APPENDIX A

Benefit-Cost Analysis

MD 5 GREAT MILLS IMPROVEMENT PROJECT

BENEFIT-COST ANALYSIS SUPPLEMENTARY DOCUMENTATION

FY2021 RAISE DISCRETIONARY GRANT PROGRAM

PREPARED FOR: MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION (MDOT SHA)
JULY 12, 2021
PREPARED BY WSP USA

EXECUTIVE SUMMARY

A benefit-cost analysis (BCA) was conducted for the **MD 5 Great Mills Improvement Project** for submission to the U.S. Department of Transportation (U.S. DOT) as a requirement of a discretionary grant application for the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) 2021 program. The analysis was conducted 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 February 2021. The period of analysis corresponds to 26 years and includes 6 years of construction and 20 years of benefits after operations begin in 2028.

The Project serves as a principal connector for regional traffic to Great Mills Road (MD 246), a vital transportation link for local Science, Technology, Engineering, and Math (STEM) employment centers supporting activities on several military installations in the region. The Patuxent River Naval Air Station (NAS PAX) installation, located 3 miles from the Project area, employs 21,542 active-duty personnel, civilians, and contractors, many of whom rely on MD 5 for access to destinations around Washington, D.C. and Maryland and in the event of a state or national emergency.

With traffic in the project area predicted to increase by 27% by 2040, traffic condition in the Great Mills area will be significantly impacted, especially along MD 5 between MD 471 (Indian Bridge Road) and MD 246. The Project aims to reduce roadway crashes, reduce road congestion, and improve pedestrian connectivity with the expansion of a lane in each direction, the installation of bicycle lanes and sidewalks, the replacement of a bridge over the St. Mary's River, and the installation of a right turn prohibition from Old Great Mills Road onto MD 5.

COSTS

The capital cost for this Project is expected to be $27.6 million in year-of-expenditure dollars. After adjustment for inflation, the capital costs are estimated to be $24.5 million in undiscounted 2019 dollars. At a 7 percent real discount rate, these costs are $17.1 million in 2019 dollars. Table ES-1 shows how these costs are allocated across time and major expense category.

Table ES-1: Project Costs by Category and Year, in Undiscounted 2019 Dollars

Cost Category	2022	2023	2024	2025	2026	2027	Total
Planning and Design	$4,657,000	$596,000	$339,000	$112,000	-	-	$5,703,000
Right of Way	$1,313,000	$1,407,000	$1,304,000	$566,000	-	-	$4,590,000
Construction	-	-	-	-	$7,613,000	$3,360,000	$10,973,000
Utilities	$140,000	$1,191,000	$1,482,000	$440,000	-	-	$3,254,000
Total	**$6,110,000**	**$3,195,000**	**$3,124,000**	**$1,117,000**	**$7,613,000**	**$3,360,000**	**$24,519,000**
Total, Discounted 7%	***$4,987,000***	***$2,437,000***	***$2,228,000***	***$745,000***	***$4,741,000***	***$1,956,000***	***$17,093,000***

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA), WSP

Net operations and maintenance costs are projected to average $55,400 per year in undiscounted 2019 dollars in the "Build" and "No Build" scenarios. Over the entire 20-year operations period these costs accumulate to net zero change in operations and maintenance cost. Finally, net reductions in rehabilitation and replacement (R&R) costs are expected to total $275,400 in discounted 2019 dollars over this same period.

BENEFITS

In 2019 dollars, the project is expected to generate $23.6 million dollars in discounted benefits using a 7 percent discount rate. The project creates these benefits by increasing economic competitiveness and commuter mobility through reducing travel time and costs for drivers, transit users, and bicyclists. The project also enhances recreational mobility for bicyclists and health benefits for the community through reduction in emissions. Lastly, the project will reduce number of traffic crashes, thus elevating the safety around the region. This leads to an overall project Net Present Value of $6.5 million dollars and a Benefit Cost Ratio (BCR) of 1.38[1]. The overall project benefit matrix can be seen in Table ES-2.

Table ES-2: Project Impacts and Benefits Summary, Monetary Values in Millions of 2019 Dollars

Current Status/Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Type of Impact	Population Affected by Impact	Economic Benefit	Summary of Results (at 7% discount rate)	Page Reference in BCA
Congestion during peak-hour and detours related to flooding events result in longer travel time	More efficient vehicle movements and reduced detours shorten travel time per trip	Cost & Time Savings	Auto, Truck and Transit Users	Reduced travel time and costs for persons	$15.6	11
Detours related to congestion and flooding events result in higher fuel and maintenance costs	Reduced flooding impacts and efficient vehicle movements reduce detours	Operating Cost	Auto, Truck and Bus Owners	Reduction in costs for fuel and vehicle maintenance	$3.1	12
Congestion and dangerous road geometry results in crashes between vehicles and pedestrians	Segregated turn lanes and signaling improvements reduce roadway conflicts	# of Crashes	Road Users	Reduced crashes	$1.4	13
Detours and idling related to congestion and flooding events result in higher emissions	Reduced flooding impacts and efficient vehicle movements reduce detours	Emission reduction	Community and road users	Reduction in costs related to air pollution	$1.6	14

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[1] Per U.S. DOT guidance, operations and maintenance costs are included in the numerator along with other project benefits when calculating the benefit-cost ratio.

Current Status/Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Type of Impact	Population Affected by Impact	Economic Benefit	Summary of Results (at 7% discount rate)	Page Reference in BCA
Commuters discouraged from traveling through the project area due to lack of bicycling infrastructure	Bicycle infrastructure encourages new users and shortens commute time	Commuter Benefits	Bicyclists	Improved commuter connectivity	$0.1	15
Current infrastructure discourages recreational use by bicyclists	Improved bicycle infrastructure encourages growth in users	Improved Long-Term Health	Bicyclists	Reduced long-term health-related expenses	$0.4	15
In its current condition, the bridge and roadway require extensive repairs to maintain functionality	The construction of the bridge structure and roadway reduce the need for extensive repairs	Net O&M and R&R Costs	MDOT	Reduced maintenance costs	$0.5	18
The current bridge and roadway is at the end of its useful life, requires progressively expensive maintenance	The improved bridge and roadway extend the useful life of the existing facility	Asset Value	MDOT	Retained value of infrastructure investment	$0.9	19

Source: WSP, 2021

The overall Project impacts can be seen in Table ES-3, which shows the magnitude of change and direction of the various impact categories.

Table ES-3: Project Impacts for Project, Cumulative 2028 – 2047

Category	Unit	Quantity	Direction
Vehicle-Miles Traveled	VMT	23,986,635	▼
Person-Hours Traveled	PHT	3,072,472	▼
Fuel Consumed	gallons	4,484,245	▼
Fatalities	#	-	▼
Injuries	#	23	▼
Property Damage Only (PDO)	#	28	▼
CO2 Emissions	tons	39,927	▼
NOX Emissions	tons	1.52	▼
PM2.5 Emissions	tons	0.09	▼
SOX Emissions	tons	0.13	▼

In addition to the monetized benefits presented in Table ES-2, the Project would create the following qualitative benefits:

ECONOMIC COMPETITIVENESS

– As the region continues to grow, the expansion of employment sites and commercial operations will require reliable infrastructure to fulfill their economic development objectives. Reducing regional roadway congestion supports the development of local communities and the mission of the military installations affected by the roadway delays.

STATE OF GOOD REPAIR

– The project improvements are predicted to help reduce the severity and frequency of flooding events affecting the roadway, reducing the damage to the pavement, the bridge and regional water management systems.

ENVIRONMENTAL SUSTAINABILITY

– The project supports St. Mary County's efforts to comply with Maryland's Greenhouse Gas Emissions Reduction Acts Plan (GGRA). As such, the project will decrease vehicle idling along the corridor and leverage climate friendly design practices and material substitutions.

– The analysis does not directly quantify environmental benefits as a result of the project improvements, but the potential reduction in diverted traffic trips due to reductions in flooding events and daily roadway congestion would significantly reduce direct damages to the environment. The efficient diversion of floodwaters will reduce the harmful effects on the local plant and animal habitat.

EQUITABLE COMMUNITY DEVELOPMENT

– The project will provide increased access for underserved rural communities, access to job centers, and local schools.

QUALITY OF LIFE

– While the Great Mills project provides critical connections between military installations and growing businesses in the area, the corridor also connects important community landmarks, ranging from housing to public services to recreation spots. Improvements to the intersection and bridge within the project limits will help residents gain access to these community facilities and recreational amenities.

INCREASING TRANSPORTATION CHOICES FOR THE COMMUNITY

- The project will increase the number of options for individuals to utilize when commuting, playing, and travelling along the corridor. Added services include bike lanes, sidewalks, and general increased convenience of using public transportation.

JOB OPPORTUNITIES FOR DISADVANTAGED BUSINESSES

- The MDOT SHA Procurement Review Group (PRG) will review the proposed procurement solicitation for the MD 5 Great Mills construction project and will establish an appropriate recommendation for a DBE Goal for the project before the project solicitation is published.

While these benefits are not easily quantifiable, they do provide real advantages and improvements that will be experienced by individuals and businesses in the region.

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LIST OF TABLES

1 INTRODUCTION

A benefit-cost analysis (BCA) was conducted for the **MD 5 Great Mills Improvement Project** for submission to the U.S. Department of Transportation (U.S. DOT) as a requirement of a discretionary grant application for the RAISE 2021 program. The following section describes the BCA framework, evaluation metrics, and report contents.

1.1 BCA FRAMEWORK

A 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 Case 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 assesses the incremental difference between the Base Case and the Build Case, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare over a project lifecycle. 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 analysis was conducted in accordance with the benefit-cost methodology as recommended by the U.S. DOT in the 2021 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 base case as well as under the Build Case;
- Assessing the independent utility of each project if the overall application contains multiple separate projects linked together in a common objective;
- Estimating benefits and costs during project construction and operation, including 20 years of operations beyond the Project completion when benefits accrue;
- Using U.S. DOT recommended monetized values for reduced fatalities, injuries, property damage, travel time savings, and emissions, while relying on best practices for monetization of other benefits;
- Presenting dollar values in real 2019 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 guidance.

[2] U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Applications, February 2021.

1.2 REPORT CONTENTS

Section 2 of this report contains a description of **MD 5 Great Mills Improvement Project**, information on the general assumptions made in the analysis, and a description of the Base Case compared to the Build Case. Section 3 provides a summary of the anticipated project costs. Section 4 reviews the expected economic benefits MD 5 Great Mills Improvement Project would generate, including a review of the assumptions and methodology used to calculate the benefits. Finally, Section 5 reports the summarized results of the benefit-cost analysis.

2 PROJECT OVERVIEW

2.1 DESCRIPTION

The Great Mills project provides a much-needed safety and traffic flow solution to a critical intersection in rural Maryland to improve the connection between key U.S. military and private sector employment centers and facilitate growth in the region. The project encompasses transportation improvements to MD 5 (Point Lookout Road) between MD 246 (Great Mills Road) and MD 471 (Indian Bridge Road) in Great Mills, St. Mary's County. Over the last 10 years, St. Mary's County has grown over 10 percent - the fifth highest in the State of Maryland - well above the U.S. national average of 7 percent. The county has the fastest-growing workforce in the State, with the highest share of high-tech jobs in its local economy in the country, mostly attributed to growth at the NAS PAX and WOLF, and to population moving from the Washington, D.C. area. This growth has resulted in increased traffic volumes in and surrounding the Great Mills project area.

New commercial and residential developments planned near and within the Great Mills project area are expected to generate higher traffic volumes and congestion, especially during peak travel periods, over the next 20 years. High traffic volumes resulting from existing development already contribute to operational failure. The additional traffic generated by future development will worsen congestion along the corridor. The intersections of MD 5/MD 471 and MD 5/MD 246 are projected to experience failing Levels of Service (LOS) in the design year of 2040.

The improvements in the project scope include:

- The widening and resurfacing of MD 5 (Point Lookout Road) from an undivided two-lane roadway to an undivided four-lane closed section roadway,
- 11-foot-wide outside travel lanes with 5-foot bicycle lanes,
- 5-foot-wide sidewalk along both sides of MD 5,
- A new bridge over the St. Mary's River at the same grade as the existing bridge, and
- Stormwater management facilities, erosion control, drainage improvements, landscaping and stream restoration.

2.2 GENERAL ASSUMPTIONS

The evaluation period for this project includes a 6-year design and construction period, from 2022 to 2027, during which capital expenditures are undertaken, plus 20 years of operations beyond Project completion within which to accrue benefits, through 2047.

Dollar figures in this analysis are expressed in constant 2019 dollars (2019$). In instances where certain cost estimates or benefit valuations were expressed in dollar values from other (historical) years, the U.S. Bureau of Economic Analysis' Implicit Price Deflator was used to adjust them to 2019 prices.[3]

The real discount rate used for this analysis was 7.0 percent, consistent with U.S. DOT guidance for 2021 RAISE grants and OMB Circular A-94.[4]

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[3] U.S. Bureau of Economic Analysis. Table 1.1.9. Implicit Price Deflators for Gross Domestic Product. 2012=100

[4] White House Office of Management and Budget, Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs (October 29, 1992).

2.3 BASE CASE AND BUILD CASE

The analysis of the project segment considered how the balance of costs and benefits resulting from the construction of the project improvements would result in long-term benefits to its users and general society. In the “Build” Case, the Project includes the widening to a four-lane road and bridge with bike lanes and pedestrian sidewalks in each direction over the St. Mary’s River near the intersection of MD 5 and Great Mills Road. The construction will include improved roadway turning geometry at intersections with MD 246 and MD 471. Due to the project’s limited disturbance to existing roadways, construction-related closures and early year disbenefits are not assumed to occur.

The “No Build” Case examines the societal costs of increasing traffic on the existing adjacent arterial roads without any planned safety or capacity improvements, resulting in increasing crashes and traffic delays on MD 5 and increased damage to the existing bridge over St. Mary’s River requiring major repair and rehabilitation.

3 PROJECT COSTS

3.1 CAPITAL COSTS

Initial project investment costs include right-of-way acquisition, engineering and design, and construction. Total capital costs of $27.6 million in year-of-expenditure dollars were included in the project budget and included costs beginning in 2022 and ending in 2027, as shown in Table 1.

Table 1: Project Costs by Category and Year, in Year-of-Expenditure Dollars

Cost Category	2022	2023	2024	2025	2026	2027	Total
Planning and Design	$4,979,000	$650,000	$377,000	$127,000	-	-	$6,133,000
Right of Way	$1,404,000	$1,536,000	$1,451,000	$643,000	-	-	$5,033,000
Construction	-	-	-	-	$8,825,000	$3,975,000	$12,800,000
Utilities	$150,000	$1,300,000	$1,650,000	$500,000	-	-	$3,600,000
Total	**$6,533,000**	**$3,486,000**	**$3,478,000**	**$1,270,000**	**$8,825,000**	**$3,975,000**	**$27,566,000**

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA)

Using an adjustment factor for inflation of 1.048 and a cost escalation rate of 2 percent, the total capital costs are calculated to be equivalent to $24.5 million in undiscounted 2019 dollars. At the discount rate of 7 percent, the total capital costs are $17.1 million in discounted 2019 dollars, as shown in Table 2.

Table 2: Project Costs by Category and Year, in Undiscounted 2019 Dollars

Cost Category	2022	2023	2024	2025	2026	2027	Total
Planning and Design	$4,657,000	$596,000	$339,000	$112,000	-	-	$5,703,000
Right of Way	$1,313,000	$1,407,000	$1,304,000	$566,000	-	-	$4,590,000
Construction	-	-	-	-	$7,613,000	$3,360,000	$10,973,000
Utilities	$140,000	$1,191,000	$1,482,000	$440,000	-	-	$3,254,000
Total	**$6,110,000**	**$3,195,000**	**$3,124,000**	**$1,117,000**	**$7,613,000**	**$3,360,000**	**$24,519,000**
Total, Discounted 7%	***$4,987,000***	***$2,437,000***	***$2,228,000***	***$745,000***	***$4,741,000***	***$1,956,000***	***$17,093,000***

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA)

The improved facility is expected to be open and operational at the beginning of 2028.

3.2 OPERATIONS AND MAINTENANCE COSTS

The annual costs of operating and maintaining the project are included in the analysis. In the “Build” Case, the operations and maintenance costs for the project include the regular maintenance and repairs to the replacement bridge and roadway. Since the project involves the replacement and enhancement of existing infrastructure, operating and maintenance costs for the bridge and roadway are calculated to have similar costs, yet maintenance activities will be on a deferred schedule.

The project improvements will not change the frequency or costs of annual operations and maintenance to maintain the quality of the asset, resulting in zero net change in costs for Maryland DOT. The average annual operations and maintenance cost for the bridge structure and roadway is approximately $55,400. During the construction phase of the Project, annual operations and maintenance activities will not be performed. The annual operations and maintenance costs for the “Build” and the “No Build” Case for the project segment are shown in Table 3.

3.3 REPAIR AND REHABILITATION (R&R) COSTS

The pavement of the road and bridge lanes will need to be replaced or rehabilitated during the evaluation period under the Base and Build scenarios. The Project will defer the painting of the bridge structure from 2036 to 2041 and the patching and new overlay for the bridge deck from 2032 to after the end of the 20-year analysis period; additionally, the Project eliminates the necessity of planned minor rehabilitation work to perform steel repairs and install additional grout bags for scour protection in 2025. Table 3 details the cost schedule of the annual operations and maintenance and the periodic repair and rehabilitation activities.

Table 3: Schedule of Operations and Maintenance and Repair/Rehabilitation/Replacement Costs (in undiscounted 2019 Dollars)

Year	Build		No Build	
	O&M	R&R	O&M	R&R
2022 to 2024	-	-	$55,400	-
2025	-	-	$55,400	$71,600
2026 to 2031	$55,400	-	$55,400	-
2032	$55,400	-	$55,400	$477,000
2033 to 2035	$55,400	-	$55,400	-
2036	$55,400	-	$55,400	$190,900
2037 to 2040	$55,400	-	$55,400	-
2041	$55,400	$190,900	$55,400	-
2042 to 2044	$55,400	-	$55,400	-
2045	$55,400	-	$55,400	$71,600
2046 to 2047	$55,400	-	$55,400	-
Total	**$1,107,000**	**$190,900**	**$1,383,700**	**$811,200**

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA), WSP

4 PROJECT BENEFITS

The benefits of the project improvements can be described as user benefits, including travel time savings and reduction in vehicle operating costs, and social benefits, including emissions reductions and the reduction in damage to property and injuries as the result of fewer collisions. The analysis covers the following benefit categories:

- Travel Time Savings
- Vehicle Operating Cost Savings
- Safety Benefits
- Reduced Roadway Damage
- Reduced Emissions
- Improved Bicycle Commuter Mobility
- Recreational Benefits
- Health Benefits
- Agency Net O&M and R&R Costs

The analysis uses standardized factors provided by governmental and industry sources to efficiently determine the monetized value of user and social benefits resulting from the project improvements. These benefits include the reduction of existing costs or the prevention of future costs related to the operation and use of the existing road facility. Table 4 shows how the benefit categories align with the merit criteria of the RAISE Grants program.

Table 4: Project Benefits

Benefit (Disbenefit) Category	Description	Monetized	Quantified	Qualitative
Travel Time Savings	Elimination of bottlenecks in the traffic, avoided detours and faster vehicle-trips	✓		
Safety	Reduction in fatalities/injuries for vehicle, pedestrian and bicyclist traffic	✓		
Vehicle Operating Cost Savings (including Fuel)	Reduction in vehicle operating and maintenance costs for personal and commercial vehicles	✓		
Reduced Emissions	Reduction in air pollutants, leading to improved long-term health outcomes and reduced environmental impacts	✓		
Reduced Agency O&M/R&R Costs	Reduction of agency costs for maintaining existing infrastructure	✓		
Residual Value	Promotion of good infrastructure condition and effective capital investment	✓		
Health and Recreation Improvements	Promotion of enhanced quality of life and improved long-term health outcomes	✓		

Source: WSP

4.1 DEMAND PROJECTIONS

Traffic demand projections illustrate the growth in roadway use in response to the availability of capacity and user demand and the social costs and benefits associated with the use of the facility. Projections of

future traffic patterns indicates whether project improvements will improve safety and decrease congestion and trip length with additional capacity and infrastructure features.

At the request of MDOT SHA, WRA was asked to apply the MSTM Chapter 30 process to the MD 5 Great Mills Project, which includes the redesign of MD 5 from west of MD 471 through the intersection with MD 246. For this analysis, the 2016 network and 2040 "No Build" networks were reviewed to ensure the network accurately reflected the "No Build". The "No Build" alternatives consist of 1-lane in each direction with a 2-lane left turn lane for eastbound traffic turning north. The left turn lane is not included in the model network. In addition, a south bound connection is included connecting MD 246 to MD 5 with right in / right out access for west bound MD 5 traffic. For the "Build" alternative, the corridor was coded as two lanes in each direction throughout the project limits and included the removal of the connector.

The analysis incorporates growth projections developed by MDOT SHA using travel forecasting and analysis to project traffic patterns within the project segment on MD 5 from 2016 to 2040. The travel demand analysis resulted in a projected annual traffic growth rate of 1.45% for the project segment, which is reflected in the traffic projections in this study. As Great Mills is designated as a community within the Lexington Park metro area and the project segment performs as a key corridor for regional travel, the induced demand due to the project improvements in the local area is captured in the regional traffic growth projections. The factors and assumptions related to the traffic modeling in the project area are detailed in the table below.

Table 5: Demand Projection Assumptions and Sources

Variable	Unit	Value	Source
Average Daily Trips - MD 471 to MD 246 on MD 5 – 2016	trips	22,300	Maryland DOT SHA Travel Demand Forecasting
Average Daily Trips - MD 471 to MD 246 on MD 5 – 2040	trips	28,555	Maryland DOT SHA Travel Demand Forecasting
Average Daily Trips – Compound Annual Growth Rate	%	1.04%	Maryland DOT SHA Travel Demand Forecasting
% Peak Period Trips of Total Daily Traffic	%	28.9%	Maryland DOT SHA Travel Demand Forecasting
Average Daily VMTs - MD 471 to MD 246 on MD 5 – 2016	VMTs	20,962	Maryland DOT SHA Travel Demand Forecasting
Average Daily VMTs - MD 471 to MD 246 on MD 5 – 2040	VMTs	26,842	Maryland DOT SHA Travel Demand Forecasting
Average Speed - MD 471 to MD 246 on MD 5 – 2016	mph	24	Maryland DOT SHA Travel Demand Forecasting
Average Speed - MD 471 to MD 246 on MD 5 – 2040 – Build	mph	35	Maryland DOT SHA Travel Demand Forecasting
Average Speed - MD 471 to MD 246 on MD 5 – 2040 – No Build	mph	16	Maryland DOT SHA Travel Demand Forecasting
Average Traffic Mix – Auto/Truck	%	99%/1%	St. Mary's County Transportation Plan, 2006
Daily Peak Period Auto Vehicle Occupancy	users/auto	1.48	U.S. DOT BCA Guidance, January 2020
Weekly Peak Period Bus Trips	trips/weekday	12	St. Mary's County Transportation Department
Daily Peak Period Local Bus Vehicle Occupancy	passengers/bus	18.8	St. Mary's County Government/Federal Transit Administration NTD
Annualization Factor	days/year	250	WSP

Source: WSP

The effects of the project improvements are captured in the travel time savings during the peak period; traffic is assumed to be travel at free-flow speeds outside of the peak period. The peak period is defined as 6 am to 9 am and 3 pm to 6 pm, capturing the commute traffic traveling in both directions. After the construction of the project improvements, a steady ramp-up in improved traffic performance over the analysis period is modeled to capture changes in travel behavior as a long-term trend. While the project segment does not experience variations in the number of vehicle-miles traveled between the Build and No Build scenarios, the effect of the project improvements on regional traffic demonstrates the average length of total trips decreases due to less detour behavior resulting from expected roadway congestion. The project area represents a choke point in the regional traffic system, therefore changes in travel time are captured there and do not include regional impacts. The resulting demand projections are presented in the following table.

Table 6: No Build and Build Demand Projections

Variable	Project Opening Year		Final Year of Analysis	
	No Build	Build	No Build	Build
Annual Weekday ADTs – MD 4 and MD 235	6,309,000	6,309,000	7,673,000	7,673,000
Average Speed (mph)	19 mph	35 mph	14 mph	35 mph
Daily Peak Period VHTs	349	234	609	206
Annual Weekday VMTs – Greater Lexington Park Area	5,930,460	5,930,460	7,212,620	7,212,620

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA), WSP

In addition to alleviating roadway congestion for weekday peak period traffic, the Project is expected to reduce the frequency of roadway flooding resulting in lengthy detours. The proposed bridge design is expected to reduce the advent of flood waters overtopping onto the roadway by up to 80 percent, as the frequency of future flooding in the project area is expected to become more frequent and severe over the next 20 years. As a designated AE flood zone, according to FEMA, the project area presents a 1 percent annual probability of flooding under current climate conditions. According to flood projections by Climate Central and First Street Foundation for the areas on Chesapeake Bay, the annual probability of flooding in the project area is expected to grow to 5 percent over the next 20 years, according to flood projections by Climate Central and First Street Foundation for St. Mary’s County. Using the probabilistic risk methodology for assessing the number of flooding events per year over the analysis period, the analysis estimates the total number of vehicle-trips affected by the increasing frequency of flooding in the project area with and without the proposed project improvements. The affected vehicle-trips would be required to take a longer detour to complete their trip, resulting in longer travel distances and additional travel delays. The projected impacts on traffic and underlying assumptions are shown in below in Table 7.

Table 7: Traffic Impacts from Flooding Assumptions and Sources

Variable	Unit	Value	Source
Annual Probability of Flooding in Project Area - 2020	percentage	1%	FEMA Flood Zone Maps, St. Mary's County
Annual Probability of Flooding in Project Area - 2040	percentage	5%	"Surging Seas Risk Finder", Climate Central; "Flood Factor", First Street Foundation
Average Annual Probability of Flooding in Project Area	percentage	2.5%	FEMA; Climate Central; First Street Foundation
Traffic Annualization Factor	factor	250	MDOT SHA Travel Demand Model
Average Number of Flooding Days per Year	days	6	FEMA; Climate Central; First Street Foundation
Percentage of Daily Trips Impacted by Flooding Event	percentage	100%	Estimate based on MDOT SHA Travel Demand Model
Reduction in Flooding Impacts with Proposed Improvements	percentage	40%	MDOT Operations Bridge Design Specifications
Percentage of Annual Traffic Volumes Affected by Flooding	percentage	1.0%	Estimate based on MDOT SHA Travel Demand Model
Detour Route - MD 4 - Detour Length	miles	13	MDOT SHA Travel Demand Model
Detour Route - MD 4 - Detour Duration per Trip	minutes	20	MDOT SHA Travel Demand Model
Percentage of ADTs using Detour	percentage	35%	MDOT SHA Travel Demand Model
Detour Route - MD 235 - Detour Length	miles	12	MDOT SHA Travel Demand Model
Detour Route - MD 235 - Detour Duration per Trip	minutes	18	MDOT SHA Travel Demand Model
Percentage of ADTs using Detour	percentage	65%	MDOT SHA Travel Demand Model

Based on the assumptions shown in Table 7, the baseline number of annual vehicle-trips affected by a flooding event and their additional travel distance and travel time can be estimated. The reduced probability of overtopping resulting from the proposed bridge design is expected to result in avoiding a percentage of the additional travel distance and travel time experienced by the affected vehicle-trips. The projected impacts of the flooding events are shown below in Table 8.

Table 8: No Build and Build Projected Traffic Impacts from Flooding

Variable	Project Opening Year		Final Year of Analysis	
	No Build	Build	No Build	Build
Annual Vehicle-Trips Affected by Roadway Flooding (Auto/Trucks)	151,400	60,600	184,100	73,700
Annual Detour Vehicle-Miles Resulting from Roadway Flooding (Auto/Trucks)	1,809,300	723,700	2,200,500	880,200
Annual Detour Vehicle-Hours Resulting from Roadway Flooding (Auto/Trucks)	47,200	18,900	57,400	23,000
Annual Vehicle-Trips Affected by Roadway Flooding (Transit)	72	29	72	29
Annual Detour Vehicle-Miles Resulting from Roadway Flooding (Transit)	900	400	900	400
Annual Detour Person-Hours Resulting from Roadway Flooding (Transit)	500	200	500	200

Source: Maryland Department of Transportation State Highway Administration (MDOT SHA), WSP

4.2 ECONOMIC COMPETITIVENESS

This project would contribute to increasing the economic vitality and competitiveness of the region by improving in the mobility of people and goods in the study area. Two types of societal benefits are measured in the assessment of economic competitiveness: travel time savings and vehicle operating cost savings. The analysis quantifies benefits related to travel time and vehicle operating savings associated with the project improvements.

With the reduction of roadway congestion resulting from the project improvements, travel time savings are a significant direct benefit for users of the road facility. The user benefits represent a reduction of future costs related to the personal and commercial use of the roadway. The reduction in time delays allows personnel to reach employment centers and freight trucks to deliver equipment and materials to technical facilities and military installations in a cost- and time-efficient manner, impacting economic industries throughout the region. As a central component in improving traffic movements throughout St. Mary's County, the project improvements facilitate the development of commercial properties and employment sites in the Lexington Area, while improving connectivity to regional pedestrian and bicyclist infrastructure.

4.2.1 *TRAVEL TIME SAVINGS*

Travel time savings includes in-vehicle travel time savings for auto drivers, bus passengers and truck drivers. Travel time is considered a cost to users, and its value depends on the disutility that travelers attribute to time spent traveling. A reduction in travel time translates into more time available for work, leisure, or other activities. The MD 5 Great Mills Improvement Project will provide additional capacity on a vital connector in the region, alleviating peak-hour congestion on adjacent arterials with reduced travel time and higher travel speeds for commuters, freight traffic, and recreational users throughout the region. The reduction in travel time for the project is calculated to be $15.6 million in discounted 2019 dollars.

Table 9: Travel Time Savings Estimation of Benefits, Millions of 2019 Dollars

Benefit	Project Opening Year		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
Travel Time Savings - Auto	$1.50	$0.80	$48.65	$13.58
Travel Time Savings - Truck	$0.02	$0.01	$0.73	$0.20
Travel Time Savings - Bus Passengers	$0.30	$0.16	$5.93	$1.83
Total	$1.82	$0.99	$55.30	$15.61

Source: WSP

The assumptions used in the estimation of travel time savings are presented in the following table.

Table 10: Travel Time Savings Assumptions and Sources

Variable	Unit	Value	Source
Value of Travel Time Savings - Personal, Local	2019$ per person hour	$16.50	U.S. DOT BCA Guidance, February 2021
Value of Travel Time Savings - Business, Local	2019$ per person hour	$27.90	U.S. DOT BCA Guidance, February 2021
Value of Travel Time Savings - All Purposes, Local	2019$ per person hour	$17.90	U.S. DOT BCA Guidance, February 2021

4.2.2 *VEHICLE OPERATING COST SAVINGS*

Vehicle operating cost savings includes the cost of fuel, as well as maintenance and repair, replacement of tires, and the depreciation of the vehicle over time. The project improvements do not measurably reduce the direct distance through the project area, yet the reductions in road congestion and faster travel times could incidentally reduce fuel consumption and general wear-and-tear by minimizing idling in stop-go traffic. However, the improvement in road conditions are expected to result in a minor reduction in vehicle-miles traveled throughout the region. Additionally, as the project improvements aim to reduce the frequency and severity of flooding events on MD 5, it would avoid the need for drivers to take lengthy detours around the flooded area to complete their journey, thereby reducing total vehicle-miles traveled. These impacts from the Project generate a net cost savings of $3.1 million in discounted 2019 dollars.

Table 11: Vehicle Operating Cost Savings Benefits, Millions of 2019 Dollars

Benefit	Project Opening Year		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
Vehicle O&M Costs - Auto	$0.46	$0.25	$10.21	$3.08
Vehicle O&M Costs - Truck	$0.01	$0.01	$0.22	$0.07
Total Net Vehicle O&M Costs	**$0.47**	**$0.26**	**$10.43**	**$3.14**

Source: WSP

The assumptions used in the estimation of vehicle maintenance and operating costs are presented in the following table.

Table 12: Vehicle Operating Cost Savings Assumptions and Sources

Variable	Unit	Value	Source
Vehicle Operating Costs - Light Duty Vehicles	2019$ / VMT	$0.43	U.S. DOT BCA Guidance Feb 2021
Vehicle Operating Costs - Commercial Trucks	2019$ / VMT	$0.93	U.S. DOT BCA Guidance Feb 2021

Source: WSP

4.3 SAFETY

The safety benefits assessed in this analysis include a reduction in fatalities and injuries, as well as a reduction in other property damage crash costs resulting directly from the project. Due to the mix of residential neighborhoods and commercial developments in the vicinity, the traffic in the area around Lexington Park includes personal vehicles, freight trucks, on-road bicyclists and pedestrians.

The constriction of daily commuter traffic down to two lanes on MD 5 and Great Mills Road leads to frequent crashes resulting from inattention, abrupt stops and impatient driving. From 2009 to 2019, 187 crashes occurred within a half-mile of the project segment around the intersections of MD 5 with MD 246 and MD 471, of which resulted in 93 significant injuries. The project segment experiences an average of 9.2 significant injuries from collisions and 11 collisions resulting in property damage on an annual basis over the previous five years, according to the crash statistics provided by Maryland DOT SHA. As the number of crashes has steadily risen in recent years, the number of projected crashes is expected to continue growing at a rate of 1.3 percent during the analysis period.

The analysis assumes accident rates modified with a crash modification factor reflective of the roadway improvements for the “Build” scenario. As a result, any changes in the number of accidents will be a result of structural changes to the safety conditions on the roadway network tied to the growth of traffic. In the debrief of 2019’s application, the U.S. DOT review team determined in their research that the project improvements would result in a reduction of crashes between 0 percent and 20 percent, advising a reduction of 10 percent would be reasonable. Therefore, a crash reduction factor of 10 percent has been used in the analysis of the project improvements. The assumptions used in the estimation of safety benefits are presented below in Table 14.

The expansion of the roadway and changes of roadway geometry on MD 5, in addition to the improved facilities for bicycles and pedestrians, are projected to reduce crashes by an average of about 10%, or an average of one to two incidents annually. The prevention of these crash incidents is expected to result in benefits of $1.4 million in discounted 2019 dollars.

Table 13: Safety Benefits, Millions of 2019 Dollars

Benefit	Project Opening Year		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
Injury Reduction	$0.20	$0.11	$4.61	$1.38
Property Damage Reduction	$0.01	$0.01	$0.13	$0.04
Total Safety Benefits	**$0.21**	**$0.11**	**$4.74**	**$1.42**

Source: WSP

The assumptions used in the estimation of safety benefits are presented in the following table.

Table 14: Safety Benefits Assumptions and Sources

Variable	Unit	Value	Source
Cost per Injury (KABCO)	2019$	$197,600	U.S. DOT Guidance, February 2021
Cost per Property-Damage Only Crash	2019$	$4,500	U.S. DOT Guidance, February 2021
Crash Modification Factor	factor	10%	U.S. DOT BUILD Grant Review Team (2019)

4.4 STATE OF GOOD REPAIR

The state of good repair condition benefits assessed in this analysis include maintenance and repair savings, deferral of replacement cost savings, reduced VMT which leads to less road and facility damage, as well as use of design and technologies to increase resilience performance during natural hazard events and long-term use. While prevented damage to roadway pavement is associated with reductions in VMTs, the replacement of the bridge will ensure the vital transportation link for the region will continue to operate at peak performance while reducing the probability of flooding events. While not quantified in this analysis, the improvements to the roadway and bridge will help reduce the probability that the flooding of the St. Mary's River will adversely affect the condition of the roadway or the bridge. The regional roadway network experiences a slight bump in total VMTs in the Build scenario as induced demand results in people making more trips while the average length of trips is shortened due to reductions in detouring behavior. Considering these impacts, the net effect on the analysis is determined to be negligible and therefore is described here in qualitative terms.

4.5 ENVIRONMENTAL SUSTAINABILITY

The project will create environmental and sustainability benefits relating to reduction in waterway and air pollution associated with fewer detouring events, reduced flooding events and more efficient traffic flow. It supports St. Mary's County's efforts to comply with Maryland's Greenhouse Gas Emissions Reduction Act Plan (GGRA) by reducing congestion which will in turn could also decrease the number of vehicles idling along the corridor. The decrease in the number of vehicles idling on the road and the faster average speed reduces the overall tonnage of emissions from the vehicles. The amount of emissions reduced is measured and monetized through the marginal difference over the project lifecycle.

Four forms of emissions were identified, measured and monetized, including: nitrous oxide (NOx), particulate matter (PM2.5), sulfur dioxide (SO_2), and carbon dioxide (CO_2). The assumptions used in the estimation of emissions reduction benefits are summarized in Table 16. The benefit of the emissions reduction from the project is valued at $1.6 million in discounted 2019 dollars.

Table 15: Benefits of Emissions Reductions, 2019 Dollars

Benefit	Project Opening Year		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
CO2 Emissions Reduction	$95,000	$72,000	$2,807,000	$1,588,000
NOx Emissions Reduction	$2,000	$1,000	$27,000	$9,000
SOx Emissions Reduction	$300	$200	$6,000	$2,000
PM2.5 Emissions Reduction	$4,000	$2,000	$73,000	$23,000
Total Emissions Reduction	**$101,000**	**$76,000**	**$2,914,000**	**$1,623,000**

Source: WSP

The assumptions used in the estimation of environmental sustainability benefits are presented in the following table.

Table 16: Emissions Reductions Assumptions and Sources

Variable	Unit	Value	Source
Cost of CO2 emissions	2019$ per metric ton	$50 (in 2020) - $84 (in 2050)	U.S. DOT Guidance, February 2021
Cost of NOx emissions	2019$ per metric ton	$15,700 (in 2020) - $18,000 (in 2050)	U.S. DOT Guidance, February 2021
Cost of PM2.5 emissions	2019$ per metric ton	$729,300 (in 2020) - $852,700 (in 2050)	U.S. DOT Guidance, February 2021
Cost of SOx emissions	2019$ per metric ton	$40,400 (in 2020) - $48,200 (in 2050)	U.S. DOT Guidance, February 2021
Emissions per VMT for NOx, PM2.5, and Sox	grams per VMT	Varies by year, vehicle type, speed, and emission type	California Air Resources Board EMFAC Database, 2017
CO2 emissions per gallon of gasoline	lbs per gallon	$8,887	U.S. EPA, Greenhouse Gas Equivalencies Calculator
CO2 emissions per gallon of diesel	lbs per gallon	$10,180	U.S. EPA, Greenhouse Gas Equivalencies Calculator
Fuel efficiency	gallons per mile	Varies by year and vehicle type	U.S. EIA, Annual Energy Outlook 2021 and
Fuel efficiency factor	factor	Varies by type of vehicle and speed	U.S. EIA 2013

4.6 QUALITY OF LIFE / LIVABILITY

The Project creates quality of life / livability benefits associated with encouraging pedestrian and bicyclists traffic around Great Mills and Lexington Park. Extending and completing pedestrian infrastructure to increase connectivity within the community has been shown to induce foot and bicycle traffic for commuting and recreation. Additionally, the project improvements would build pedestrian and bicycle connections to the National Park Service-designated Southern Maryland Potomac Heritage Trail on-road bicycling route that runs on MD 5 from the county seat of Leonardtown south to Point Lookout. The improved connectivity of the regional pedestrian and bike infrastructure network will increase access to recreational opportunities, employment centers and social institutions. Annual health benefits, commuter mobility benefits, and recreational benefits for bicyclists are estimated to be valued at $0.4 million in discounted 2019 dollars.

Table 17: Quality of Life / Livability Benefits, 2019 Dollars

Benefit	Project Opening Year		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
Health Benefits	$53,000	$29,000	$1,065,000	$328,000
Commuter Mobility Benefits	$13,000	$7,000	$266,000	$82,000
Recreational Benefits – Bicyclists	$2,000	$1,000	$48,000	$15,000
Total Health Benefits	**$69,000**	**$37,000**	**$1,378,000**	**$425,000**

Source: WSP

The assumptions used in the estimation of quality of live benefits are presented in the following table.

Table 18: Quality of Life / Livability Assumptions and Sources

Variable	Unit	Value	Source
Health Benefit for Bicyclists	2019$ / bicycle-mile	$0.20	Derived from VTPI 2018
Annual Health Benefit	2019$ / person	$158.36	NCHRP 2006
Population Density in Project Area	persons/sq.mi.	1,972	Lexington Park, MD, US Census Bureau. 2020.
Annual Population Growth	%	0.0%	Lexington Park, MD, US Census Bureau. 2020.
Length of the Bicycle Facility	mile	0.70	MD 5 Great Mills Project Scope. Maryland Department of Transportation.
Percentage of Adult Residents in Area	%	76.8%	Lexington Park, MD, US Census Bureau. 2020.
Percentage of Commuters	%	50%	NCHRP Guidelines for Analysis of Investments in Bicycle Facilities, 2006.
Percentage of Bicycle Commute Share	%	1%	Based on Maryland average. Alliance for Biking and Walking: Bicycling and Walking in the United States - 2018 Benchmarking Report
Percentage of Children who Ride a Bike on a Given Day	%	5.0%	2001 National Household Travel Survey (NHTS)
NCHRP Biking Likelihood Multiplier of Population Living Within 1/4 mile of a Bike Trail	unit	2.93	NCHRP Guidelines for Analysis of Investments in Bicycle Facilities, 2006.
NCHRP Biking Likelihood Multiplier of Population Living Within 1/2 mile of a Bike Trail	unit	2.11	NCHRP Guidelines for Analysis of Investments in Bicycle Facilities, 2006.
NCHRP Biking Likelihood Multiplier of Population Living Within 1 mile of a Bike Trail	unit	1.16	NCHRP Guidelines for Analysis of Investments in Bicycle Facilities, 2006.

4.7 AGENCY O&M AND R&R

Project improvements resulting in reductions in agency costs related to the operation, maintenance, repair or rehabilitation of an asset can be the result of improved management processes or the

replacement of underperforming equipment. The bridge structure will require significant rehabilitation in the next 20 years as it approaches the end of its useful life amidst increasingly frequent flood events and regular wear and tear. The lifespan of the roadway is estimated at 20 years before requiring complete replacement; the existing roadway is slated for replacement in 2036. Additionally, planned repair and rehabilitation activities of the bridge structure would be avoided with the Project. The construction of the project improvements will defer scheduled maintenance and repair on the bridge and roadway, resulting in reduced costs over the analysis period. Agency's O&M and R&R cost reduction benefits for the entire project lifecycle are valued at $0.5 million in 2019 discounted dollars.

Table 19: Agency Estimation of Net O&M and R&R Costs, Millions of 2019 Dollars

Benefit	Project Opening Year		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
O&M Costs	$0.06	$0.05	$0.33	$0.23
R&R Costs	$0.07	$0.05	$0.62	$0.28
Total Agency O&M and R&R Costs	**$0.13**	**$0.10**	**$0.95**	**$0.51**

Source: WSP

The assumptions used in the estimation of agency cost reductions are presented in the following table.

Table 20: Agency Costs Reduction Assumptions and Sources

Variable	Unit	Value	Source
Annual Operations & Maintenance Cost	2019$	$55,400	MDOT SHA Operations
Repair & Rehabilitation – Road (No Build)	2019$	Every 20 years	MDOT SHA Operations
Repair & Rehabilitation – Bridge (No Build)	2019$	2025, 2032, 2045	MDOT SHA Operations
Repair & Rehabilitation – Road (Build)	2019$	20 Years after Construction	MDOT SHA Operations
Repair & Rehabilitation – Bridge (Build)	2019$	15 Years after Construction	MDOT SHA Operations

4.8 RESIDUAL VALUE

The residual capital value (RCV) is calculated by determining the percentage of useful life remaining beyond the analysis period and multiplying that percentage by the construction cost for that component. The design life of the roadway is estimated at 20 years following construction, while the engineer's estimate for the bridge structure assumes a 40-year useful life to be reasonable. Since we are using a 20-year analysis period and a 40-year design life, the residual value is 50% of the initial cost using the straight-line depreciation method. The remaining capital value is viewed as cost offset or "negative cost" and is applied to the last year of analysis period as a negative value. The residual value of the project improvements is valued at $0.8 million in 2019 discounted dollars.

Table 21: Residual Value Estimation of Benefits, Millions of 2019 Dollars

Benefit	Final Analysis Year – 2047	
	Undiscounted	Discounted (7%)
MD 5 Bridge Deck and Structure Remaining Capital Value in Final Year	$5.49	$0.83
Total Residual Value Benefits	**$5.49**	**$0.83**

Source: WSP

The assumptions used in the estimation of residual value benefits are presented in the following table.

Table 22: Residual Value Assumptions and Sources

Asset Name	Expected Life Span	Capital Cost	Last Purchase Year
MD 5 Bridge Deck and Structure	40	$10,973,000	2027

5 SUMMARY OF RESULTS

5.1 EVALUATION MEASURES

The benefit-cost analysis 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 benefit-cost ratio; the present value of incremental benefits is divided by the present value of incremental costs to yield the benefit-cost ratio. 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.
- Internal Rate of Return (IRR): The IRR is the discount rate which makes the NPV from the Project equal to zero. In other words, it is the discount rate at which the Project breaks even. Generally, the greater the IRR, the more desirable the Project.

5.2 BCA RESULTS

The table below presents the evaluation results for the project. Results are presented in undiscounted, discounted at 7 percent as prescribed by the U.S. DOT. All benefits and costs were estimated in constant 2019 dollars over an evaluation period extending 20 years beyond system completion in 2027.

The total benefits from the project improvements within the analysis period are calculated to be $23.6 million in discounted 2019 dollars. The total capital costs, including engineering, construction, and right-of-way and land acquisition, are calculated to be $17.1 million in discounted 2019 dollars. The difference of the discounted benefits and costs equal a net present value of $6.5 million in discounted 2019 dollars, resulting in a benefit-cost ratio (BCR) of 1.38.

Table 23: Benefit Cost Analysis Results, Millions of 2019 Dollars

BCA Metric	Undiscounted	Discounted (7%)
Total Benefits	$81.2	$23.6
Travel Time Savings	$55.3	$15.6
Safety	$4.7	$1.4
Vehicle Operating Cost Savings (including Fuel)	$10.4	$3.1
Reduced Emissions	$2.9	$1.6
Health and Mobility Improvements	$1.4	$0.4
Reduced Agency O&M Costs	$0.9	$0.5
Residual Value	$5.5	$0.8
Total Costs	$24.5	$17.1
Net Present Value (NPV)	$56.7	$6.5
Benefit Cost Ratio (BCR)	3.31	1.38
Internal Rate of Return (IRR)	10%	

Source: WSP