V. Appendix

2021 Raise Grant Application

City of Tuscaloosa University Boulevard Corridor Project

Business-Cost Analysis Technical Memo

July 2021

Contents

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This benefit-cost analysis (BCA) was conducted for the City of Tuscaloosa University Boulevard Corridor Project. To the maximum extent possible given available data, the formal BCA prepared in connection with this RAISE grant application reflects quantifiable economic benefits. All analyses contain live formulas, clear documentation of assumptions, and assume 2019 constant dollars. To conduct the analysis, all provided cost estimates were deflated to 2019 dollar values. The results of the BCA presented in this document were inflated to 2021 dollar values. All the calculations and results are included in the spreadsheets accompanying this document.

Separate BCAs were conducted for the seven segments of the Tuscaloosa University Boulevard Corridor Project as described in the scope of work. Table 1 in this Memo presents quantifiable benefits for each for the seven segments. Table 2 presents the cumulative BCA results for the entire program, provided the benefits and costs for all the seven segments of the University Boulevard are considered in the aggregate.

Table 1. BCA Summary

University Boulevard Corridor Segment	Types of quantifiable Economic Impacts	Affected Populations	Quantifiable Economic benefits
University Boulevard East Sidewalk Improvement Project	Installation of curbs, and roadway lighting improvements reduce the number of crashes involving vehicles, bicycles, and pedestrians	Local drivers, bicyclists, and pedestrians	Safety benefits: reduction in vehicle, bicycle, and pedestrian crashes
Underground Utility Installation	Lighting improvements reduce the number of crashes involving vehicles, bicycles, and pedestrians	Local drivers, bicyclists, and pedestrians	Safety benefits: reduction in vehicle, bicycle, and pedestrian crashes
University Boulevard Security Enhancements	Installation of bike lanes and curbs, and lighting improvements reduce the number of crashes involving vehicles, bicycles, and pedestrians (for this segment, these quantifiable benefits are included in the University Boulevard Section III safety benefits calculations). Resurfacing of this portion of University Boulevard will generate additional safety	Local drivers, bicyclists, and pedestrians	Safety benefits: reduction in vehicle, bicycle, and pedestrian crashes

	benefits by reducing the number of crashes on this segment.		
Landscape Improvements	Lighting improvements and curbs installation reduce the number of crashes involving vehicles, bicycles, and pedestrians	Local drivers, bicyclists, and pedestrians	Safety benefits: reduction in vehicle, bicycle, and pedestrian crashes
Western University Boulevard Corridor Improvements Section I	Installation of a landscaped median and curbs, and lighting improvements reduce the number of crashes involving vehicles, bicycles, and pedestrians	Local drivers, bicyclists, and pedestrians	Safety benefits: reduction in vehicle, bicycle, and pedestrian crashes
Western University Boulevard Corridor Improvements Section II	Installation of bike lanes and curbs, and lighting improvements reduce the number of crashes involving vehicles, bicycles, and pedestrians	Local drivers, bicyclists, and pedestrians	Safety benefits: reduction in vehicle, bicycle, and pedestrian crashes
Western University Boulevard Corridor Improvements Section III	Installation of bike lanes and curbs, and lighting improvements reduce the number of crashes involving vehicles, bicycles, and pedestrians	Local drivers, bicyclists, and pedestrians	Safety benefits: reduction in vehicle, bicycle, and pedestrian crashes

The calculations of safety benefits were conducted using crash data recorded over the time period between 2015-2019 on the seven segments of the University Boulevard listed below. No crash statistics from 2020 were used for this analysis because in 2020, there were significant reductions in the number of crashes due to decreased travel as a result of the COVID-19 pandemic.

- University Boulevard East Sidewalk Improvement Project -30th Avenue East to Crescent Ridge Road
- Underground Utility Installation - 20th Avenue to 21st Avenue
- University Boulevard Security Enhancements - Gene Stallings Avenue to Frank Thomas Avenue
- Landscape Improvements - Lurleen Wallace Boulevard North to Greensboro Avenue
- Western University Boulevard Corridor Improvements Section I - 21st Avenue to Queen City Avenue
- Western University Boulevard Corridor Improvements Section II - Queen City Avenue to Reed Street
- Western University Boulevard Corridor Improvements Section III - Reed Street to Wallace Wade Avenue

Some of the improvements included in the scope of work for each of the seven segments of the Tuscaloosa University Boulevard Corridor Project do not result in any quantifiable economic benefits and therefore were not included in the economic benefits calculations. Particularly, the calculations of economic benefits from the following improvements were not included in the BCA: decorative improvements, irrigation, landscaping, improvement of traffic light loop detectors and cameras operations, traffic light signal head adjustments, demolition of existing elements, conduit for underground utilities, water main and sanitary sewer relocation, installation of retractable bollards, and roadway signing and striping. Although these improvements may definitely have a positive impact on the communities affected by the project and improve the quality of life of community members, they may not significantly affect mobility, traffic volume, travel time, speed or safety within the study area.

Additionally, the calculations of economic benefits from the installation of sidewalks were not included in the analysis for several reasons explained below. All segments of the study area, except for the University Boulevard East Sidewalk Improvement Project segment, currently have sidewalks installed. Although improving the condition of existing sidewalks may improve the quality of life in the communities affected by the project, mobility, traffic volume, travel time, speed or safety may not be significantly affected. There are currently no sidewalks installed along the East Sidewalk Improvement Project segment of University Boulevard. However, the calculations of the benefits from sidewalk installation on this segment were omitted because our analysis of the crash data recorded from 2015-2019 for the portion of University Boulevard between 30th Avenue East to Crescent Ridge Road showed that there have not been any crashes involving pedestrians recorded on this segment during the specified time period. Since all the crash modification factors (CMF) that were identified for this analysis using the CMF Clearinghouse database are to be used for computation of the effect of sidewalk installation on pedestrian crashes, it would not be possible to use any of these CMFs to compute the effect of sidewalk installation on other types of crashes (such as vehicle-to-vehicle, vehicle-to-bicycle, and others). Second, a more complex analysis would be needed to examine the effect of sidewalk installation on crash statistics within the study segment of University Boulevard. Previous research shows that sidewalk installation may help reduce the number of crashes involving pedestrians, assuming that the volume of pedestrians walking along the studied segment of road remains the same (McMahon, 2002). However, in many cases, it may be expected that the installation of sidewalks may encourage more pedestrian traffic in the area which in turn may lead to an increase in the number of crashes on the studied segment of the road (Alluri et al., 2017; Raihan et al., 2019). Since the effect of sidewalk installation on crash statistics in the study area is unclear without a more extensive analysis, the calculation of safety benefits from sidewalk installation were omitted from this study.

Benefit Cost Analysis

The benefit-cost ratios for the City of Tuscaloosa University Boulevard Corridor Project were computed using a seven percent real discount rate recommended by the Benefit-Cost Analysis Guidance for Discretionary Grant Programs. The BCA compares the capital construction costs to

the quantifiable benefits of the project for an analysis period of 21 years with construction occurring in the first year. The quantifiable economic benefits include safety benefits from a reduced number of crashes as a result of proposed improvements.

For the following segments of the project, construction is expected to start in 2022, and project benefits are expected to begin in 2023: (1) Landscape Improvements (Lurleen Wallace Boulevard North to Greensboro Avenue), (2) Underground Utility Installation (20th Avenue to 21st Avenue), (3) Security Enhancements (Gene Stallings Avenue to Frank Thomas Avenue), and (4) Western University Boulevard Corridor Improvements Section I (21st Avenue to Queen City Avenue). For the following segments of the project, construction is expected to start in 2023, and project benefits are expected to begin in 2024: (1) Western University Boulevard Corridor Improvements Section II (Queen City Avenue to Reed Street), and (2) Western University Boulevard Corridor Improvements Section III (Reed Street to Wallace Wade Avenue). The safety benefits from lighting improvements, curbs installation and bike lanes installation completed on the segment of University Boulevard between Gene Stallings Avenue and Frank Thomas Avenue were included in the economic benefits calculations completed for the Western University Boulevard Corridor Improvements Section III (Reed Street to Wallace Wade Avenue) to avoid double-counting of these benefits. For the University Boulevard East Sidewalk Improvement Project (30th Avenue East to Crescent Ridge Road), the construction is expected to start in 2024 and project benefits are expected to begin in 2025.

Discount Rates

Federal guidance recommends that applicants discount future benefits and costs and present discounted rates of both the stream of benefits and the stream of costs. For this analysis, final streams of benefits and costs are presented at a seven percent discounted rate.

Project Description and Cost Estimates

This analysis includes the following segments of the Tuscaloosa University Boulevard Corridor Project:

- University Boulevard East Sidewalk Improvement Project - 30th Avenue East to Crescent Ridge Road
- Underground Utility Installation - 20th Avenue to 21st Avenue
- University Boulevard Security Enhancements - Gene Stallings Avenue to Frank Thomas Avenue
- Landscape Improvements - Lurleen Wallace Boulevard North to Greensboro Avenue
- Western University Boulevard Corridor Improvements Section I - 21st Avenue to Queen City Avenue
- Western University Boulevard Corridor Improvements Section II - Queen City Avenue to Reed Street
- Western University Boulevard Corridor Improvements Section III - Reed Street to Wallace Wade Avenue

For BCA calculations, all 2021 dollar amounts were deflated to 2019 dollars as recommended by the 2021 Benefit-Cost Analysis Guidance for Discretionary Grant Programs. For convenience, below are presented the BCA results of the entire program that includes all the seven segments of the Tuscaloosa University Boulevard Corridor Project, in both 2021 dollars (Table 2) and 2019 dollars (Table 3).

In 2021 dollars, total project costs, including annual maintenance costs over the 20-year period were estimated at $36.2 million (undiscounted). At a seven percent discount rate, the total project cost is $27.8 million. Total project benefits were estimated at $68.7 million. At seven percent discount rate, the total project benefits are $27.1 million. The project benefit-cost ratio (undiscounted) is 1.899. The benefit-cost ratio discounted at 7% is 0.976. The net present value of the project is $32.5 million. At seven percent discount rate, the net present value of the project is -$0.68 million. Table 2 below provides a brief summary of estimated project construction costs, project benefits, benefit/cost ratios and net present values (NPV) for each project included in the analysis.

Table 2. Tuscaloosa University Boulevard Corridor Project BCA (2021 $)

Project	Project Benefits (Undiscounted)	Project Benefits (Discounted at 7%)	Project Costs (Undiscounted)	Project Costs (Discounted at 7%)
University Boulevard East Sidewalk Improvement Project	$20,886,057.9	$7,934,769.02	$11,992,700.00	$8,716,760.46
Underground Utility Installation	$2,306,325.9	$932,744.35	$142,980.00	$124,884.27
University Boulevard Security Enhancements	$132,156.5	$61,143.68	$1,452,750.00	$1,268,888.11
Landscape Improvements	$8,763,746.2	$4,054,644.59	$357,000.00	$201,729.23
Western University Boulevard Corridor Improvements Section I	$9,614,202.0	$4,277,887.46	$6,630,000.00	$5,367,797.83
Western University Boulevard Corridor Improvements Section II	$22,266,999.9	$7,714,850.02	$8,280,000.00	$6,418,733.00
Western University Boulevard Corridor Improvements Section III	$4,685,631.2	$2,124,429.85	$7,300,000.00	$5,677,780.78
Total	$68,655,119.7	$27,100,468.97	$36,155,430.0	$27,776,573.7
Benefit/Cost Ratio, Undiscounted:				**1.899**
Benefit/Cost Ratio, Discounted at 7%:				**0.976**
NPV, Undiscounted:				**$32,499,688**
NPV, Discounted at 7%:				**-$676,105**

In 2019 dollars, total project costs, including annual maintenance costs over the 20-year period were estimated at $34.9 million (undiscounted). At a seven percent discount rate, the total project cost is $26.8 million. Total project benefits were estimated at $66.2 million. At seven percent discount rate, the total project benefits are $26.1 million. The project benefit-cost ratio (undiscounted) is 1.899. The benefit-cost ratio discounted at 7% is 0.976. The net present value of the project is $31.4 million. At seven percent discount rate, the net present value of the project is -$0.65 million. Table 3 below provides a brief summary of estimated project construction costs, project benefits, benefit/cost ratios and net present values (NPV) for each project included in the analysis.

Table 3. Tuscaloosa University Boulevard Corridor Project BCA (2019 $)

Project	Project Benefits (Undiscounted)	Project Benefits (Discounted at 7%)	Project Costs (Undiscounted)	Project Costs (Discounted at 7%)
University Boulevard East Sidewalk Improvement Project	$20,139,521	$7,651,154	$11,564,041	$8,405,195
Underground Utility Installation	$2,223,890	$899,405	$137,869	$120,420
University Boulevard Security Enhancements	$127,433	$58,958	$1,400,824	$1,223,534
Landscape Improvements	$8,450,501	$3,909,718	$344,240	$194,519
Western University Boulevard Corridor Improvements Section I	$9,270,559	$4,124,982	$6,393,022	$5,175,935
Western University Boulevard Corridor Improvements Section II	$21,471,103	$7,439,096	$7,984,045	$6,189,306
Western University Boulevard Corridor Improvements Section III	$4,518,151	$2,048,496	$7,039,074	$5,474,838
Total	**$66,201,158**	**$26,131,808**	**$34,863,115**	**$26,783,747**
Benefit/Cost Ratio, Undiscounted:				**1.899**
Benefit/Cost Ratio, Discounted at 7%:				**0.976**
NPV, Undiscounted:				**$31,338,043**
NPV, Discounted at 7%:				**-$651,938**

The next section of this memo presents the results of BCAs completed separately for each of the seven segments of the project.

Benefit-Cost Ratios

Although all the BCA calculations were performed assuming 2019 constant dollars, as recommended by the 2021 Benefit-Cost Analysis Guidance for Discretionary Grant Programs, all the BCA dollar values in the tables below were inflated to 2021 dollars. All the calculations and results assuming 2019 are included in the spreadsheets accompanying this document.

Table 4 summarizes the University Boulevard East Sidewalk Improvement Project costs and the quantifiable benefits of the project in terms of net present value. The total project costs are estimated at $11.99 million undiscounted and $8.7 million at a seven percent discount rate. The total project costs include construction costs as well as maintenance cost over the 20-year period. The project segment includes the portion of University Boulevard from 30th Avenue East to Crescent Ridge Road. The project scenario has a net present value of $8.9 million undiscounted and -$0.78 million at a seven percent real discount rate. The benefit cost ratio of the University Boulevard East Sidewalk Improvement Project is 0.91 discounted at seven percent.

Table 4. University Boulevard East Sidewalk Improvement Project BCA (2021 $)

Category	Undiscounted	Present Value at 7%
Construction Costs	$7,712,700.00	$6,736,570.88
Maintenance Costs	$4,280,000.00	$1,980,189.58
Total Estimated Costs	$11,992,700.00	$8,716,760.46
Safety Benefits	$20,886,057.89	$7,934,769.02
Total Evaluated Benefits	$20,886,057.89	$7,934,769.02
NPV	$8,893,358	($781,991)
B-C Ratio	1.742	0.910

Table 5 summarizes the University Boulevard Underground Utility Installation Project costs and the quantifiable benefits of the project in terms of net present value. The total project costs are estimated at $0.14 million undiscounted and $0.12 million at a seven percent discount rate. The project segment includes the portion of University Boulevard from 20th Avenue to 21st Avenue. The project scenario has a net present value of $2.2 million undiscounted and $0.8 million at a seven percent real discount rate. The benefit cost ratio of the University Boulevard East Sidewalk Improvement Project is 7.5 discounted at seven percent.

Table 5. University Boulevard Underground Utility Installation Project BCA (2021 $)

Category	Undiscounted	Present Value at 7%
Construction Costs	$142,980	$124,884
Evaluated Benefits		
Safety Benefits	$2,306,326	$932,744
Total Evaluated Benefits	$2,306,326	$932,744
NPV	$2,163,346	$807,860
B-C Ratio	16.130	7.469

Table 6 summarizes the University Boulevard Security Enhancements Project costs. The project segment includes the portion of University Boulevard from Gene Stallings Avenue to Frank

Thomas Avenue. Some of the quantifiable benefits of the project (specifically, safety benefits from lighting improvement, bike lanes and curbs installation) are included in the Western University Boulevard Corridor Improvements Section III (Reed Street to Wallace Wade Avenue) segment of the program to avoid double-counting of these benefits. In the BCA results table below, only safety benefits from resurfacing of the portion of University Boulevard between Gene Stallings Avenue and Frank Thomas Avenue were included. The total project costs are estimated at $1.5 million undiscounted and $1.3 million at a seven percent discount rate. The project scenario has a net present value of -$1.32 million undiscounted and -$1.2 million at a seven percent real discount rate. The benefit cost ratio of the University Boulevard Underground Utility Installation Project is 0.048 discounted at seven percent.

Table 6. University Boulevard Security Enhancements Project BCA (2021 $)		
Category	**Undiscounted**	**Present Value at 7%**
Construction Costs	$1,452,750	$1,268,888
Evaluated Benefits		
Safety Benefits	$132,157	$61,144
Total Evaluated Benefits	$132,157	$61,144
NPV	($1,320,593)	($1,207,744)
B-C Ratio	0.091	0.048

Table 7 summarizes the University Boulevard Landscape Improvements Project BCA costs and the quantifiable benefits of the project in terms of net present value. The project segment includes the portion of University Boulevard from Lurleen Wallace Boulevard North to Greensboro Avenue. The total project costs include construction costs as well as maintenance cost over the 20-year period. The total project costs are estimated at $0.35 million undiscounted and $0.2 million at a seven percent discount rate. The project scenario has a net present value of $8.4 million undiscounted and $3.9 million at a seven percent real discount rate. The benefit cost ratio of the University Boulevard East Sidewalk Improvement Project is 20.1 discounted at seven percent.

Table 7. University Boulevard Landscape Improvements Project BCA (2021 $)		
Category	**Undiscounted**	**Present Value at 7%**
Construction Costs	$89,000	$77,736
Maintenance Costs	$268,000	$123,993
Total Estimated Costs	$357,000	$201,729
Evaluated Benefits		
Safety Benefits	$8,763,746	$4,054,645
Total Evaluated Benefits	$8,763,746	$4,054,645
NPV	$8,406,746	$3,852,915
B-C Ratio	24.548	20.099

Table 8 summarizes the Western University Boulevard Corridor Improvements Section I costs and the quantifiable benefits of the project in terms of net present value. The project segment includes the portion of University Boulevard from 21st Avenue to Queen City Avenue. The total project costs are estimated at $6.6 million undiscounted and $5.4 million at a seven percent discount rate.

The total project costs include construction costs as well as maintenance cost over the 20-year period. The project scenario has a net present value of $2.9 million undiscounted and -$1.1 million at a seven percent real discount rate. The benefit cost ratio of the Western University Boulevard Corridor Improvements Section I is 0.797 discounted at seven percent.

Table 8. Western University Boulevard Corridor Improvements Section I Project BCA (2021 $)

Category	Undiscounted	Present Value at 7%
Construction Costs	$5,600,000	$4,891,257
Maintenance Costs	$1,030,000	$476,541
Total Estimated Costs	$6,630,000	$5,367,798
Evaluated Benefits		
Safety Benefits	$9,614,202	$4,277,887
Total Evaluated Benefits	$9,614,202	$4,277,887
NPV	$2,984,202	($1,089,910)
B-C Ratio	1.450	0.797

Table 9 summarizes the Western University Boulevard Corridor Improvements Section II costs and the quantifiable benefits of the project in terms of net present value. The project segment includes the portion of University Boulevard from Queen City Avenue to Reed Street. The total project costs are estimated at $8.3 million undiscounted and $6.4 million at a seven percent discount rate. The total project costs include construction costs as well as maintenance cost over the 20-year period. The project scenario has a net present value of $13.99 million undiscounted and $1.3 million at a seven percent real discount rate. The benefit cost ratio of the Western University Boulevard Corridor Improvements Section II is 1.2 discounted at seven percent.

Table 9. Western University Boulevard Corridor Improvements Section II Project BCA (2021 $)

Category	Undiscounted	Present Value at 7%
Construction Costs	$6,300,000.00	$5,502,663.99
Maintenance Costs	$198,000.00	$91,606.90
Total Estimated Costs	$8,280,000	$6,418,733.00
Evaluated Benefits		
Safety Benefits	$22,266,999.92	$7,714,850.02
Total Evaluated Benefits	$22,266,999.92	$7,714,850.02
NPV	$13,987,000	$1,296,117
B-C Ratio	2.689	1.202

Table 10 summarizes the Western University Boulevard Corridor Improvements Section III costs and the quantifiable benefits of the project in terms of net present value. The project segment includes the portion of University Boulevard from Reed Street to Wallace Wade Avenue. The total project costs are estimated at $8.3 million undiscounted and $6.4 million at a seven percent discount rate. The total project costs include construction costs as well as maintenance cost over the 20-year period. The project scenario has a net present value of -$2.6 million undiscounted and

-$3.5 million at a seven percent real discount rate. The benefit cost ratio of the Western University Boulevard Corridor Improvements Section II is 0.37 discounted at seven percent.

Table 10. Western University Boulevard Corridor Improvements Section III Project BCA (2021 $)

Category	Undiscounted	Present Value at 7%
Construction Costs	$5,600,000	$4,891,257
Maintenance Costs	$1,700,000	$786,524
Total Estimated Costs	$7,300,000	$5,677,781
Evaluated Benefits		
Safety Benefits	$4,685,631	$2,124,430
Total Evaluated Benefits	$4,685,631	$2,124,430
NPV	($2,614,369)	($3,553,351)
B-C Ratio	0.642	0.374

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