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February 26, 2024

To: The Honorable Pete Buttigieg, Secretary of Transportation  
U.S. Department of Transportation

From: Nick Foster, AICP, RSP<sup>1</sup>; Scott Curry, AICP, CNU-A; Josh Hurst, PE, PTOE, LEED AP; Justin Bansen, PE; Emily Chen; Luke Morin; Riva Heinrich, AICP

RE: Garrison LEARNS Corridor Project: RAISE Grant Application  
Benefit-Cost Analysis Memorandum

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## Introduction

This memorandum summarizes the assumptions, methodologies, and results of the benefit-cost analysis (BCA) completed for the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant Application for the Garrison Library, Education, Arts, Recreation, Nature, and Science (LEARNS) Corridor project.

The BCA provides a means to measure a project's overall benefit by assigning a monetary value to benefits that can be compared against costs, such as construction and maintenance. Adjustments to the values are made to compare all benefits and costs with a common base year. Benefits and costs are calculated for the project and then compared to the benefits and costs for a baseline condition.

Garrison Boulevard is home to the most significant concentration of civic anchors outside the City of Gastonia's downtown core. Those civic anchors include the Schiele Museum of Natural History, the Grier Middle School campus, the Gaston County Library, Lineberger Park, and the Avon/Catawba Creeks Greenway trailhead. The corridor is known throughout the greater metropolitan region for these recreational, cultural, and educational facilities. For example, the Schiele Museum of Natural History hosted over 72,000 visitors in 2021, including over 47,000 students and teachers who participated in their educational programs and over 32,000 guests who enjoyed the James H. Lynn Planetarium & Science Theater.<sup>1</sup> Also of note, the Grier Middle School campus is in the midst of a transformation with the construction of a new 155,000 square foot, \$60M school facility that will house up to 1,200 students and become a "showplace for learning in the heart of Gastonia."<sup>2</sup> That cultural and educational identity is the foundation for designating this area the Garrison LEARNS Corridor and a motivator for the community's alignment behind the proposed Garrison LEARNS Corridor project.

The proposed project corridor extends from Fern Forest Drive (Lineberger Park) to New Hope Road. In addition to the key civic anchors mentioned above, the Garrison LEARNS Corridor hosts other significant multimodal generators including two large churches, several healthcare services, and a variety of local businesses. The corridor is a significant part of the City's transportation network, providing east-to-west

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<sup>1</sup> Schiele Museum 2021 Annual Report. <https://www.schielemuseum.org/schiele-who-we-are/>

<sup>2</sup> Transformation in Store for Grier Middle School Campus. Gaston County Schools. <https://www.gaston.k12.nc.us/newgriermiddleschool>

mobility south of the City's downtown area, while acting as a parallel route to US 74 (Franklin Boulevard). This project corridor directly serves 3,000 residents and 3,500 jobs and is also a bus route for the Gastonia Transit Blue Line.

As it exists today, the corridor is an automobile centric, 5-lane arterial, that does not support its growing civic anchors and multimodal demand. With the addition of bike lanes, new sidewalks, new pedestrian crossings, improved intersection treatments, traffic calming, a new traffic signal, a pedestrian bridge, an improved greenway underpass, access management improvements, landscaping, and lighting, the Garrison LEARNS Corridor project will transform the Garrison Boulevard corridor and create a new civic heart for the City of Gastonia, NC.

This project will generate measurable benefits in key areas related to safety (pedestrian, bicycle, and vehicular expected crash reduction), reduced maintenance costs over time, decreased auto usage, improved health and quality of life outcomes, noise reduction, increased property values, and environmental sustainability. Using 2022 dollars and a 3.1% discount rate, the substantial positive impacts of the project are monetized at \$25.6 million in benefits, compared to a discounted project cost of \$21.0 million. As a result, the project has a benefit-cost ratio (BCR) of 1.22 (at the 3.1% discount), which represents a favorable investment of federal funds and a significant benefit to the residents of Gastonia and the greater metro region.

# Summary of Benefits

The benefits and costs associated with the projects are provided in **Table 1**. 2028 is the assumed project use start year, and benefits are calculated over a 20-year period of operation from 2028 to 2047 based on US Department of Transportation (USDOT) BCA Guidance for capacity expansion projects. Details for each calculation are provided in the following sections.

**Table 1 Summary of Benefits**

Benefits	Quantifiable Measure	Total Benefit (-Cost)	Present Value (3.1% Discount Rate)
<b>Safety</b>			
<b>Crash Savings</b>	Reduction in number and severity of crashes	\$11,907,386	\$7,514,861
<b>Travel Time Savings</b>			
<b>Peak Hour Travel Time Savings</b>	Change in travel time due to conversion of two-way left turn center lane to raised median (trip rerouting) and number of auto trips taken (shifting of some auto trips to walking/cycling trips)	-\$804,438	-\$506,213
<b>Operational Savings</b>			
<b>Decreased Auto Usage</b>	Vehicle operating costs such as gasoline, maintenance, tires, and depreciation	\$1,742,200	\$1,099,518
<b>Environmental Sustainability</b>			
<b>Vehicle Emissions Savings/-Costs</b>	Decrease in CO2, VOC, NOx, PM2.5, and SO2 emissions due to decreased SOV trips	\$2,236,499	\$1,408,456
<b>Quality of Life</b>			
<b>Health Benefit</b>	Mortality reduction benefit of induced active transportation	\$7,119,701	\$4,493,309
<b>Economic Competitiveness</b>			
<b>Real Estate Value Increase</b>	Increase in property values due to increased access to walking and cycling facilities	\$1,221,546	\$1,017,087
<b>Operations &amp; Maintenance</b>			
<b>Maintenance Savings</b>	Decreased maintenance costs related to the construction of the project	\$1,405,732	\$1,147,143
<b>Other Benefits</b>			
<b>Amenity Comfort Benefit</b>	Change in pedestrian and bicyclist amenities including additional sidewalk, vehicular speed reduction, crossings, and bike lanes	\$8,730,475	\$5,509,883
<b>Residual Value</b>	Residual value of assets at the end of the analysis period	\$7,947,779	\$3,704,923
<b>Noise and Congestion</b>	Noise and congestion benefits from a decrease in auto vehicle usage	\$327,744	\$206,842
<b>Total Benefits</b>		\$41,834,623	\$25,595,808
<b>Total Costs</b>		-\$23,843,336	-\$20,984,482
<b>Benefit/Cost Ratio</b>		1.75	1.22

# Baselines and Alternatives

Consistent with the direction provided by the USDOT, the BCA compares the Baseline Condition with the Build Alternative.

## BASELINE CONDITIONS

The Baseline, or No-Build, alternative maintains the existing conditions on Garrison Boulevard without any elements of this project. These conditions include:

- Five-lane roadway with a center two-way-left-turn-lane;
- No sidewalk for most of the south side of the corridor, and back-of-curb sidewalk of varying quality on the north side of the corridor;
- No bicycle facilities;
- A lack of pedestrian crossing opportunities (average spacing between crossings = 1,700 linear feet) resulting in unsafe crossing conditions or significant out of direction travel for pedestrians and transit riders;
- A greenway underpass that is continuously silted, wet, and impassable; and
- Higher than average driveway density.

The Baseline condition is auto centric and provides limited infrastructure and connectivity for people walking and biking. This Baseline is used to compare the benefits of implementing the Build Alternative.

## BUILD ALTERNATIVE

The Build Alternative includes the following elements to improve multimodal mobility and safety for all users along the corridors:

**Table 2 Build Alternative Improvements**

Streetscape Improvements	Accessibility Improvements	Safety and Speed Management	Multimodal Improvements
<ul style="list-style-type: none"> <li>• Landscaped medians</li> <li>• Roadway milling and resurfacing</li> </ul>	<ul style="list-style-type: none"> <li>• Repairing / widening sidewalks (north side)</li> <li>• Installing ADA curb ramps</li> </ul>	<ul style="list-style-type: none"> <li>• Lane narrowing (lane diet)</li> <li>• Speed limit reduction</li> <li>• New traffic signal at Laurel Lane</li> <li>• Improved lighting</li> <li>• Pedestrian countdown timers</li> <li>• Center median</li> </ul>	<ul style="list-style-type: none"> <li>• Pedestrian bridge</li> <li>• Improved Avon/Catawba Creeks Greenway underpass</li> <li>• Consistent bicycle lanes (both sides)</li> <li>• Improved pedestrian crossings at four signalized intersections</li> <li>• Bicycle crossing treatments</li> <li>• Fill in sidewalk gaps (south side)</li> </ul>

Together, these improvements will increase safety and multimodal connectivity through these vital neighborhoods in Gastonia. Enhancements to mobility will result in more equitable transportation choices, reduce environmental impacts, increase real estate value, and support positive health outcomes for residents.

## Methodology

The BCA was developed using the 2024 guidance provided by the USDOT. Analysis was completed as necessary to develop the benefits and costs of the Baseline and Alternative. Major components of the analysis include:

- Safety Benefits
- Travel Time Costs
- Operational Savings
- Environmental Benefits
- Health Benefits
- Real Estate Benefits
- Operations & Maintenance Savings
- Amenity Benefits
- Residual Value
- Noise Reduction Benefits

In addition to the benefits listed above, unquantified benefits were also identified. These benefits describe the additional value of implementing the project beyond the quantified results of the BCA. These unquantified benefits are discussed later in this memorandum and in greater detail in the grant application narrative (**Factors Not Quantified**).

The BCA spreadsheet included in this application includes project inputs (Tab A), a summary of benefits (Tabs B & C), and the individual costs and benefits for each analysis (Tabs D through M). These analyses are discussed in more detail below.

## BENEFIT COST ANALYSIS INPUTS

### Inputs – Tab A

The primary inputs of the BCA consist of peak hour traffic delays, annual average daily traffic volumes, US Census- and traffic count-based mode splits, and monetization factors as recommended by USDOT guidance.

The AM and PM peak hour traffic analysis was completed using a 2022 existing year for the Baseline, as well as 2028 and 2048 Baseline and Alternative years. Signal timing updates are assumed to occur between now and 2028, and a compound annual growth rate of 0.25% is assumed for the facility based on historical and projected (regional travel demand model) trends. Combining the anticipated delay and

annual average daily traffic (AADT) volumes resulted in an estimate of total vehicle hours of delay along the Garrison Boulevard project limits under the Baseline and Alternative scenarios.

A mode shift was assumed based on induced demand from improved walk and bike facilities. The bike mode split was adjusted based on NCHRP Report 552. Previous grants have generally assumed a doubling in pedestrian traffic. A scaled back 10% increase in walk trips was assumed to be conservative following another grant application with similar proposed improvements to the Baseline. Mode share was calculated based on Gastonia's American Communities Survey (ACS) Commuting Characteristics Data (2022) as well as traffic count data collected in May 2023. Combining the AADT, the existing area mode split, and the assumed mode shift increase factor resulted in an estimate of bike and pedestrian volumes under the baseline and alternative scenarios. The remaining calculated benefits are based largely on the annualized delays, traffic volumes, and bicycle and pedestrian estimates.

The base year of the analysis is 2022, as recommended by the 2024 USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs. Design is expected to begin in 2025, and construction is expected to occur over two years starting in 2026. As the project is primarily addressing existing multimodal capacity issues, the 2024 USDOT guidance recommends that "projects aimed primarily at capacity expansion or to address other operating deficiencies should use an operating period of 20 years." A 20-year operating period of benefits was analyzed for the years following the completion of the project, from 2028 through 2047. The present value of all benefits and costs was calculated using 2022 dollars, per USDOT guidance. The overall BCA analysis was completed for a 23-year period (2025 to 2047).

## Output Table and Summary – Tabs B & C

Tab B provides a summary of benefits by category, denoting the total monetized benefits, project costs, and benefits/costs ratio noted in **Table 1**. Tab C delineates these costs year-over-year from the design phase through 2047 operations.

## Cost Estimate – Tab D1

The City has completed preliminary planning for the corridor. The grant application includes design and construction funds. Design is expected to begin as soon as grant funds are available. For the BCA analysis, design is assumed to begin in 2025 and last one year, while construction is assumed to begin in 2026 and last two years. Implementation of all project components is scheduled to be completed by 2028 with project use occurring the same year. Any temporary net benefits or indirect costs caused by the implementation of the project or travel time delays due to construction are assumed to be minimal and were excluded from the analysis.

The project costs include individual construction line items and percentages for project unknowns, design, right-of-way (ROW), and construction management. Project costs were developed using 2024 dollars, then discounted back to 2022 dollars per USDOT BCA guidelines. Based on the delivery schedule, the project costs will be approximately \$23.8 million undiscounted and approximately \$21.0 million using a 3.1% discount rate. Calendar year 2028 is the first full year that benefits from the project are scheduled.

## Construction & Residual – Tab D2

Due to the extent of construction, the Garrison LEARNS Corridor project is assumed to have a service life beyond the analysis period (i.e., a 30-year service life as compared to a 20-year analysis period). Because of this, a residual capital value was calculated for the Alternative, which was then applied as a benefit using linear depreciation. The total benefit associated with the residual value is approximately \$7.9 million undiscounted, or approximately \$3.7 million using a 3.1% discount rate.

## Safety – Tab E

The Alternative improves safety by lowering speed limits by 10 miles per hour (MPH), replacing the two-way left turn lane with a raised median, reducing travel lane width, providing bike lanes, improving pedestrian crossings, adding sidewalks, improving lighting, and installing a traffic signal. These measures reduce the propensity and severity of crashes involving vehicles, bicyclists, and pedestrians.

Crash data along Garrison Boulevard for the five-year period of May 2018 to April 2023 was collected from the North Carolina Department of Transportation (NCDOT) Traffic Engineering Accident Analysis System (TEAAS) and reviewed within the project study limits. A total of 189 crashes occurred along the corridor during the review period. Of those crashes, none resulted in a fatality and 54 resulted in injury or possible injury.

This project will include a variety of countermeasures to improve safety along the corridor. Based on a review of the FHWA Crash Modification Factors (CMF) Clearinghouse, four CMFs were chosen for the BCA as seen in **Table 3**. The benefits of the project were quantified by applying CMFs for replacing a two-way left turn lane with a raised median, converting 12-foot lanes to 11-foot lanes, lowering the speed limit by 10 MPH, and installing a traffic signal. CMFs with at least a 3-star rating were selected where possible. The safety countermeasures were applied to certain segments of the project site, depending on where the improvements were made.

**Table 3 Crash Modification Factor Methods**

CMF Name	CMF ID	CMF	Star Quality	Crash Severity	Crash Type	Project Application
Replace Two-Way Left Turn Lane with Raised Median	2514	0.77	3	All	All	Garrison Blvd from Fern Forest Dr to New Hope Rd
Convert 12-Foot Lanes to 11-Foot Lanes	7825	0.76	3	All	All	Garrison Blvd from Fern Forest Dr to New Hope Rd
Lower Posted Speed by 10 MPH	1239	0.96	2	All	All	Garrison Blvd from Fern Forest Dr to New Hope Rd
Install a Traffic Signal	7848	0.61	4	All	All	Intersection of Garrison Blvd and Laurel Ln

Source: Vehicle Crash Modification Factors (CMF): Crash Modification Factors Clearinghouse ([www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)).

The historic crash data were segmented to apply the correct countermeasures on the specific sites. **Table 4** describes the segmentation of the crashes, the applicable countermeasures for the improvements, and the countermeasures used. Application of CMFs was limited to three per segment to avoid overestimating the crash reduction. While not captured by the CMFs, additional safety benefit is expected from installing bicycle lanes, enhancing roadway lighting, improving the Avon/Catawba Creeks Greenway underpass, installing sidewalk on the south side of the corridor, installing high-visibility crosswalks at signalized intersections, and adding pedestrian countdown timers to approaches currently without them. These treatments were not quantified because a CMF was not available, current Highway Safety Manual (HSM) guidance recommends not combining more than three CMFs at a single site, and/or there was not a reported crash history addressed by the applicable CMF (e.g., crossing improvements at a site without a recent crash involving a crossing pedestrian). These treatments are discussed further in the Factors Not Quantified section.



**Table 4 Safety Analysis Segments**

Segment Location	Applied CMF(s)	Combined CMF	Number of Crashes	BCA Tab
Garrison Blvd: Fern Forest Dr to New Hope Rd	2514; 7825; 1239	0.56	181	E-1
Intersection of Garrison Blvd and Laurel Ln	7825; 7848	0.46	8	E-2

Source: NCDOT Traffic Engineering Accident Analysis System (TEAAS)

The USDOT guidance includes monetization values for crashes following the KABCO severity levels. These values are provided in **Table 5**.

**Table 5 USDOT Guidance on Crash Severity Monetization Value**

KABCO Level		Monetized Value (2022 \$)
<b>K</b>	Killed	\$12,500,000
<b>A</b>	Incapacitating	\$1,188,200
<b>B</b>	Non-Incapacitating	\$233.800
<b>C</b>	Possible Injury	\$111,700
<b>O</b>	No Injury/Property Damage Only	\$5,000
<b>U</b>	Injured (Severity Unknown)	\$217,600

Source: USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2024

The average annual number of crashes was calculated based on the availability crash data. The cost per entering vehicle on the corridor based on crash severity was developed applying USDOT guidance and AADT estimates.

The rate of annual crashes was assumed to remain constant over time and consistent with the historical corridor performance. Based on these factors, over a 20-year operating period, the total safety benefits, which can be monetized at \$11.9 million, or \$7.5 million at a 3.1% discount over the full analysis period, can be seen in **Table 6**.

**Table 6 Monetized Safety Benefit**

Segment	Total Benefit	Present Value (3.1% Discount Rate)
1	\$11.8M	\$7.5M
2	\$75k	\$48k

## Travel Time – Tab F

The Alternative will affect travel time along the facility through providing an additional signal at Laurel Lane and by restricting driveway turning movements with a center landscaped median, which will result in some traffic rerouting and an increase in left- and U-turns. In addition, the posted speed limit along the facility is planned to decrease from 45 MPH to 35 MPH. As a result, the Alternative is expected to increase weekday AM and PM peak hour delays. The number of annual trips was assumed to increase at a 0.25% compound annual growth rate for both the Baseline and Alternative. While a mode shift to increased walking and cycling is expected as part of this project, these non-auto trips are not expected to outweigh the effects of increased delay for vehicles in the Alternative when compared to the Baseline. The result of this is a cost, rather than a benefit, related to travel time with the Alternative.

Recommended Hourly Values of Travel Time Savings (2022 dollars per person-hour) were provided by the USDOT guidance as \$19.60 for all purposes and \$33.50 for truck drivers. An average vehicle occupancy for passenger vehicles during the weekday peak was provided by USDOT guidance of 1.67. Commercial vehicle occupancy was assumed to be 1.0. The heavy vehicle percentage of the facility is estimated to be 7.0%, as indicated by traffic counts collected along the facility in May 2023. The average annual weekday peak delay, average vehicle hours traveled (VHT) savings, and average person delay savings for passenger vehicles and trucks can be seen in **Table 7**. Negative values indicate a cost instead of a savings.

**Table 7 Travel Time Savings Values**

Mode	Annual Weekday Peak Delay		
	Avg. VHT Savings (Vehicles)	Avg. Delay Savings (Persons)	Total Delay Savings (\$)
Passenger Vehicle	-25,514	-37,760	-\$740,105
Heavy Vehicle/Truck	-1,920	-1,920	-\$64,333

Based on these factors, over a 20-year operating period, the total vehicle travel time cost was monetized at approximately \$804,000, or \$506,000 using a 3.1% discount rate, over the full analysis period.

## Decreased Auto Usage – Tab G

With an anticipated shift in some automobile trips to pedestrian and bicyclist trips, a decrease in passenger vehicle usage is expected to result in vehicle operating cost savings. The USDOT guidance estimates a recommended value of \$0.52 per mile for light duty vehicles. This value includes operating costs such as gasoline, maintenance, tires, and depreciation.

The Alternative is predicted to reduce weekday passenger vehicle trips by approximately 1.2 million over the course of the 20-year operating period, or an average of approximately 61,000 trips per year. While the average one-way commuter distance is estimated to be greater than ten miles for this project area according to the US Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) data from 2021, it is assumed that most vehicular trips replaced by walking or cycling will be shorter distance trips. Therefore, a trip distance savings of 1.37 miles—equal to the project length—was assumed for a more conservative approach. This results in an average annual reduced automobile commute distance of approximately 168,000 miles, or 3.4 million miles throughout the entirety of 20-year operating period, assuming 2.74 miles for a two-way trip.

Based on these factors, the total benefit from decreased auto usage was monetized at approximately \$1.7 million, or \$1.1 million using a 3.1% discount rate, over the full operating period.

## Environmental Benefits – Tab H

The overall reduction in the number of single-occupant vehicles (SOVs) on the corridor is expected to reduce emissions. Emissions reductions based on the reduction in the number of SOVs were calculated based on the annual vehicle miles traveled (VMT) savings using VMT projections from the year 2028 through the year 2047. In the Alternative, the increased network connectivity is expected to result in a total of approximately 1.8M fewer miles traveled over the analysis period.

The delay time was conservatively assumed to be spent at idle to only include the minimum amount of emission reduction possible in the Alternative. Mileage-dependent emissions rates were obtained from the Environmental Protection Agency's (EPA) Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks for nitrogen oxides (NO<sub>x</sub>), particulate matter (PM<sub>2.5</sub>), and sulfur dioxide (SO<sub>2</sub>). Additional carbon dioxide (CO<sub>2</sub>) emissions rates for each passenger vehicles and trucks were obtained from research sources provided in the backup materials. Damage costs for pollutant emissions from USDOT guidance were used to calculate savings in the Build Alternative.

The total benefit associated with the emissions reduction was monetized at \$2.2 million, or \$1.4 million using a 3.1% discount rate, over the full analysis period.

## Health Benefit – Tab I

The use of active transportation can lead to positive health outcomes for users, such as improved cardiovascular health. A key health outcome produced by the USDOT guidance is a reduction in mortality risk for users that are induced to active transportation modes, such as walking and biking, from inactive modes, such as driving.

The USDOT guidance provides a recommended value for monetizing reduced mortality risks associated with increased walking and biking for included trips as seen in **Table 8**. The values are only applicable to populations within certain age ranges. A national average proportion was applied to the bicycle and walking trips. The reduced mortality benefits are only applied to the number of users switching from non-active transportation modes to active transportation modes.

**Table 8 Mortality Reduction Benefits of Induced Active Transportation Values**

Mode	Recommended Value per Induced Trip (2022 \$)	Applicable Age Range	Proportion of Expected Users Falling into the Age Range
Walking	\$7.63	Ages 20-74	68%
Bicycling	\$6.80	Ages 20-64	59%

Source: USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2024

The Alternative improves active transportation by providing new bike lanes, new sidewalks, and new and enhanced crossings in the project area. This will result in an increase in mode split and induce users from the inactive transportation mode. The increase in average annual daily trips, average annual trips, and average induced trips in the applicable age range for bicycle and pedestrian modes can be seen in **Table 9**.

**Table 9 Total Increase in Active Transportation Trips**

Mode	Total AADT Increase	Total Annual Trips	Total Induced Trips in Age Range
Walking	1,450	529k	360k
Bicycling	3,587	1.3M	773k

Over a 20-year operating period, the total health benefit was monetized at \$7.1 million, or \$4.5 million using a 3.1% discount rate, over the full analysis period.

## Real Estate – Tab J

An improved multimodal network to access many of the City of Gastonia’s key civic destinations is likely to increase adjacent property values for nearby parcels. The proposed improvements to walking and biking facilities, reduced speeds, and crossing improvements will create a more livable environment and will make these areas more accessible for people walking, biking, and accessing transit. Appraisal data was obtained for all parcels adjacent to the corridor from Gaston County. Commercial parcels often see increased rental rates when a multimodal project is implemented. Similar projects have been seen to increase values by 10%. This 10% increase was applied only to mixed use and commercial sites

immediately adjacent (33 parcels) to the study area. Over a 20-year operating period, the total real estate benefit was monetized at \$1.2 million, or \$1.0 million using a 3.1% discount rate, over the full analysis period.

## **Maintenance – Tab K**

The City of Gastonia provided estimated maintenance costs for the Baseline and Alternative. Reconstructing Garrison Boulevard will provide overall maintenance expenditure savings. The largest savings comes from needing one less mill and pave asphalt rehabilitation within the analysis period. The elimination of the center-turn lane from the Baseline condition in the Alternative also reduces asphalt and striping maintenance costs. Increased maintenance costs associated with the Alternative include the maintenance of an additional signal at Laurel Lane, pavement markings for bicycle symbols, new pavement associated with U-turn bulbs, and maintaining the planted median. These increases are more than offset by the previously noted savings. Over a 20-year operating period, the total maintenance costs benefit was monetized at \$1.4 million, or \$1.1 million using a 3.1% discount rate, over the full analysis period.

## **Amenity Comfort Benefit – Tab L**

Improvements to pedestrian and cycling facilities often provide amenities that can improve the quality or comfort of journeys made by active transportation users. Over a 20-year operating period, the total pedestrian and bicycle benefits were monetized at \$8.7 million, or \$5.5 million using a 3.1% discount rate, over the full analysis period.

### **PEDESTRIAN FACILITIES**

The increased comfort of specific pedestrian infrastructure can be assessed as a valued benefit. New sidewalks, speed reduction, the greenway underpass, and the new pedestrian bridge are key facilities that directly affect the comfort, convenience, and safety of the facility for pedestrian use.

The estimated value per projected pedestrian trip should be capped at 0.86 miles, the average length of a walking trip in the 2017 National Household Travel Survey. The Alternative provides 1.37 miles of new 5-foot-wide sidewalks, a 10 MPH speed limit reduction, and two new grade-separated crossings. These new facilities provide a \$2.1 million value in pedestrian comfort over the study period.

### **CYCLING FACILITIES**

Dedicated cycling facilities can improve journey quality and comfort for cyclists. The estimated value per projected cyclist on a proposed facility should be capped at 2.38 miles, the average length of a cycling trip in the 2017 National Household Travel Survey.

New bicycle facilities for the Alternative include 1.37 miles of bike lanes on both sides of Garrison Boulevard between Fern Forest Drive and New Hope Road. These new facilities provide a \$6.6 million value in cyclist comfort over the study period.

## Noise & Congestion – Tab M

Noise pollution occurs from high levels of environmental sound that may annoy, distract, or even harm people and animals. The Alternative will lower levels of noise generated by current transportation activity by reducing roadway noise from a decrease in auto average annual daily trips and decreased speed limits. Monetized values for noise and congestion reduction are provided by the USDOT Guidance and shown in **Table 10**.

**Table 10 External Highway Use Costs: Noise and Congestion Values**

Vehicle Type and Location	Recommended Value of Cost per Vehicle Mile Traveled (2022 \$)	
	Congestion	Noise
Light-Duty Vehicles – Urban	\$0.138	\$0.0019
Light-Duty Vehicles – Rural	\$0.029	\$0.0002
Light-Duty Vehicles – All Locations	\$0.116	\$0.0011
Buses and Trucks – Urban	\$0.345	\$0.0437
Buses and Trucks – Rural	\$0.075	\$0.0037
Buses and Trucks – All Locations	\$0.236	\$0.0220
All Vehicles – Urban	\$0.154	\$0.0051
All Vehicles – Rural	\$0.036	\$0.0007
All Vehicles – All Locations	\$0.128	\$0.0031

The Alternative improves noise and congestion by decreasing the annual auto trips and vehicles miles traveled. A trip distance of 0.69 miles, or half the project length, was assumed for a one-way trip, and 1.37 for a two-way trip. Over a 20-year operating period, the total noise and congestion reduction benefit was monetized at approximately \$328,000, or \$207,000 using a 3.1% discount rate, over the full analysis period.

## Factors Not Quantified

Several factors were not quantified as part of the analysis but provide additional benefits beyond those quantified above. Unquantified benefits of the corridor project include:

- Safety:** There are several safety benefits associated with the project that were not quantified in the safety benefit analysis. These safety features were excluded either due to the lack of a CMF (or

historical crash data that would be impacted by a CMF) to quantify safety benefits or to avoid overestimating combined CMFs and safety benefits along the corridor. Additional features of the corridor project expected to provide a safety benefit include:

- *Two grade separated crossings (Avon/Catawba Creeks Greenway & Pedestrian Bridge at Grier Middle School/Gaston County Public Library)* – There were not any pedestrian crashes at these locations during the 5-year crash analysis period. Providing grade-separated crossings at these locations with high pedestrian volumes will likely reduce the risk of future crashes occurring.
  - *Pedestrian countdown timers* – There is a CMF for pedestrian countdown timers, however it applies to converting full intersections and the corridor only needs spot improvements, so to be conservative, the CMF was not used.
  - *Bike lanes* – The CMF for adding bike lanes also includes lane narrowing, so to not double count benefits, only the CMF for lane narrowing was used. The bike lanes provide the additional benefit of improving pedestrian safety and comfort by providing more distance from moving vehicles. This benefit was also not quantified.
  - *A complete sidewalk network* – There is a CMF for adding sidewalk, but there have not been any reported crashes in the last five years that would be affected by the sidewalk addition, so the benefits of preventing future crashes could not be quantified.
  - *High-visibility crosswalks at all signalized and midblock crossing locations* – Again, there were no reported crashes at these locations, so the benefit of preventing future crashes could not be quantified.
- **ADA compliance:** Reconstruction of curb ramps and repairing/adding sidewalk along the corridor will make the corridors ADA compliant and create a more consistent, level surface for pedestrians.
  - **Landscaping:** The addition of green space in the medians and buffer spaces will further reduce emissions beyond those quantified in the environmental benefits. More pervious area will reduce the amount of stormwater runoff and help reduce urban heat island effects.
  - **Lighting:** The Alternative assumes a complete reinstallation of new lighting. As previously mentioned, this new lighting is expected to provide safety benefits for pedestrians, cyclists, and motorists. Additionally, replacing existing roadway lighting with more energy efficient lighting is expected to reduce maintenance costs; however, the expected reduction in costs was not available at the time of this analysis.
  - **Aesthetics:** The addition of the pedestrian bridge connecting the Schiele Museum and Grier Middle School to the Gaston County Library will create a signature new gateway feature for the Garrison LEARNS Corridor, providing an aesthetic and identity benefit that was not quantified.
  - **Economic Development:** In other similar contexts, multimodal improvement projects such as this have helped to spur economic development – infill development and redevelopment of properties adjacent to the corridor. This is a benefit to adjacent property owners, local business owners, developers, and the future tax base, above and beyond the one-time increase in real estate values that was quantified.

# BCA Results

The results of the BCA conducted for the Garrison LEARNS Corridor are presented in terms of a benefit-cost ratio (BCR) and a net present value (NPV). A BCR greater than 1.0 and NPV greater than \$0 mean that quantified project benefits outweigh project costs. The larger the BCR and NPV, the greater the quantified benefits of the project. The BCR provides the amount of benefit per unit cost, which can be useful for identifying the highest dollar for dollar benefit when comparing projects.

The results of the BCA for the project, calculated using the methodology described above, are presented in the table below. The results are shown both without any discount applied and with a 3.1% discount. As can be seen in **Table 11**, there are substantial benefits associated with the project.

**Table 11 BCA Results**

	Benefits	Costs	BCR	NPV
Undiscounted	\$41.8M	\$23.8M	1.75	\$18.0M
3.1% Discount	\$25.6M	\$21.0M	1.22	\$4.6M