercial vehicles and create a 1.65-mile detour) and the alternative or "Build" scenario (the detour is avoided). The benefits, disbenefits and additional costs are calculated by comparing the "Build" scenario against the "No-Build" scenario. Since the BCA calculates the anticipated benefits expected to accrue from the "Build" scenario over a specified period and compares them to the anticipated costs of the project, both calculations are discounted into the present to identify their present value.

### Key Methodological Components

Following USDOT guidance, the key methodological elements of this analysis include:[2]

- Defining existing and future conditions under both the "No-Build" scenario as well as under the "Build" scenario.
- Assessing the project benefits with respect to selection criteria defined by the USDOT over the 30 years of operations beyond the project completion (2028 in this case) when benefits accrue and using USDOT recommended values to monetize benefits or disbenefits.
- Estimating the project capital costs, during project's construction, and the project's operation and maintenance costs over the 30 years of operations beyond the project completion when benefits accrue.
- Establishing 2022 as the base year and presenting all benefits and cost values in 2022 dollars.

[2] U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2023.

- Discounting project benefits and costs using a real discount rate of 3.1 percent per year, except in the case of carbon dioxide ($CO_2$) emissions, where a 2.0 percent per year discount rate is applied.

### Key Assumptions

To complete the BCA of the California Avenue Bridge project, the following assumptions were made:

- **Project Analysis Period.** This period includes the design and engineering and construction of the project during which capital expenditures are undertaken, plus 30 years of operations beyond the project completion within which to evaluate the ongoing project benefits and costs.
- **Project Construction Period.** The project construction is assumed to begin in 2026 and end in 2027 at which point the project will be deemed complete.
- **Project Operating Period.** This period covers the 30-year operating period. The period starts in 2028, the calendar year immediately following the completion of the construction and when the project opens to the public and concludes in 2057.
- **Service Life.** The reconstructed bridge will have a service life of 60 years. Therefore, the bridge will have a 50% residual value of the bridge costs in year 2057.
- **Average Annual Daily Traffic (AADT).** The project uses the AADT defined by the NBI which forecasts a 2022 AADT of 16,644 with 20 percent pertaining to trucks. The NBI's Calculated Average Annual Daily Traffic (AADT) Growth Rate is 0.76 percent.
- All project benefits and costs are conservatively assumed to occur at the end of each calendar year for purposes of present value discounting.

### "Build" and "No Build" Scenarios

The analysis of the ***California Avenue Bridge project*** considered how the balance of costs and benefits resulting from the construction of the project would result in long-term benefits to its users and general society. This is accomplished by comparing the "Build" scenario relative to the "No-Build" scenario.

The **"Build"** scenario will replace the bridge carrying ***California Avenue Bridge*** over the Chicago Sanitary and Ship Canal, and this critical safety investment will:

- Replace the bridge deck, and designated members of the roadway stingers, lateral and diagonal bracing members, various gusset plates, sidewalk brackets replacing the existing handrail, and replacing pedestrian lighting and other mechanical and electrical components.
- Improve the structural integrity, mobility, and safety of the California Avenue Bridge, bringing it to current design standards.

The **"No-Build"** scenario assumes that no capital investments are made to replace the current. If the bridge is not replaced, CDOT expects that by 2027 the bridge will be decommissioned. At this point, traffic will be detoured.

## 4. Project Benefits

The BCA uses the BIP Benefit Cost Analysis Tool. There are six benefits associated to the project that were quantified for this BCA:

- Safety benefits
- Travel time savings
- Vehicle operating cost savings
- Environmental sustainability
- Operations & Maintenance (O&M) cost savings
- Residual asset value

### Safety Benefits (Avoided Detour Crash Cost)

Safety benefits stem from the potential reduction in crashes linked to avoided detour Vehicle Miles Traveled (VMT) under the "Build" scenario. Illinois DOT (Departments of Transportation) City Crash Statistics[3] from Chicago were analyzed to estimate the average number of annual crashes. Crashes included the number of injuries and fatalities, as well as property damage only.

Using the safety data and VMT estimates for the City of Chicago over 10 years (2013-2022), the total crashes by crash type and total VMT were used to calculate 10-year average crash rates by crash type. Table 2 summarizes the crashes by type and the resulting crash rates for Chicago.

*Table 2. Chicago Crash Data (2013 - 2022)*

| Chicago Crash Statistics | Fatal | Injury | Property Damage Only (PDO) |
|---|---|---|---|
| 2013 – 2022 Total Crashes | 1,405 | 162,039 | 756,520 |
| 10-Year Average Crashes per million VMT | 0.002457853 | 0.2834648 | 1.323427017 |

Source: Cambridge Systematics Analysis based on IDOT City Crash Statistics

Avoided Detour Crash benefits are estimated by multiplying the "No Build" AADT times the detour length (1.65 miles as per CDOT report), by the average detour crash costs by mode. The default crash costs are already populated in the BIP tool based on the USDOT BCA

[3] https://idot.illinois.gov/transportation-system/transportation-safety/roadway-safety/illinois-roadway-crash-data/facts-and-statistics/city-crash-statistics.html

Guidance, December 2023. Under the "Build" scenario, the project is expected to deliver around **$24.9** million in reduced crash costs, approximately **5 percent** of total benefits.

### Build Detour Avoidance: Travel Time and Vehicle Operating Cost Savings

The "Build" scenario would eliminate the possibility of load posting and truck traffic to detour 1.65 miles around the bridge. Benefits associated with the "Build" detour avoidance include travel time savings and vehicle operating costs savings.

Travel time savings are associated to the disutility that travelers attribute to time spent traveling. A reduction in travel time translates into more time available for work, leisure, or other activities. Vehicle operating costs (VOC) include fuel costs and all the necessary replacement items on the vehicle and regular maintenance (e.g., oil and fluid changes, tire rotations, tire replacements, and wiper replacement) as well as truck/trailer lease or purchase payments, permits and licenses, and other related costs to owners of commercial vehicles. In addition, the BIP-BCA model includes noise and congestion externalities in the vehicle operating costs.

**Travel time savings** for the project are associated with the avoided detour travel time. Benefits accrue when the project prevents load postings or closures to vehicle traffic. Travel time savings in this BCA are computed using the BIP Benefit Cost Analysis Tool. Thus, the "No Build" AADT is multiplied by the minutes of delay avoided (4.1 minutes per detour), times the average car occupancy (1.67 for passenger vehicles and 1.0 for trucks), multiplied by the value of time by mode, i.e. for trucks ($33.50 per hour) and passenger vehicles ($19.60 per hours for All Purposes).

**Vehicle operating costs (VOC) savings** are based on the avoided detour VMT under the "Build" scenario (zero miles detour) relative to the "No Build" (1.65 miles detour). To calculate VOC savings under the "Build" scenario, the "No Build" AADT is multiplied by the detour VMT, times VOC per vehicle type. The VOC are given by the USDOT BCA Guidance as $0.52 and $1.32 per mile for light duty vehicles and commercial trucks respectively.

The monetized travel time savings and VOC savings from the avoided detour VMT for the project sum up to **$284.9 and $125.0 million, respectively,** discounted to 2022 dollars over the 30-year operating period. Table 3 presents the annual monetized values for each of the detour avoidance benefits, travel time and VOC savings. The detour avoidance benefits under the "Build" scenario add up to **82 percent of the total benefits**.

*Table3. Summary of the "Build" Detour Avoidance Benefits*

| Year | Travel Time Cost Savings (Discounted 2022$) | Vehicle Operating Cost Savings (Discounted 2022$) | Total Detour TT & VOC Cost Savings (Discounted 2022$) |
|---|---|---|---|
| 2028 | $12,933,387 | $5,675,414 | $18,608,802 |
| 2029 | $12,651,400 | $5,551,665 | $18,203,065 |
| 2030 | $12,374,677 | $5,430,227 | $17,804,904 |
| 2031 | $12,103,157 | $5,311,072 | $17,414,230 |
| 2032 | $11,836,778 | $5,194,174 | $17,030,952 |
| 2033 | $11,575,475 | $5,079,504 | $16,654,979 |
| 2034 | $11,319,185 | $4,967,033 | $16,286,218 |
| 2035 | $11,067,842 | $4,856,734 | $15,924,575 |
| 2036 | $10,821,380 | $4,748,577 | $15,569,957 |
| 2037 | $10,579,733 | $4,642,533 | $15,222,266 |
| 2038 | $10,342,834 | $4,538,573 | $14,881,407 |
| 2039 | $10,110,617 | $4,436,668 | $14,547,285 |
| 2040 | $9,883,013 | $4,336,788 | $14,219,801 |
| 2041 | $9,659,956 | $4,238,903 | $13,898,858 |
| 2042 | $9,441,377 | $4,142,983 | $13,584,360 |
| 2043 | $9,227,209 | $4,049,000 | $13,276,209 |
| 2044 | $9,017,385 | $3,956,922 | $12,974,307 |
| 2045 | $8,811,837 | $3,866,721 | $12,678,558 |
| 2046 | $8,610,497 | $3,778,367 | $12,388,864 |
| 2047 | $8,413,298 | $3,691,831 | $12,105,129 |
| 2048 | $8,220,173 | $3,607,082 | $11,827,256 |
| 2049 | $8,031,056 | $3,524,093 | $11,555,149 |
| 2050 | $7,845,880 | $3,442,832 | $11,288,712 |
| 2051 | $7,664,579 | $3,363,273 | $11,027,852 |

| | | | |
|---|---|---|---|
| 2052 | $7,487,087 | $3,285,385 | $10,772,472 |
| 2053 | $7,313,339 | $3,209,140 | $10,522,480 |
| 2054 | $7,143,271 | $3,134,511 | $10,277,782 |
| 2055 | $6,976,819 | $3,061,467 | $10,038,286 |
| 2056 | $6,813,918 | $2,989,983 | $9,803,900 |
| 2057 | $6,654,505 | $2,920,029 | $9,574,534 |
| **Total** | **$284,931,663** | **$125,031,485** | **$409,963,148** |

Source: Cambridge Systematics Analysis

## Environmental Sustainability Benefits

### Emissions Reductions

This analysis examined the potential automotive emissions associated with the "No-Build" detour that would be avoided if the project is built. Similar to the safety benefits, USDOT provides monetized values per VMT for $CO^2$ and non-$CO^2$ emissions. These are provided as defaults in the BIP-BCA Tool. Multiplying these values by the avoided detour related VMT provides the emissions reduction benefits of the project. Over 30 years, the project reduces $CO^2$ costs by around **$40.4 million** and non-$CO^2$ emissions by **$11.8 million** discounted to 2022. Table 4 presents the annual emissions reduction benefits, which combined is **$52.2 million** in discounted dollars, which is approximately **10 percent** of benefits.

*Table 4. Annual Emissions Savings*

| Year | Discounted $CO^2$ Emissions Cost Reductions (Discounted 2022$) | Discounted Non-CO2 Emissions Cost Reductions (Discounted 2022$) | Total Emissions Cost Reductions (Discounted 2022$) |
|---|---|---|---|
| 2028 | $1,623,864 | $1,330,078 | $2,953,942 |
| 2029 | $1,624,853 | $1,325,202 | $2,950,054 |
| 2030 | $1,392,648 | $557,031 | $1,949,679 |
| 2031 | $1,403,562 | $544,806 | $1,948,369 |
| 2032 | $1,403,359 | $532,813 | $1,936,172 |
| 2033 | $1,413,349 | $521,049 | $1,934,398 |
| 2034 | $1,417,654 | $509,510 | $1,927,163 |
| 2035 | $1,421,575 | $498,194 | $1,919,769 |
| 2036 | $1,425,119 | $487,098 | $1,912,217 |

| | | | |
|---|---|---|---|
| 2037 | $1,433,289 | $476,219 | $1,909,508 |
| 2038 | $1,431,108 | $465,553 | $1,896,661 |
| 2039 | $1,433,565 | $455,099 | $1,888,664 |
| 2040 | $1,292,497 | $281,560 | $1,574,057 |
| 2041 | $1,294,030 | $275,204 | $1,569,235 |
| 2042 | $1,299,482 | $268,976 | $1,568,459 |
| 2043 | $1,300,370 | $262,874 | $1,563,244 |
| 2044 | $1,305,087 | $256,895 | $1,561,982 |
| 2045 | $1,305,355 | $251,039 | $1,556,394 |
| 2046 | $1,309,365 | $245,302 | $1,554,667 |
| 2047 | $1,313,007 | $239,683 | $1,552,690 |
| 2048 | $1,316,287 | $234,180 | $1,550,468 |
| 2049 | $1,315,345 | $228,792 | $1,544,137 |
| 2050 | $1,260,584 | $214,890 | $1,475,475 |
| 2051 | $1,259,165 | $209,924 | $1,469,089 |
| 2052 | $1,257,518 | $205,062 | $1,462,580 |
| 2053 | $1,255,649 | $200,303 | $1,455,952 |
| 2054 | $1,239,674 | $195,644 | $1,435,318 |
| 2055 | $1,223,843 | $191,085 | $1,414,927 |
| 2056 | $1,208,156 | $186,622 | $1,394,778 |
| 2057 | $1,192,613 | $182,256 | $1,374,869 |
| **Total** | **$40,371,972** | **$11,832,941** | **$52,204,913** |

Source: Cambridge Systematics Analysis

## Other Environmental Benefits

The BIP model calculates “Other Environmental Benefits” as a result of avoiding detours, primarily noise reduction benefits. This is a relatively small value benefit amounting to **$1.9 million** discounted to 2022.

## Bridge Maintenance and Operation Costs

As per USDOT BCA Guidance, this analysis assumes that no capital investments will be made in the "No Build" scenario and the bridge will be decommissioned by 2027, at the latest. Therefore, no operation and maintenance costs will be incurred in this scenario. Maintenance and operations of the project is expected to cost $62,000 per year which adds up to around $**1.25** million in discounted dollars.

## Project's Residual Value

This BCA assumes that the project will have a useful service life that exceeds the 30-year project operating period. Therefore, per USDOT guidance, assets with useful lives beyond the operating period are valued for the remaining useful life and discounted at the 30-year discount value. Under the "Build" Scenario, the bridge will have a useful life of 60 years and will depreciate linearly. Thus, the expected residual benefit that exceeds the 30-year project operating period is approximately **$15 million** discounted to 2022.

## Project Benefits Summary

The benefits of the the ***California Avenue Bridge project*** include the reduction of existing costs, or the prevention of future costs related to the current bridge. Total benefits for the project are estimated at **$1,299 million ($502.8 million** discounted to 2022) over 30-years. Table 5 shows the ***California Avenue Bridge project*** long-term benefits.

*Table 5. Chicago South California Avenue Bridge Project - Long Term Benefits*

| Benefits and Costs | Discounted Value (2022$) |
|---|---|
| Safety Crash Cost Savings (Avoided Crashes) | $24,865,518 |
| Travel Time Savings (Avoided Detours) | $284,931,663 |
| Vehicle Operating Cost Savings (Avoided Detours) | $125,031,485 |
| CO2 Emissions Cost Reduction | $40,371,972 |
| Non- CO2 Emissions Cost Reduction | $11,832,941 |
| Other Environmental Benefits | $1,886,489 |
| Residual Asset Value | $15,166,547 |
| O&M Cost Savings | $(1,245,769) |
| Total Benefits | **$502,840,846** |

# 5. Project Costs

## Capital Costs

The capital costs associated with the ***California Avenue Bridge project*** are primarily related to construction costs. These costs were derived from construction cost estimates provided by Chicago DOT (Departments of Transportation). As shown in Table 6, construction of the project will occur between 2026 and 2027, with the project opening in 2028. Project capital expenditures will total $64.1 million in discounted 2022 dollars**.**

*Table 6. Project Schedule and Capital Costs*

| Project Schedule | Value | Unit |
|---|---|---|
| First Year of Construction | 2026 | year |
| Last Year of Construction | 2027 | year |
| Project Opening | 2028 | year |

| Total Project Cost | Value | Unit$ |
|---|---|---|
| | $73,584,906 | Undiscounted 2022$ |
| | $64,146,851 | Discounted 2022$ |

# 6. Summary of Results

This BCA converts potential gains (benefits) and losses (costs) from the ***California Avenue Bridge 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.

Table 7 present the evaluation results for the project. Benefits and costs are presented in undiscounted and discounted values at 3.1 percent per year, except in the case of savings in $CO_2$ emission costs, where a 2.0 percent per year discount rate is applied.

*Table 7. Chicago South California Avenue Bridge Project - Evaluation Measures*

| Evaluation Measures | Value ( discounted 2022$) |
|---|---|
| Project Benefits = PB | $502,840,846 |
| Total Project Costs = PC | $64,146,851 |
| Net Present Value = PB - PC = NPV | $438,693,995 |
| Benefit Cost Ratio = BCR = PB / PC | 7.84 |

All project benefits and costs were estimated over the analysis period which includes the design and engineering and construction of the project during which capital expenditures are undertaken, plus 30 years of operations beyond the project completion within which to evaluate the ongoing project benefits and costs. The total net benefits from the ***California Avenue Bridge project*** project within the analysis period are **$502,8 million** (including the asset residual value) in discounted 2022 dollars. The total project capital costs are calculated to be **$64 million** in discounted 2022 dollars. The difference of the discounted project benefits and costs equal a NPV of **$438.7 million**, resulting in a BCR of **7.84**

## 7. Sensitivity Testing

A sensitivity analysis is used to help identify which variables have the greatest impact on the BCA results. This analysis can be used to estimate how changes to key variables from their preferred value affect the results and how sensitive the results are to these changes. This allows for the assessment of the strength of the BCA, including whether the results reached using the preferred set of input variables are significantly different by reasonable departures from those values. Table 8 summarizes the key variables which have been tested for sensitivity and the results of this analysis.

- **Test 1**. A decrease of the AADT associated with the “No-Build” scenario by 25 percent yields a discounted BCR of 5.93, with a NPV of **$316.6** million.
- **Test 2**. An increment in the cost of the replacement bridge by 25 percent yields a discounted BCR of 6.27 with a NPV of **$422.7** million.

The analysis shows that the BCA estimates are robust and demonstrate project feasibility under extreme assumptions.

*Table 8 Sensitivity Tests - Alternative Values for Key Parameters*

| Sensitivity Variable | Sensitivity Value | New BCR (Discounted) | New NPV (Millions of Discounted $2022) |
|---|---|---|---|
| Decrease AADT | -25% | 5.93 | $316.6 |
| Increase Cost of Replacement Bridge | +25% | 6.27 | $422.7 |

Source: Cambridge Systematics, Inc.