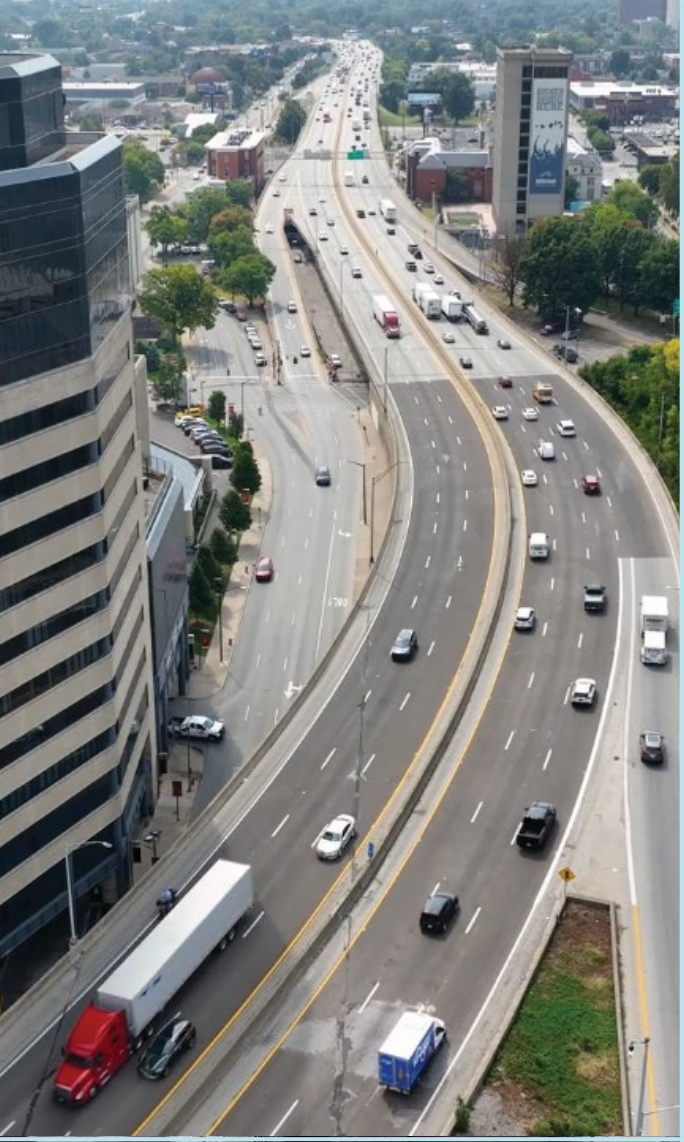

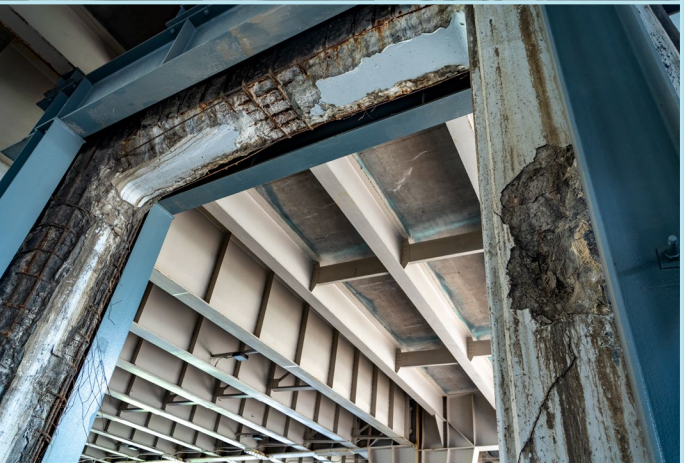

I-65 Bridge Bundling Project

Louisville, Kentucky

FY26 Bridge Investment Program (BIP)

Large Bridge Project Grants

Benefit Cost Analysis Memo

Submitted to Federal Highway Administration (FHWA)
U.S. Department of Transportation (USDOT)

By Kentucky Transportation Cabinet (KYTC)

I-65 Bridge Bundling Grant

TEAM KENTUCKY
TRANSPORTATION CABINET

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Executive Summary

A benefit-cost analysis (BCA) was conducted for the I-65 Bridge Bundling Project (the "Project") for submission to the U.S. Department of Transportation (U.S. DOT) as a requirement for the Fiscal Year (FY) 2026 Bridge Investment Program (BIP) Large Bridge Project Grants. The analysis was conducted in the Federal Highway Administration's (FHWA's) Bridge Investment Program Benefit-Cost Analysis Tool (BIP BCA Tool)[1] in accordance with the benefit-cost methodology as outlined by U.S. DOT in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs, released in May 2025. Note that the input values in the BIP BCA Tool were updated to those provided in the most recent U.S. DOT BCA Guidance. The period of analysis corresponds to 35 years (including five years of Project development and construction) and 30 years of benefits after operations begin in 2030.

The Kentucky Transportation Cabinet (KYTC) owns, operates, and maintains the I-65 corridor and bridge structures. KYTC is submitting an amended BIP application due to changes in scope, schedule, and budget of the previous FY 24-25 rolling application. The overall project remains as presented in the original application and includes the replacement or rehabilitation of 18 bridges along 4.6 miles of I-65, an elevated expressway running through the heart of Louisville, Kentucky. However, due to their deteriorating poor condition and the critical need for the reliability of the I-65 corridor, three of the 18 bridges (056B00183N, 056B00179N, 056B00212N), have been prioritized and advanced toward construction anticipated to begin in Fall 2025. To allow expedient succession of the replacement/rehabilitation of the remaining 15 bridges, which will fulfill the BIP program goals and maximize benefits to the I-65 corridor the KYTC is seeking $208,422,000 in FY26 Bridge Investment Program (BIP), Large Bridge Project Grant funds for the I-65 Bridge Bundling Project. While three of the 18 bridges are prioritized for immediate construction, the BCA is accounting for the replacement and rehabilitation costs of all 18. This is because replacing every bridge is essential for ensuring the long-term reliability of the I-65 corridor.

The Project will deliver modern bridges to address critical reliability, structural, geometric mobility, and safety issues. Local surface streets under the Project bridges will be improved to address drainage and replace the pedestrian and bicycle infrastructure that will be impacted due to the reconstruction of the bridge foundations. In addition to rehabbing or replacing the remaining 15 bridges, the Project includes three ramp improvements identified in a recent planning study that support safety and better traffic flow as well as pavement resurfacing for the entire 4.6-mile interstate corridor.

Costs

Total costs for the Project, including previously incurred costs, are expected to be $430.7 million in discounted 2023 dollars using a 7 percent real discount rate. Table ES - 1 shows how these

[1] https://www.fhwa.dot.gov/bridge/bip/bca/. Accessed April 18, 2025.

costs are allocated across time and major expense categories. Note that these costs differ from those reported in the Project Narrative due to the use of 2023 dollars rather than year-of-expenditure dollars ($624.0 million) and inclusion of previously incurred or ineligible costs.

Table ES - 1. Project Costs, in Millions of Undiscounted 2023 Dollars

Category	Previously Incurred Costs	2025	2026	2027	2028	2029	Total
Design	$0.8	$6.7	$14.4	$9.8	$2.2	$0.0	**$34.0**
Utility	$0.0	$3.0	$1.5	$0.8	$0.2	$0.0	**$5.5**
ROW	$0.0	$0.7	$0.8	$0.5	$0.1	$0.0	**$2.2**
Construction	$17.0	$27.9	$122.0	$144.5	$107.0	$22.5	**$440.9**
Contingency	$0.0	$0.3	$7.8	$21.3	$18.0	$3.8	**$51.2**
Administration / CEI	$0.0	$1.4	$6.8	$9.0	$5.5	$1.1	**$23.8**
Total	**$17.8**	**$39.9**	**$153.4**	**$186.0**	**$133.1**	**$27.4**	**$557.6**

Benefits

In 2023 dollars, the Project is expected to generate $812.5 million in discounted benefits using a 7 percent discount rate. When compared to total discounted costs of $430.7 million, this results in a Net Present Value (NPV) of $381.8 million and a Benefit-Cost Ratio (BCR) of 1.89.

The cumulative Project impacts are summarized in Table ES - 2. The overall benefit matrix for the Project can be seen in Table ES - 3.

Table ES - 2. Project Impacts, Cumulative 2030-2059

Impacts	Unit	Reduction	Direction
Property Damage Only (PDO) Crashes	Crashes	179	↓
Injury Crashes	Crashes	17	↓
Fatal Crashes	Crashes	2	↓
Incapacitating Injuries	Injuries	241	↓
Fatalities	Injuries	66	↓
Person Hours Traveled	Millions of PHT	95.3	↓

Table ES - 3. Project Impacts and Benefits Summary, Millions of 2023 Dollars

Current Status & Problem to be Addressed	Change to Baseline	BIP Merit Criterium	Economic Benefit	Summary of Results (7% Discount Rate)	Page Reference in BCA
The Project area includes 15 bridges with 4 bridges in poor condition and 9 bridges in fair condition at risk falling into poor condition within the next 3 years.	The Project brings a critical interstate segment up to a state of good repair by replacing or rehabilitating the 15 bridges along the I-65 corridor.	State of Good Repair	O&M and R&R Cost Savings	$41.8	p.13
			Residual Value	$22.1	p.14
Deteriorating bridge conditions have resulted in multiple safety hazards for all users on and under I-65, including potholes and falling concrete.	The Project rehabilitates these deteriorating bridges and improves traffic with modified lane configurations and extended acceleration lanes from ramps.	Safety and Mobility	Safety Cost Savings	$173.0	p.15
			Safety Disbenefits	-$68.6	p.12
The condition of these bridges potentially impact the traffic flow of the Project area, affecting supply chain management, reliability of personal and freight movement along this section.	The Project eliminates the need for emergency closures and detours by rehabilitating the bridges to good condition, saving 83.5 million person-hours for passengers and 10.9 million person-hours for trucks.	Economic Competitiveness and Opportunity	Travel Time Cost Savings	$429.3	p.17
			Travel Time Disbenefit	-$161.6	p.12
			Vehicle Operating Cost Savings	$409.1	p.**Error! Bookmark not defined.**
			External Highway Use Cost Disbenefit	-$45.2	p.12
		Sustainability, Resiliency, and the Environment	Non CO2 Emission Costs	$6.6	p.17
			Other Environmental Benefits	$6.1	p.17
Unforeseen maintenance and rehabilitation will hinder the efficiency of public-transportation routes and burden the transportation network for all users.	Project improvements will minimize the need to take unforeseen detours due to emergency closures and allow for efficient public-transportation routes.	Quality of Life	Increased Quality of Life	N/A	p.17

1. INTRODUCTION

1.1 BCA Framework

A Benefit-Cost Analysis (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 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 is a forward-looking exercise which assesses the incremental difference between the No Build scenario and the Build scenario, which represents the net change in welfare. 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 BCA was conducted in accordance with the benefit-cost methodology as recommended by the U.S. Department of Transportation (U.S. DOT) in the *2025 Benefit-Cost Analysis Guidance for Discretionary Grant Programs.*[2] This methodology includes the following analytical assumptions:

- Defining existing and future conditions under a No Build scenario and under the Build scenario.
- Estimating benefits and costs during Project construction and operation, including 30 years of operations beyond the Project completion when benefits accrue.
- Using U.S. DOT-recommended monetized values for reduced injuries, travel time savings, and emissions, while relying on best practices for monetization of other benefits.
- Presenting dollar values in real 2023 dollars. In instances where cost estimates and benefits valuations are expressed in historical or future dollar years, using an appropriate inflation factor to adjust the values.
- Discounting future benefits and costs with a real discount rate of 7 percent, consistent with U.S. DOT BCA guidance.

[2] U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs. May 2025. *https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance*

Note that at the time of analysis, the FHWA BIP BCA Tool was not updated to reflect the most recent U.S. DOT BCA Guidance for 2025 released in May 2025. The BCA team manually updated the monetary values of the tool to reflect the most recent 2025 guidance.

1.2 Report Contents

This report provides technical information on the BCA conducted in support of the Large Bridge Investment Program (BIP) Grant Application for the Project. The report is structured as follows:

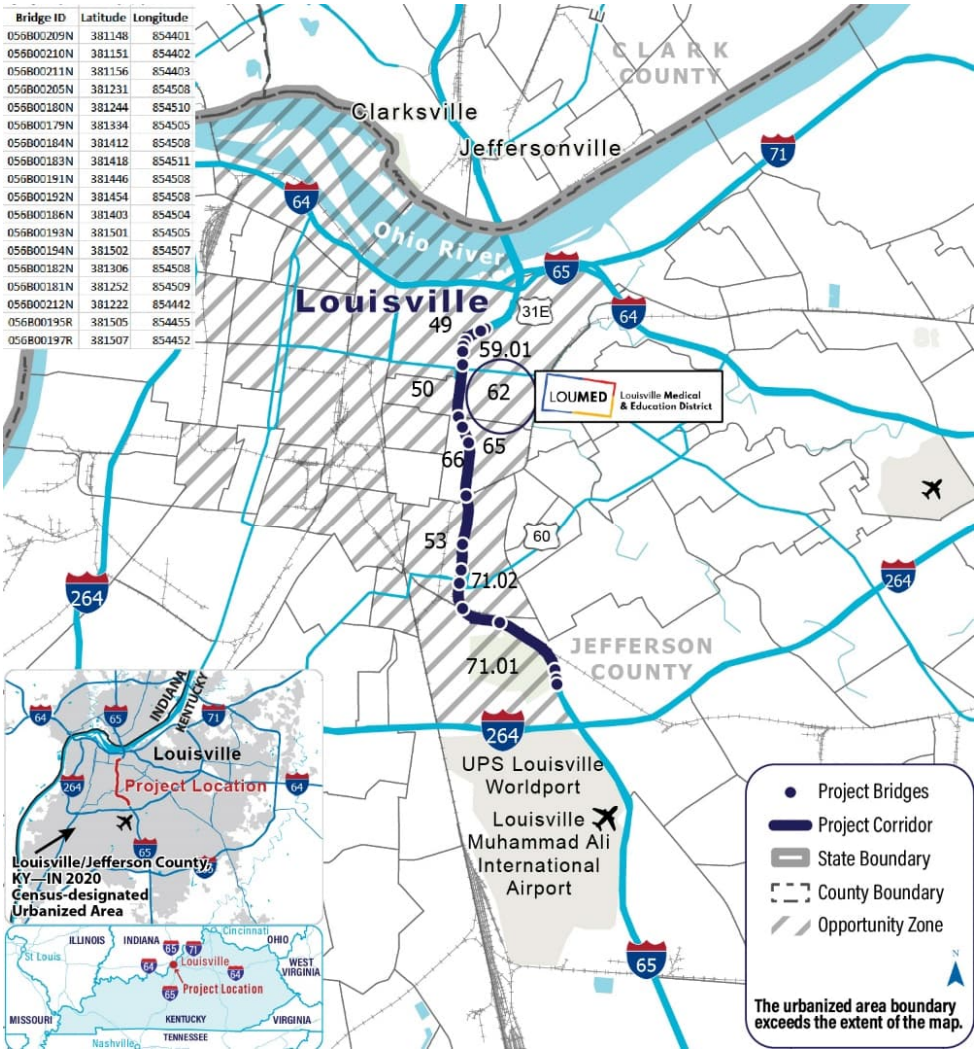
- Project Overview – Contains a description of the Project, information on the general assumptions made in the analysis, and a description of the No Build and Build scenarios.
- Project Costs – Provides a summary of the anticipated capital, operations and maintenance (O&M) and repair and rehabilitation (R&R) costs.
- Project Outcome Criteria – Reviews the expected economic benefits the Project would generate, including a review of the assumptions and methodology used to calculate the benefits.
- Summary of Results – Reports the high-level results of the BCA.
- Sensitivity Testing – Provides results of the sensitivity analysis that evaluates the different assumptions and the impact that the variability of those assumptions may have on the overall Project's BCR.

2. PROJECT OVERVIEW

2.1 Description

The Project includes the replacement or rehabilitation of 18 bridges along 4.6 miles of I-65, an elevated expressway running through the heart of Louisville, Kentucky. However, due to their deteriorating poor condition and the critical need for the reliability of the I-65 corridor, three of the 18 bridges (056B00183N, 056B00179N, 056B00212N), have been prioritized and advanced toward construction anticipated to begin in Fall 2025. A total of 15 bridges will be funded with this BIP grant request. **Error! Reference source not found.** shows a map of the Project location.

Figure 1: Project Location



Originally constructed between 1957 and 1963, four (056B00180N, 056B00182N, 056B00191N and 056B00193N) of the 15 bridges included in the Project are currently in Poor Condition and nine (056B00181N, 056B00184N, 056B00186N, 056B00192N, 056B00197R, 056B00205N, 056B00209N, 056B00210N, 056B00211N) are in Fair Condition and at risk of falling into Poor Condition within the next three years. The remaining two bridges (056B00194N, 056B00195R) are also in Fair Condition. With Average Daily Traffic (ADT) of 119,270 daily vehicles in 2021, the four Poor Condition bridges within the Project limits are the most traveled structurally deficient bridges in Kentucky.

The Project will deliver modern bridges to address critical reliability, structural, geometric, mobility, and safety issues. Local surface streets under the Project bridges will be improved to address drainage and replace the pedestrian and bicycle infrastructure that will be impacted due to the reconstruction of the bridge foundations. In addition to rehabbing or replacing the 15 bridges, the Project includes three ramp improvements identified in a recent planning study that

support safety and better traffic flow (discussed in Criteria 2: Safety and Mobility) as well as pavement resurfacing for the entire 4.6-mile interstate corridor. These ramp and resurfacing improvements, along with the replacement of the three critical bridges currently being rehabilitated, will be funded outside of the BIP grant request. While three of the 18 bridges are prioritized for immediate construction, the BCA is accounting for the replacement and rehabilitation costs of all 18. This is because replacing every bridge is essential for ensuring the long-term reliability of the I-65 corridor.

2.2 General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of Project development and includes 30 years of operations upon completion of the Project improvements. The evaluation period for this Project includes five years (2025-2029) of preliminary engineering, design, ROW acquisition, utilities, administration, and construction, with an additional 30 years of operations beyond Project completion within which benefits accrue through 2059. The monetized benefits and costs are estimated in 2023 dollars with amounts occurring in future years discounted back to 2023 in compliance with federal discretionary grant requirements using a 7 percent real discount rate. The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are expressed in 2023 dollars.
- The period of analysis begins in 2025 and ends in 2059. It includes preliminary engineering, design, ROW acquisition, utilities, and construction plus 30 years of operations as follows:
  - 2025-2029: preliminary engineering, design, ROW acquisition, utilities, administration, and construction costs with improvements completed by 2032.
  - 2030-2059: 30-year operational benefits evaluation period.
- Previously incurred costs (I-65 corridor studies) have been inflated to 2023 dollars and assigned to year 2023 since they do not require discounting. The purchase of steel ahead of bridge construction 2025 has been deflated to 2023 dollars and included as previously incurred costs.
- A constant 7 percent real discount rate is assumed throughout the period of analysis, consistent with the most recent U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs.
- Unless specified otherwise, the results shown in this document correspond to the effects of the Build Scenario.

Overall, this analysis reflects updates to the U.S. DOT BCA Guidance released in May 2025. Specifically, CO2 emissions were excluded from the analysis, and a 7 percent real discount rate was applied for benefit calculations. These emissions and discount rate changes are reflected in tables A-5 and A-11, respectively, in the “Defaults” tab of the BCA model.

The BCA produces several important measures to assess the cost-effectiveness of a proposed infrastructure project. The Benefit-Cost Ratio (BCR), calculated by dividing the Project’s

discounted societal benefits by its discounted Project capital costs, measures the societal return on each dollar spent on Project costs. A BCR of more than 1.0 indicates that for each dollar spent, more than one dollar worth of benefits will be generated by the Project. Another important measure is the net present value (NPV), calculated by subtracting the discounted Project costs from the discounted societal benefits created by the Project. This measure indicates the present value of the net social worth created by the Project, after accounting for its costs.

However, the BCR and NPV only account for benefits that can be successfully quantified and monetized; some benefits generated by a Project may be difficult to quantify or monetize and are therefore excluded from the measures described above. It is important that the BCR and NPV of a Project be considered in conjunction with other criteria when judging a Project's overall worth.

2.3 No Build and Build Scenarios

In the No Build scenario, most of the bridges in the I-65 corridor will continue to deteriorate and decrease in reliability. Fifteen bridges will fall into Poor Condition within the next three years without Project improvements.

In the Build scenario, all bridges in the I-65 corridor will be in a state of good repair. The Project will address the critical reliability, structural, geometric, mobility, and safety issues. Local surface streets under the Project bridges will be improved to address drainage. In addition to the rehabilitation and replacement of 15 bridges, three ramp improvements identified in a recent planning study that support safety and traffic floor will be improved.

3. PROJECT COSTS

3.1 Capital Costs

Total capital costs for the Project, including previously incurred costs, are expected to be $557.6 million in undiscounted 2023 dollars (Table 1), or $430.7 million in discounted 2023 dollars using a 7 percent real discount rate. Note that these costs differ from those reported in the Project Narrative due to the use of 2023 dollars rather than year-of-expenditure dollars ($624.0 million).

Table 1: Project Costs, in Millions of 2023 Dollars

Bridges	Previously Incurred Costs	2025	2026	2027	2028	2029	Total
CSX/Hill/Burnett	-	$16.0	$33.1	$7.7	-	-	**$56.7**
Kentucky/Brook	-	$20.9	$48.7	$11.5	-	-	**$81.0**
Bradley Avenue	-	$2.9	$6.9	$1.6	-	-	**$11.5**
Jacob/Broadway/Gray	-	-	$31.8	$59.5	$9.4	-	**$100.7**
Chestnut Street	-	-	$2.6	$1.4	$0.2	-	**$4.2**
Brook/Muhammad Ali	-	-	$21.3	$42.5	$6.8	-	**$70.6**
Brook/Muhammad Ali on Ramp	-	-	$0.3	$0.6	$0.1	-	**$0.9**
Floyd Street NB	-	-	$1.1	$2.3	$0.4	-	**$3.8**
E. Liberty Street NB	-	-	$2.8	$5.0	$0.8	-	**$8.5**
St. Catherine Street	-	-	-	$4.4	$10.7	$2.5	**$17.7**
Oak Street	-	-	-	$5.1	$12.6	$3.0	**$20.7**
US 60 (Eastern Pkwy)	-	-	-	$7.9	$19.2	$4.6	**$31.7**
Warnock Street (University Blvd)	-	-	-	$3.8	$9.5	$2.3	**$15.6**
Brandeis Avenue	-	-	-	$3.4	$8.4	$2.0	**$13.8**
Norfolk Southern RR	-	-	-	$7.9	$19.4	$4.6	**$32.0**
Phillips Lane	-	-	-	$5.6	$12.4	$2.9	**$20.8**
Manning Road	-	-	-	$2.7	$5.9	$1.4	**$10.0**
KFEC Gate 6 Drive	-	-	-	$4.0	$9.6	$2.3	**$15.8**
Preston Striping	-	$0.0	$0.0	$0.0	-	-	**$0.0**
Crittenden Loop Ramp	-	$0.1	$0.3	$0.1	-	-	**$0.5**
Brook/Broadway Ramp	-	-	$0.6	$1.1	$0.2	-	**$1.8**
Mill & Overlay I -65 Corridor	-	-	$3.8	$8.0	$7.7	$1.9	**$21.3**
Steel Purchase and I-65 Studies	$17.8	-	-	-	-	-	**$17.8**
Total	**$17.8**	**$39.9**	**$153.4**	**$186.0**	**$133.1**	**$27.4**	**$557.6**

3.2 Operations & Maintenance and Repair & Rehabilitation Costs

Operations and Maintenance (O&M) and Repair and Rehabilitation (R&R) costs are based on the net increase or decrease between maintaining the facilities necessary in the No Build and Build scenarios. The BCA does not account for No Build O&M and R&R cost estimates for the bridges after the bridge is closed due to their poor condition. However, the Project anticipates a net reduction in O&M and R&R costs over the 30 year analysis period. The estimates for Build O&M and R&R costs incorporate the reduced numbers of spans in the bridges. Span reduction will reduce the amount of bridge assets that need to be maintained or rehabilitated. Table 2 summarizes the O&M and R&R Cost schedule in both the No Build and Build scenarios. These costs for the bridges related to annual maintenance and repair were calculated by the KYTC District 5 Engineers.

Table 2: O&M and R&R Cost Schedule, in Millions of Undiscounted 2023 Dollars

Year	No Build O&M and R&R	Build O&M and R&R	O&M and R&R Cost Savings
2027	$7.68	$0.00	$7.68
2028	$15.18	$0.01	$15.17
2029	$13.00	$0.01	$12.99
2030	$0.07	$0.01	$0.06
2031	$7.78	$0.01	$7.77
2032	$15.31	$0.01	$15.30
2033	$13.19	$0.01	$13.18
2034	$0.07	$0.01	$0.05
2035	$0.07	$0.01	$0.05
2036	$0.07	$2.39	-$2.32
2037	$0.07	$6.78	-$6.72
2038	$0.07	$1.90	-$1.84
2039	$0.07	$0.01	$0.05
2040	$0.07	$0.01	$0.05
2041	$4.67	$0.01	$4.66
2042	$9.46	$0.22	$9.24
2043	$9.05	$1.24	$7.81
2044	$0.07	$0.01	$0.05
2045	$0.07	$0.01	$0.05
2046	$0.07	$2.39	-$2.32
2047	$0	$6.78	-$6.78
2048	$0	$1.90	-$1.90
2049	$0	$0.01	-$0.01
2050	$0	$0.01	-$0.01
2051	$0	$1.67	-$1.67
2052	$0	$4.86	-$4.86
2053	$0	$1.34	-$1.34
2054	$0	$0.01	-$0.01
2055	$0	$0.01	-$0.01
2056	$0	$3.57	-$3.57
2057	$0	$10.30	-$10.30
2058	$0	$2.85	-$2.85
2059	$0	$0.00	$0.00
Total	**$96.04**	**$48.38**	**$47.66**

4. PROJECT OUTCOME CRITERIA

The following sub-sections provide the assumptions used to calculate benefits as well as the monetized and quantified benefits for each of the applicable merit criteria. Benefit estimates reflect the variance between the No Build and Build scenarios, where positive benefits reflect Project improvements compared to the No Build scenario. The original BCA submitted as part of the I-65 Bridge Bundling Project in November 2023 treated each bridge independently to estimate the independent utility of each bridge. However, FHWA Economic Analysis reviewers suggested during the March 2024 grant debrief that conducting the BCA for a composite bridge would be more appropriate. The BCA used AADT information from Jacob Broadway bridge as a representative volume of vehicles traveling through the I-65 corridor in Louisville, KY. Jacob

Broadway bridge has a lower volume of vehicles compared to other I-65 bridges in the National Bridge Inventory (NBI). The estimated benefits in this BCA are therefore likely conservative. A sensitivity test with higher AADT estimates from other bridges (Phillips or Manning Road) is presented in Table 16 in the Sensitivity Testing Section.

4.1 Demand Projections

The BCA relies on the default annual average daily traffic (AADT) estimates from National Bridge Inventory (NBI) data that comes preloaded into the FHWA BIP BCA Tool. The No Build and Build AADT estimates are the same since the Project is not expected to result in changes to overall corridor demand. The following tables provide a summary of the demand projections for the composite bridge included in this analysis.

Table 3: Summary of Demand Projections from NBI

Bridge	Variable	NBI Year of AADT	NBI Year of Future AADT	Project Opening year	Final Year of Analysis
Composite Bridge (Jacob Broadway)	Year	**2012**	**2032**	**2030**	**2059**
	No Build/Build - Passenger AADT	71,401	78,541	77,796	89,325
	No Build/Build - Truck AADT	12,600	13,860	13,729	15,763

4.1.1 Detour Assumptions

The analysis uses likely detour routes, provided by AECOM, during I-65 closures for bridge replacement (presented in Figure 2). Generally, traffic would be diverted around I-65 on I-264 or I-64 / I-264. This information on detours during construction is also used for detour assumptions in future bridge closures in the No Build case.

Figure 2: Likely Detours During I-65 Bridge Closures

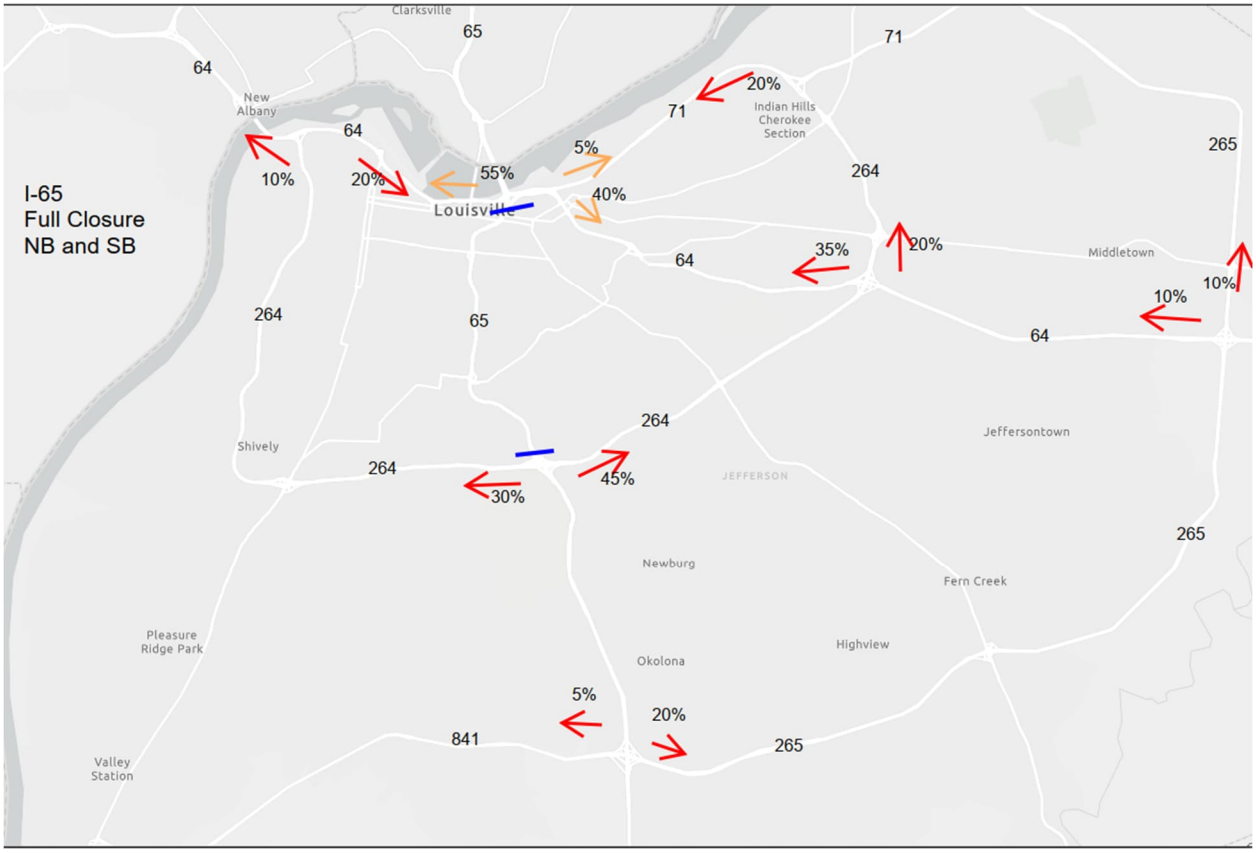


Figure 3: NB Traffic Routes

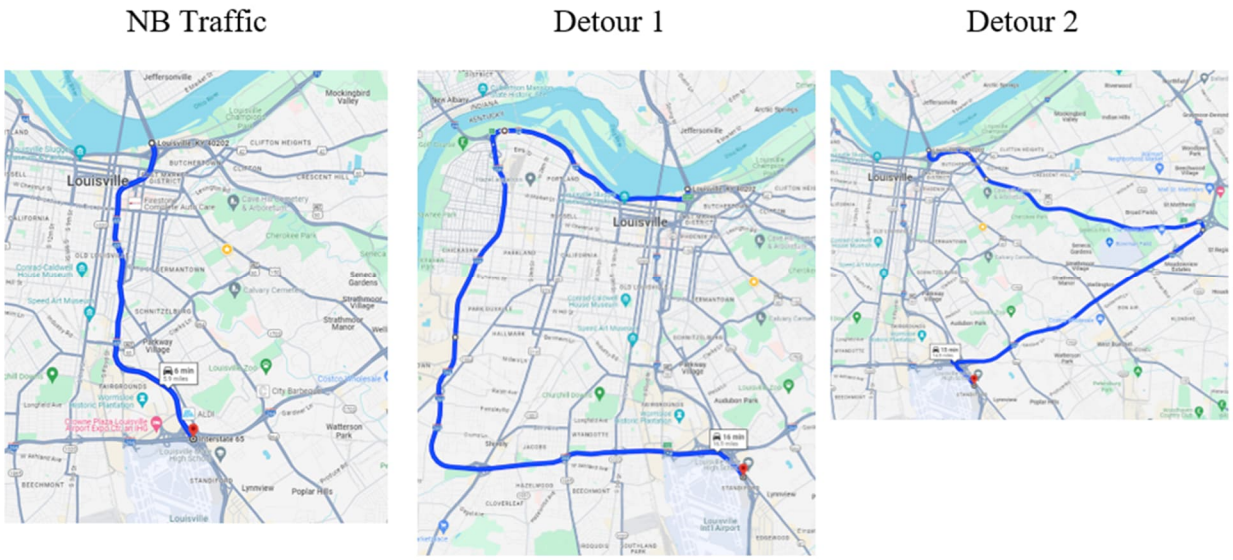
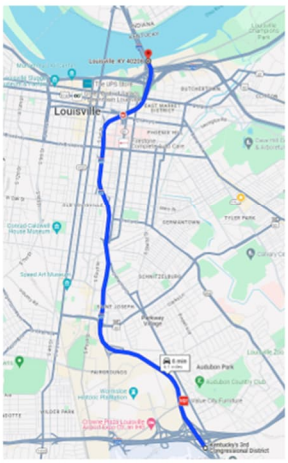
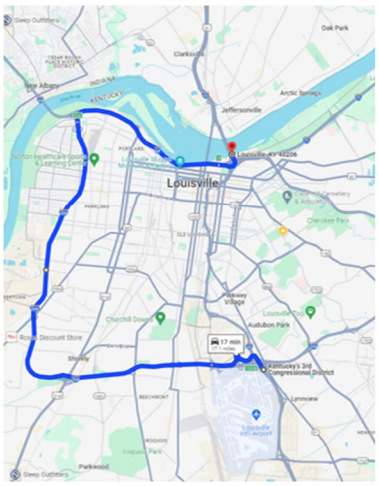


Figure 4: SB Traffic Routes

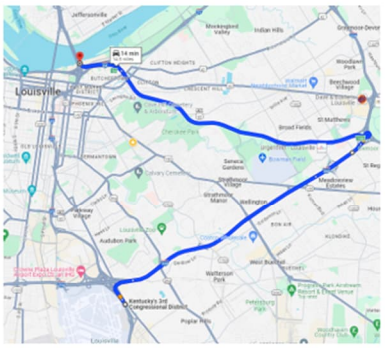
SB Traffic



Detour 1



Detour 2



A summary of key detour assumptions is presented in Table 4 and Table 5. For simplicity, the BCA assumes that any diverted traffic would be rerouted between those two main routes shown in Figure 3 and Figure 4. Other likely detours shown in Figure 2 are likely to result in even longer detours.

Table 4: Key Detour Assumptions

Variable	Unit	NB	SB	Average	Notes
Base I-65 Travel Distance	miles	5.9	6.1	6.0	Source: Google Maps
Detour 1: Rerouted Distance through I-264	miles	16.9	17.1	17.0	Source: Google Maps
Detour 2: Rerouted Distance through I-64/I-264	miles	14.6	14.5	14.6	Source: Google Maps
Percent Diverted to Route 1 [1]	percent	55%	55%	n/a	Assumptions based on likely detours (KYTC, AECOM, 2024)
Percent Diverted to Route 2 [1]	percent	45%	45%	n/a	Assumptions based on likely detours (KYTC, AECOM, 2024)
Average Rerouted Distance	miles	15.9	15.9	15.9	Calculation
Average Rerouted Net Distance	miles	10.0	9.8	9.9	Calculation
Average Detour Speed	mph	n/a	n/a	60.0	Assumption based on average speed assumption for detours in FHWA's BIP BCA Tool
Average Delay during Lane Reductions	mins/veh	n/a	n/a	3.05	AECOM estimation of lane closure impacts on I-65. The estimate assumes that two lane traffic will be maintained in each direction.
Percent Auto Local Traffic [2]	percent	n/a	n/a	10.1%	Percent local traffic for passenger cars on I-65 based on Replica data for Spring of 2023. Local traffic is defined as travel distance of less than eight miles.
Representative Detour Distance	miles			14.5	Calculation: after accounting for local traffic not experiencing additional detours
Representative Net Detour Distance	miles			8.5	Calculation (subtracting base I-65 travel distance)

[1] Notes: For simplicity, BCA assumes that any diverted traffic would be rerouted between those two main routes. Other routes shown in Figure 2 result in higher net detour length.

[2] BCA also accounts for the fact that local traffic may have marginal or non-existent impact on net detour length due to the use of local streets. Based on Replica's information on I-65 corridor traffic, about 10.1 percent of auto traffic is local with a total travel distance of eight miles. BCA assumes that this local auto traffic will not experience additional delays due to bridge closures.

Table 5: Bridge Closure and Traffic Reduction Assumptions

Bridge	Closure Year Forecast	% Reduction in Traffic	Detour Length (mi)	Detour Average Speed (mph)
Composite Bridge	2047; Based on when year Overall Condition Rating 2 is reached plus average time to closure of 3.68 years	100%	8.5	60

Source: FHWA BIP BCA Tool

4.1.2 Construction Disbenefits

The BCA analyzed construction-related disbenefits during the bridge construction period. For most of the proposed bridge work, an accelerated bridge construction (ABC) method will be utilized to minimize traffic impacts. During the closure, traffic will have to take a detour of an additional 8.5 miles. The BCA calculates this disbenefit using KYTC given assumptions shown in Table 6. The BCA counts only separate bridge closures for the purposes of analysis. For example, a closure for a paired bridge is counted as one closure.

Table 6: Bridge or Lane Closures during Construction Assumptions

Bridge	Days	Year	Closure Assumptions	Pairings
Kentucky/Brook NB	150	2025	Complete Closure	
Bradley Avenue	30	2025	Complete Closure	
Kentucky/Brook SB	61	2025	Reduced Lanes	
CSX/Hill/Burnett	61	2025	Complete Closure Weekend	
Jacob/Broadway/Gray	250	2026	Reduced Lanes	Paired with Chestnut
Chestnut Street		2026	Reduced Lanes	Paired with Jacob, Boradway, Gray
Brook/Muhammad Ali SB	175	2026	Complete Closure	
Brook/Muhammad Ali on Ramp		2026	Complete Closure	Paired with Brook/Muhammad Ali SB
Brook/Muhammad Ali NB	175	2026	Reduced Lanes	
Floyd Street NB		2026	Reduced Lanes	
E. Liberty Street NB		2026	Reduced Lanes	
Brandeis Avenue	4	2027	Complete Closure	Paired with Eastern Pkwy
Warnock Street	4	2027	Complete Closure	
Phillips Lane	4	2027	Complete Closure Weekend	Paired with Manning
Manning Road	4	2027	Complete Closure Weekend	Paired with Phillips
KFEC Gate 6 Drive	4	2027	Complete Closure Weekend	
Norfolk Southern RR	10	2027	Complete Closure Weekend	
US 60 (Eastern Pkwy)	4	2027	Complete Closure Weekend	Paired with Brandeis
St. Catherine Street	4	2027	Complete Closure Weekend	Paired with Oak Street
Oak Street	4	2027	Complete Closure Weekend	Paired with St Catherine Street

In addition to travel time impacts or delays, the BCA estimated likely safety disbenefits and external highway use costs due to diversion due to construction. Using state-wide crash rates, the

BCA estimated the impact on incapacitating injury and fatal events. These crash rates are summarized in Table 7.

Table 7: State-wide Crash Rates

Variable	Unit	Value	Source
Incapacitating Injury Rate	per 100 million VMT	5.7	FHWA State Highway Safety Report (2022) - Kentucky; https://www.fhwa.dot.gov/tpm/reporting/state/safety.cfm?state=Kentucky
Fatality Rate	per 100 million VMT	1.6	

The construction disbenefit amounts to -$275.5 million in discounted 2023 dollars, as shown in Table 8.

Table 8: Construction Disbenefit, in Millions of 2023 Dollars

Benefit	Discounted (7%)
Safety Disbenefit	-$68.6
External Highway Use Cost Disbenefit	-$45.2
Travel Time Disbenefit	-$161.6
Total	**-$275.5**

4.2 State of Good Repair

The Project brings a critical interstate up to a state of good repair by replacing or rehabilitating these 15 bridges along the I-65 corridor. The BCA estimates Operations and Maintenance (O&M) and Repair and Rehabilitation (R&R) cost savings as well as the residual value of the bridges as part of the State of Good Repair benefits.

4.2.1 O&M and R&R Cost Savings

The Project includes 15 bridges, with four bridges in Poor condition and nine bridges in Fair condition and at risk of falling into Poor condition within the next three years. The remaining two bridges are also in Fair condition. The KYTC District 5 Engineers provided a full 30 year estimate of bridge O&M and R&R costs, but the BCA does not use the full estimate because bridges would be closed in the No Build by 2047. The cost estimates for Build O&M and R&R incorporate the reduction in the number of spans in the bridges. Span reduction on the bridges will consequently reduce the amount of bridge assets needed to be maintained or rehabilitated. The O&M and R&R cost schedule used in the analysis is shown in Table 9.

Table 9: O&M and R&R Cost Schedule, in Millions of Undiscounted 2023 Dollars

Year	No Build	Build	Reduction
2027	$7.68	$0.00	$7.68
2028	$15.18	$0.01	$15.17
2029	$13.00	$0.01	$12.99
2030	$0.07	$0.01	$0.06
2031	$7.78	$0.01	$7.77
2032	$15.31	$0.01	$15.30
2033	$13.19	$0.01	$13.18
2034	$0.07	$0.01	$0.05
2035	$0.07	$0.01	$0.05
2036	$0.07	$2.39	-$2.32
2037	$0.07	$6.78	-$6.72
2038	$0.07	$1.90	-$1.84
2039	$0.07	$0.01	$0.05
2040	$0.07	$0.01	$0.05
2041	$4.67	$0.01	$4.66
2042	$9.46	$0.22	$9.24
2043	$9.05	$1.24	$7.81
2044	$0.07	$0.01	$0.05
2045	$0.07	$0.01	$0.05
2046	$0.07	$2.39	-$2.32
2047	$0	$6.78	-$6.78
2048	$0	$1.90	-$1.90
2049	$0	$0.01	-$0.01
2050	$0	$0.01	-$0.01
2051	$0	$1.67	-$1.67
2052	$0	$4.86	-$4.86
2053	$0	$1.34	-$1.34
2054	$0	$0.01	-$0.01
2055	$0	$0.01	-$0.01
2056	$0	$3.57	-$3.57
2057	$0	$10.30	-$10.30
2058	$0	$2.85	-$2.85
2059	$0	$0.00	$0.00
Total	**$96.04**	**$48.38**	**$47.66**

The BCA estimates the O&M and R&R cost savings after a 30-year benefits period to total $41.8 million in discounted 2023 dollars.

4.2.2 Residual Value

The BCA used the share of construction costs compared to the total Project cost and a useful life benchmark of 75 years to estimate the residual value of all bridges in the scope. These assumptions are presented in Table 10.

Table 10: Residual Value Assumptions

Variable	Unit	Value	Source
Construction Cost as a Percent of Total Project Cost	percent	75.6%	Calculated

The BCA estimated the residual value of the bridges after a 30-year benefits period to total $22.1 million in discounted 2023 dollars.

4.3 Safety and Mobility

The Project increases safety and mobility through two main components:

- Prevention of traffic diversion to detour routes due to bridge closures
- Ramp improvements on Preston Striping, Brook/Broadway, and Crittenden Ramp.

The ramp improvements scoped within the Project help address the major concerns identified along the corridor, including:

- **Preston Striping** at I-65 northbound (NB) on-ramp will address poor delineation of lanes leading to driver confusion.
- The NB **Brook/Broadway** off-ramp will be widened, and a through movement of Jacob Street will be relocated to increase safety by reducing conflict points and driver confusion while improving visibility.
- **Crittenden Ramp** improvements include lengthening the I-65 NB ramp at Crittenden Drive to improve the horizontal curve and lengthen the inadequate merge distance.

4.3.1 Safety Cost Savings

The BCA leveraged state-wide crash rates, shown in Table 7, to calculate safety benefits in the entire Project area, including the three ramps. Additionally, crash modification factors (CMFs) were applied to relevant historical crash information where the ramp improvements will be implemented to estimate safety benefits from ramp improvements. This historical crash data and corresponding CMFs are summarized in Table 11.

Table 11: Crash Data Summary and CMFs, 2017-2023

Location	Variable	Value	Average Annual	Source
Crittenden Ramp	Property Damage Only	106	16.7	KYTC Police
	Injured (Unknown Severity)	17	2.7	
	Fatality	0	0.0	
	CMF (ID: 5215) – Modify length of acceleration lane	0.85	N/A	CMF Clearinghouse: https://www.cmfclearinghouse.org/detail.php?facid=5215
Brook Broadway Ramp	Property Damage Only	51	8.1	KYTC Police
	Injured (Unknown Severity)	2	0.3	
	Fatality	1	0.2	
	CMF (ID: 254) – Provide a left-turn lane on one major road approach	0.67	N/A	https://www.cmfclearinghouse.org/detail.php?facid=254
Preston Ramp	Property Damage Only	11	1.7	KYTC Police
	Injured (Unknown Severity)	1	0.2	
	Fatality	0	0.0	
	CMF (ID: 3010) – Install one left-turn lane on the minor approach	0.75	N/A	CMF Clearinghouse: https://www.cmfclearinghouse.org/detail.php?facid=3010

Using U.S. DOT safety monetization values (shown in BIP BCA Tool's "Defaults" tab), the BCA estimated the safety benefits as summarized in Table 12. Over a 30-year analysis period, the Project would result in $173.0 million in discounted 2023 dollars.

Table 12: Safety Benefits, in Millions of 2023 Dollars

Benefit	Discounted (7%)
Composite Bridge	$163.9
Crittenden Ramp	$1.5
Brook Broadway Ramp	$7.4
Preston Ramp	$0.2
Total	**$173.0**

4.4 Economic Competitiveness and Opportunity

Using information from Table 5, the BCA quantified and monetized travel time savings and vehicle operating cost savings based on the expected traffic diversion due to bridge closures. According to a routine inspection conducted in December 2024, bridges Jacob/Broadway/Gray bridge and Phillips Lane are weight restricted for the heaviest trucks. The BCA moderately assumes that this weight restriction applies to approximately 10 percent of traffic on these bridges. Using U.S. DOT safety monetization values (shown in BIP BCA Tool's "Defaults" tab), the BCA estimated the travel time savings and vehicle operating cost savings as summarized in Table 13 and **Error! Reference source not found.**, respectively. Over a 30-year analysis period,

the Project would result in travel time savings of $267.7 million and vehicle operating cost savings of $409.1 million for a total benefit of $676.8 million in discounted 2023 dollars.

4.4.1 Travel Time and Vehicle Operating Cost Savings

Table 13: Economic Competitiveness and Opportunity, in Millions of 2023 Dollars

Benefit	Discounted (7%)
Travel Time Savings	$267.7
Vehicle Operating Cost Savings	$409.1
Total Economic Competitiveness and Opportunity Benefits	**$676.8**

4.5 Sustainability, Resiliency, and the Environment

4.5.1 Non-CO_2 and Other Environmental Cost Savings

The Project meets the Sustainability, Resiliency, and the Environment criteria by avoiding the need to close the bridges, which would result in avoided detour miles traveled, increased air pollution, and greenhouse gas emissions associated with traffic diversion. Using monetized values of environmental cost savings (non-CO_2 emissions, and "Other Environmental" which primarily including noise pollution) in the BIP BCA Tool's "Defaults" tab, the BCA estimates the Project would result in $12.6 million discounted 2023 dollars of environmental benefits over the 30-year analysis period.

Table 14: Sustainability, Resiliency, and Environment Benefits, in Millions of Discounted 2023 Dollars

Benefit	Discounted (7%)
Non-CO_2 Emissions	$6.6
Other Environmental	$6.1
Total Benefits	**$12.6**

4.6 Quality of Life

The Project improves the quality of life by ensuring safe, reliable infrastructure that supports essential public transit services in Louisville, Kentucky. By preventing emergency bridge closures and minimizing disruptions during maintenance, the Project increases the reliability of efficiency of public-transportation routes and unburden the local transportation network from detours.

5. SUMMARY OF RESULTS

5.1 Evaluation Measures

The BCA 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 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.

5.2 BCA Results

Table 15 presents the evaluation results for the Project. Results are presented in discounted dollars as prescribed by U.S. DOT. All benefits were estimated in constant 2023 dollars over an evaluation period extending 30 years beyond Project completion. The benefits from the Project improvements within the analysis period total $812.5 million in discounted 2023 dollars. Compared to the total costs of $430.7 million, this yields an NPV of $381.8 million and a BCR of 1.89.

Table 15: Project BCA Results, in Millions of 2023 Dollars

Benefit Category	Discounted (7%)
Safety Benefit	$173.0
Travel Time Cost Savings	$429.3
Vehicle Operating Cost Savings	$409.1
Non-CO2 Emissions Benefit	$6.6
Other Environmental Benefits	$6.1
Maintenance Cost Savings*	$41.8
Residual Value	$22.1
Travel Time Disbenefit	-$161.6
Safety Disbenefit	-$68.6
External Highway Use Cost Disbenefit	-$45.2
Total Benefits	**$812.5**
Total Costs	**$430.7**
Net Present Value (NPV)	**$381.8**
Benefit Cost Ratio (BCR)	**1.89**

**Includes O&M and R&R costs*

6. SENSITIVITY TESTING

The BCA outcomes presented in the previous sections rely on a large number of assumptions and long-term projections, both of which are subject to considerable uncertainty. The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the "critical variables". The sensitivity analysis evaluates the impact of adjusting key assumptions on the BCR and NPV. It can also be used to:

- Evaluate the impact of changes in individual critical variables – how much the final results would vary with reasonable departures from the "preferred" or most likely value for the variable; and
- Assess the robustness of the BCA and, in particular, evaluate whether the conclusions reached under the "preferred" set of input values are significantly altered by reasonable departures from those values.

Several sensitivity tests were conducted and the outcomes of this analysis for the Project are summarized in Table 16. Each sensitivity test varies one assumption, retaining the same values as the base case for all other parameters. The table provides the Project's resulting economic BCR and NPV associated with each sensitivity test.

Table 16: Sensitivity Analysis Results

Variable	Value	BCR	NPV ($M)	% Change in NPV	Notes
Base Results	N/A	1.89	$381.8	N/A	No changes to the model
Capital Cost	20% Increase	1.57	$295.6	-22.6%	20% Increase in Capital Costs
	20% Decrease	2.36	$467.9	22.6%	20% Decrease in Capital Costs
Value of Time	20% Increase	1.91	$389.9	2.1%	20% Increase in Value of Time for Personnel and Truck Drivers
Bridge Openings	20% Decrease	1.87	$373.7	-2.1%	20% Decrease in Value of Time for Personnel and Truck Drivers
Load Posting	Decrease to 5%	1.80	$344.1	-9.9%	Decreased the percentage of affected traffic to 5% from 10%
AADT	Philips Lane AADT	2.56	$672.9	76.3%	Used NBI Given Philips Lane AADT for BCA Calculations