

Technical Memorandum

Benefit-Cost Analysis for I-85 FUTURES: Funding Transportation Utilizing Resilient Equitable Solutions

Date: March 19, 2021

Subject: Benefit-Cost Analysis for I-85 FUTURES

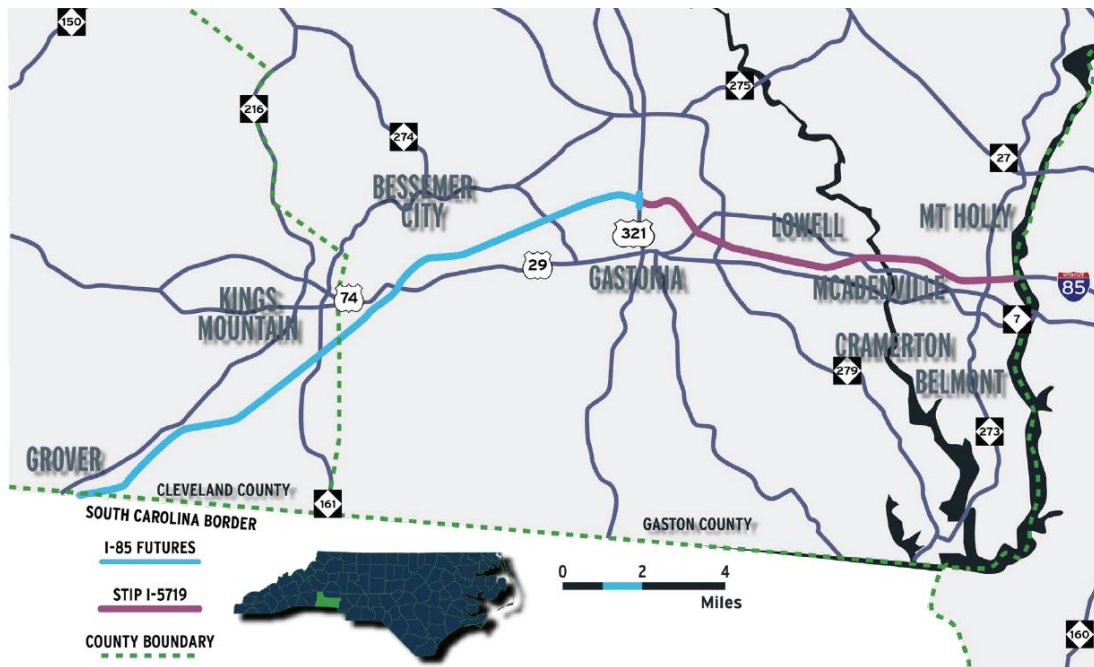
Project Description

The North Carolina Department of Transportation (NCDOT) I-85 Funding Transportation Utilizing Resilient Equitable Solutions (FUTURES) Project will provide travel time savings, improve safety, and increase reliability for one of the most traveled corridors in North Carolina. The Project proposes to accomplish these goals by widening I-85 to eight lanes with safer roadway and interchange designs that will bring the facility up to current design standards. Additionally, a suite of transportation technology improvements will be made and are described in the application narrative.

The Project will provide comprehensive improvements to the portion of I-85 between Charlotte and Atlanta, which powers the nation's third largest economic region and is a major travel route moving people and goods. Locally, I-85 serves as a primary facility for residents and businesses providing direct access to freight rail and the Charlotte-Douglass International Airport. The facility, when completed in 1965, split existing communities, creating inequities that still need to be addressed. Comprehensive improvements to the efficiency, equity, and resiliency of this vital section of I-85 are needed to support all the traveling public and move regional transportation into a sustainable future.

A map of the Project is shown in **Exhibit 1**.

Exhibit 1 - Project Location



Introduction

This technical memorandum estimates the long-term benefits associated with the Project. The long-term benefits presented relate to three primary focus points: travel time savings, safety benefits, and travel time reliability savings from fiber / broadband improvements. The final section discounts the stream of anticipated benefits and costs and calculates the Benefit-Cost Ratios for the Project.

The balance of this discussion describes the assumptions and methods used to develop the benefit-cost analysis and estimates the value of the long-term benefits generated by the project. The benefits of the capital investment have been estimated over a 30-year analysis horizon.

Years of Analysis

The Project's construction would be completed in mid-2029. A benefits period of 2029-2059 was used. This 30-year benefits period is consistent with what the *2021 BCA Guidance for Discretionary Grant Programs* states should be applied for projects involving the full reconstruction of highways or similar facilities.

Methodology

Benefits are estimated in accordance with guidance provided by U.S. Department of Transportation (U.S. DOT) for benefit-cost analysis. If no U.S. DOT guidance was available for the estimate, the Project team consulted industry research for the best practice and information on which to base the assumptions and methodology.

The benefits quantified in the benefit-cost analysis are described in the following pages in 2019 dollars (as advised by U.S. DOT). Benefits for each Project element are described within the benefit categories.

Analysis Assumptions

A list of assumptions for the project is provided in the Benefit/Cost Analysis (BCA) workbook as well as in Exhibit 2.

Exhibit 2 - BCA Calculation Inputs

Input	Value	Source
General		
Discount Rate	7%	2021 BCA Guidance for Discretionary Grant Programs
Discount Rate for Reductions in CO ₂ Emissions	3%	2021 BCA Guidance for Discretionary Grant Programs
Dollar Year	2019	2021 BCA Guidance for Discretionary Grant Programs
Analysis Period (Years)	30	2021 BCA Guidance for Discretionary Grant Programs, for projects involving full reconstruction of highways
Auto Occupancy (Passenger Vehicles, All Travel)	1.67	2021 BCA Guidance for Discretionary Grant Programs
Auto Occupancy (Trucks)	1.00	https://www.fhwa.dot.gov/tpm/guidance/avo_factors.pdf
Truck Value of Time (hourly value)	\$30.80	2021 BCA Guidance for Discretionary Grant Programs
Passenger Vehicle Value of Time (hourly value)	\$16.50	2021 BCA Guidance for Discretionary Grant Programs
Compound Annual Growth Rate (Average rate of all forecast roadway segments)	1.10%	I-5719 Project-Level Traffic Forecast (HNTB, 2019) https://connect.ncdot.gov/projects/planning/Traffic%20Forecasts/I-5719%20Gaston%20TF/I-5719%20Gaston%20Mecklenburg%202019%20TF.pdf
Operating Costs per Mile (Light Duty Vehicles)	\$0.43	2021 BCA Guidance for Discretionary Grant Programs
Operating Costs per Mile (Commercial Trucks)	\$0.93	2021 BCA Guidance for Discretionary Grant Programs
Damage Costs for Emissions	Varies by Emission	2021 BCA Guidance for Discretionary Grant Programs
VHT/VMT values in vicinity of I-85 FUTURES Project	Varies by Scenario	Metrolina Regional Model
Weighted Average Annual Daily Traffic on I-85	Varies by Scenario	I-5719 Project-Level Traffic Forecast (HNTB, 2019)
Safety		
O - No Injury	\$3,700	2021 BCA Guidance for Discretionary Grant Programs
C - Possible Injury	\$72,500	2021 BCA Guidance for Discretionary Grant Programs
B - Non-incapacitating	\$142,000	2021 BCA Guidance for Discretionary Grant Programs
A - Incapacitating	\$521,300	2021 BCA Guidance for Discretionary Grant Programs
K - Killed	\$10,900,000	2021 BCA Guidance for Discretionary Grant Programs
U - Injured (Severity Unknown)	\$197,600	2021 BCA Guidance for Discretionary Grant Programs
# of Accidents Reported (Unknown if Injured)	\$150,200	2021 BCA Guidance for Discretionary Grant Programs
Property Damage Only Crashes	\$4,500	2021 BCA Guidance for Discretionary Grant Programs
Crash Modification Factor (CMF) ID 8336 (Installing Additional Lane on Urban Freeway)	0.74	http://www.cmfclearinghouse.org/detail.cfm?facid=8336#commentanchor

Benefits

Freight Rating

I-85 in Gaston County is a critical link for both local and regional freight trips with up to 24 percent of I-85 traffic being comprised of heavy trucks at certain locations. The I-5719 Project will provide “substantial” travel time and safety benefits to freight trips that use the corridor, which is worth an estimated net present value benefit of \$124.7 million and is an approximate 24 percent of the share of the total \$521.8 million net present value benefits.

Fiber / ITS Benefits

I-85 FUTURES will include fiber optic cable and ITS improvements in Cleveland County. The Project will connect to fiber optic cable installation secured as part of the US 74 INFRA Grant (2020) and extend to the border with South Carolina along I-85. Fiber optic cable and ITS benefits were estimated to provide savings and reliability benefits worth \$128 million, with a net present value in 2019 dollars of \$26.6 million.

Travel Time

The Project will result in travel time savings for cars and freight vehicles in the Gastonia area. Vehicle hours of travel (VHT) - defined as total travel time in hours for passenger cars and trucks - was estimated for the No-Build and Build scenarios in both the opening year and design year (2045). The difference between these two scenarios provides the foundation to quantify the hours saved for passenger cars and trucks. Travel time savings benefits were estimated using total travel time saved by autos and trucks at a value of \$16.50 per hour for passenger vehicles and \$30.80 per hour for trucks. The combination of passenger and freight vehicle time-savings will result in a total savings of \$49.7 million in the opening year, and increasing to \$69.2 million at the end of the analysis period. The total travel time savings benefit is \$1.8 billion, with a net present value in 2019 dollars of \$380.0 million.

Safety

An in-depth strip analysis crash report was completed for the I-5719 Project over a 5-year period from December 1, 2010 to November 30, 2015. The crash analysis assessed all 2,846 crashes that occurred during this time, including a breakdown by crash type - fatal, non-fatal injuries (types A, B, and C), and property damage only crashes. Future Year No-Build and Build crash estimates were projected using a combination of monetized values per injury level (KABCO 2019 Dollar values per USDOT 2021 BCA Guidance), Project-specific crash rates, and traffic forecast growth rates.

The I-5719 Project will greatly benefit the safety of drivers on the facility through improved acceleration and deceleration lanes for project interchanges, the addition of auxiliary lanes where appropriate, improved vertical curves, revised horizontal curves,

widened median shoulders, and improved median barriers. After a review of multiple Crash Modification Factors (CMFs) from the CMF Clearinghouse (refer to Exhibit 3), it was determined that a 26 percent reduction in crashes for the Project facility is a reasonable estimate based on CMF ID 8336 for widening and the multiple substandard features being revised to meet current standards. The total safety benefit savings was found to be \$1.4 billion, with a net present value in 2019 dollars of \$293.0 million.

Exhibit 3 - Project Crash Reduction Factors

ID	Countermeasure Description	CMF	Expected Crash Reduction	Application
8336	Installing an Additional Lane on Urban Freeway	0.74	26%	CMF applied to Build scenario CMFs reviewed and considered as part of the multitude of improved roadway design safety benefits being generated from this widening.
720	Flatten Crest Vertical Curve	0.80	20%	
7441	Add Continuous Auxiliary Lane for Weaving Between Entrance Ramp and Exit Ramp	0.77	23%	
474	Extend Acceleration Lane by Approx. 98 ft (30 m)	0.89	11%	
475	Extend Deceleration Lane by Approx. 100 ft	0.93	7%	
3899	Provide an Auxiliary Lane Between an Entrance Ramp and an Exit Ramp	0.77	23%	

Source: <http://www.cmfclearinghouse.org/index.cfm>.

Summary

The analysis resulted in a 2.41 BCR and a \$521.8 million net present value of benefits (refer to Exhibit 4). NCDOT has concluded that these benefits reasonably justify I-85 FUTURES' costs.

Exhibit 4 - Total Project Benefit-Cost Analysis

Project	Capital Costs	Project Costs (NPV \$2019)	Total Net Benefit	Total Net Benefit (NPV \$2019)	Benefit-Cost Ratio
I-85 FUTURES	\$401,524,700	\$216,659,284	\$2,595,725,917	\$521,823,552	2.41