
Appendix G Benefit-Cost Analysis



BENEFIT-COST ANALYSIS

Version 1.2

September 20, 2021



150 South York Street

Gastonia, North Carolina, 28052

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Kimley»»Horn

200 South Tryon Street, Suite 200

Charlotte, North Carolina, 28203

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1 Executive Summary

This benefit-cost analysis (BCA) has been prepared for the Catawba Crossings Feasibility Study in Gaston and Mecklenburg counties, North Carolina.

The Catawba River creates a natural barrier to mobility between Mecklenburg County to the east, Gaston County to the west, and York County, South Carolina to the southwest. There are currently five bridges connecting Gaston and York counties to Mecklenburg County (NC 16, NC 27, I-85, and US 29/74 in Gaston County and Hwy 49 in York County). The bridge crossings in Gaston County are located approximately one to four miles apart. However, the bridge crossing in York County (Hwy 49) is located approximately ten miles from the southernmost bridge crossing in Gaston County (US 29/74).

The Catawba Crossings Project will provide a new 6.5-mile, four-lane, divided arterial that extends from NC 160 (Steele Creek Road) to NC 279 (New Hope Road) and includes bridges over the South Fork Catawba and Catawba rivers and an interchange with I-485.

This BCA is based on the project description contained in the Catawba Crossings Transportation Technical Memorandum (April 2021). The following benefits were quantified:

- Establishment of physical transportation assets (roadway alignment and bridge) with a long useful life
- Accident-prevention benefits realized by shortening of long-distance trips
- Reduced travel time for passengers and increased productivity for drivers
- Reduced morbidity and negative health outcomes associated with a more direct access to emergency services at Charlotte Area hospitals and medical campuses
- Social benefits realized by shortening of long-distance trips which reduces carbon and other mobile source emissions
- Increased property values due to enhanced mobility between Gaston and Mecklenburg counties
- Increased truck-air freight capacity and resiliency
- Increased productivity and reduced expenses for agricultural uses

The BCA has been documented in a spreadsheet format that is consistent with the US Department of Transportation (USDOT) BCA guidelines for applications to federal funding programs. This technical memorandum serves as a companion piece to the calculations and assumptions that are presented in the BCA Spreadsheet. It details the format and organization of the BCA Spreadsheet, the methodology used to calculate costs and benefits, and the assumptions, limitations, and application of the results.

There are two purposes of the BCA Spreadsheet:

- 1) To describe in a thorough, complete, and accurate manner the major costs and benefits that will occur, annually, during a prescribed analysis period; and
- 2) To yield a benefit-cost ratio (BCR) and net present value (NPV).

The BCR is one measure of the societal change that can result from transportation infrastructure investment. The BCR is calculated as the sum of project benefits divided by the sum of the project costs. A BCR greater than one is indicative of a positive return on capital investment as measured through regionally significant benefits. NPV is another measure of the return on investment for a given expenditure. NPV is calculated as the difference between the present value of all benefits and the present value of all costs. A larger and positive NPV indicates that benefits are greater than costs and that the project “pays for itself” and generates profits and value to the region.

BCAs provide a means to transparently measure a project’s overall benefit by developing a uniform measurement of the impact the project has on society. This measurement is accomplished by assigning a dollar value to benefits that can be compared to the construction costs and other related and ongoing costs.

In the BCA, the capital costs of constructing and maintaining the project are compared to the net benefit that the project provides to the region. The costs and benefits are discounted to compare all costs and benefits with a common base year measurement (2019 dollars per federal BCA guidance).

Additional project benefits are described in the report but remain unquantified due to uncertainty or lack of empirical data. These include opportunities to enhance the quality of life and economic vitality in the communities surrounding the project and the region, such as:

- Quality of Life – The Catawba Crossings Project provides a critical connection between Gaston County, York County, SC, and Mecklenburg County, creating community, access, jobs, and opportunity;
- Decreased congestion on regional roadways and at the other bridge crossings;
- Improved state of good repair and deferred maintenance or rehabilitation costs for area roadways and bridges, as a function of reduced vehicle miles traveled;
- Long Term Economic benefits from increased activity and employment due to improved accessibility (e.g., agglomeration benefits);
- Short Term Economic Impact, including creation of temporary quality jobs during construction, increasing wages, and spending in the local economy and providing economic benefits to local suppliers and contractors.

This analysis assumes that planning for the project will be completed by 2025 with construction complete for operation by 2030. Modifications to the analysis period, including a delayed opening, would likely result in a net neutral impact on the magnitude and relative performance of the BCA results (a more detailed description is available in *Section 4.2*). While the specific year that a funding application may be pursued and the year that the project may open are uncertain, the BCA still provides an accurate relative indication of the positive benefits of the project in comparison to its negative outcomes and costs.

Table 1: Benefit-Cost Analysis Summary

Possible Societal Benefits for Consideration	Key Benefits Quantified	Total Benefits	Present Value (7% Discount Rate)
Economic Competitiveness			
Travel Time Savings	Reduced driving distance and associated reduced travel time	\$443,502,921	\$114,132,270
Real Estate	Property value increases in Belmont area due to increased Highway Connectivity and River Crossing	\$25,604,193	\$12,164,368
Air Freight Resiliency	Increase in Truck-Air outbound freight at Charlotte Douglas International Airport due to reduced congestion	\$232,920,000	\$110,658,614
Agricultural Access	Increase in farm productivity / reduction in farm expense directly related to equipment and crop transportation expenses	\$9,181,293	\$2,346,644
Safety			
Crash Savings	Reduction in injury and property damage only (PDO) crashes	\$71,872,328	\$18,369,828
Environmental Sustainability			
Peak Hour Vehicle Emissions	CO ₂ , VOC, NO _x , PM _{2.5} reductions	\$216,295,786	\$81,533,312
Other			
Access to Hospitals and Emergency Services	Reduced Travel time and Morbidity due to more direct access to Charlotte Area Hospitals	\$260,133,082	\$66,491,550
Residual Value	Residual value of assets at the end of the analysis period	\$100,790,033	\$11,564,762
Maintenance Costs	Cost of regular maintenance and inspection of assets	-\$19,927,779	-\$4,308,940
Total Benefits		\$1,340,371,857	\$412,952,408
Total Costs		-\$296,712,837	-\$172,757,901
Benefit / Cost Ratio		4.52	2.39

The capital costs required to purchase the right-of-way (ROW) and build the roadway and bridge infrastructure are the key drivers of costs. Initial investment costs total \$314.8M based on cost estimates prepared in 2021, or \$296.7M in constant year 2019 dollars, with annual operating and maintenance costs to follow.

As demonstrated by the BCA, this project will contribute to quantifiable benefits to the region. The substantial positive impacts of the project in 2019 dollars are monetized at \$413M in benefits, assuming a 7 percent discount rate. This is in comparison to a discounted project cost of \$172.8M. As a result, the project has a BCR of 2.39, which represents a favorable investment of funds and a significant benefit to the region.

2 Project Description

The Catawba River creates a natural barrier to mobility between Mecklenburg County to the east and Gaston County to the west, and York County, South Carolina to the southwest. There are currently five bridges connecting Gaston and York counties to Mecklenburg County (NC 16, NC 27, I-85, and US 29/74 in Gaston County and Hwy 49 in York County). The bridge crossings in Gaston County are located approximately one to four miles apart. However, the bridge crossing in York County (Hwy 49) is located approximately 10 miles from the southernmost bridge crossing in Gaston County (US 29/74).

The limited inter-county connections force residents of southern Gaston (NC) and northern York (SC) counties traveling to Mecklenburg County to cross the Catawba River via I-85, US 29/74, or Hwy 49, each of which provide critical regional and statewide connections. As a result, the I-85, US 29/74, and Hwy 49 corridors become strained by being forced to combine traffic streams to serve much of the local, regional, and interstate traffic crossing the Catawba River leading to increased congestion and safety concerns. Western Mecklenburg, southern Gaston, and northern York counties are currently experiencing significant growth with sustained growth pressures expected in the coming years, which will increase the local traffic in these areas and create additional stress on the existing transportation networks within the region.

Creating a new crossing over the Catawba River between US 29/74 and Hwy 49 would provide regional travel benefits including enhancing connectivity, accessibility and mobility between Gaston, Mecklenburg, and York counties, while also improving equitable access to employment, medical, educational, and recreational opportunities in each county. An additional crossing would reduce traffic volumes and congestion along existing transportation corridors in the area, increasing their longevity and state of good repair.

The Catawba Crossings Project will provide a new 6.5-mile, four-lane, divided arterial that extends from NC 160 (Steele Creek Road) to NC 279 (New Hope Road), and that will include new bridges over the South Fork Catawba and Catawba rivers and will have an interchange with I-485. This addresses the significant need for transportation options in the area, improves the vitality and resiliency of the regional transportation network, and enhances quality of life for the residents and users in the area.

3 Baselines and Alternatives

Consistent with the direction provided by the United States Department of Transportation (USDOT), the BCA compares a No-Build Baseline Alternative and a Build Alternative.

3.1 No-Build Baseline

The No-Build Baseline Alternative maintains the existing number of bridges connecting Gaston and York counties to Mecklenburg County (NC 16, NC 27, I-85, and US 29/74 in Gaston County and Hwy 49 in York County) and no changes to the I-485 interchange. This develops a baseline to compare with the benefits of constructing the project. The framing of the No-Build Baseline Alternative is consistent with USDOT BCA guidance.

3.2 Build

The Build Alternative of this project includes the new 6.5-mile, four-lane, divided arterial that extends from NC 160 (Steele Creek Road) to NC 279 (New Hope Road). The benefits of constructing the project are the net benefits from the build scenario that exist beyond the capacity provided by the Baseline scenario. The construction of a new roadway alignment and new crossings between Gaston and Mecklenburg Counties would improve accessibility and mobility for Gaston, Mecklenburg, and York county residents while also improving equitable access to employment, medical, educational, and recreational opportunities in each county.

3.3 Affected Population

To focus the methodology of this BCA on real and measurable changes associated with constructing the Catawba Crossings Project, the affected population considered in the analysis are the residents and visitors of Gaston and Mecklenburg County, specifically the lower parts of each county, as well as York County, South Carolina and surrounding areas that utilize (or will utilize) the new Catawba Crossings Project roadway alignment and bridges for personal, business, agricultural, recreation, and tourism travel. Roadway users will benefit from improved connectivity and access, reduced congestion, and travel time savings. Additionally, the community surrounding the corridor will benefit from the improved economic competitiveness of the area, quality of life improvements, public health benefits, and increased safety due to reduced congestion, improved active transportation options, and enhanced access to emergency services at hospitals on the east side of the crossing.

4 Methodology

This BCA was prepared under the assumption that the Catawba Crossings Project would seek federal funding in the future. As such the BCA methodology is consistent with the latest USDOT guidelines related to the RAISE and INFRA programs in 2021¹.

Many high-level assumptions were made to facilitate the calculation of costs and benefits for this project during the analysis period.

- All final costs and benefits are expressed as 2019 dollars to be consistent with the recommended monetary values provided in the USDOT BCA guidance document.
- The average consumer price index is used to convert previous year dollars to 2019 dollars. A discount rate of 7 percent (assuming 7 percent annual inflation) is used to bring future year dollars to 2019 dollars. Each benefit or cost stream is separately discounted for each year in the analysis period such that future benefits and costs are expressed in the same present value terms.
- Net benefits are calculated by finding the difference between benefits and costs.

Project assumptions are detailed in the individual tabs of the BCA spreadsheet. Major components of the BCA analysis include:

- Operations and Maintenance costs
- Safety benefits
- Vehicular Travel Time benefits
- Emissions benefits
- Hospital Access benefits
- Value of Truck-Air Freight Efficiency benefits
- Agricultural Productivity benefits

In addition to the benefits listed above, unquantified/unmonetized benefits were also identified. These unquantified benefits are discussed in *Section 4.4.3* of this memorandum.

4.1 Scope and Limitations of BCA

Calculations and estimates used in this BCA and any economic forecasts are subject to uncertainty. Where possible, efforts were made to use values and assumptions from nationally recognized and accepted sources (NCDOT, Victoria Transport Policy Institute, Highway Capacity Manual (HCM)), or other empirical case studies that determined values through extensive research and study.

¹ <https://www.transportation.gov/sites/dot.gov/files/2021-02/Benefit%20Cost%20Analysis%20Guidance%202021.pdf>

The methodology presented herein, and the derived results represent the best effort to forecast the benefits and costs of constructing the roadway alignment and bridges, that would extend from NC 160 (Steele Creek Road) to NC 279 (New Hope Road), new crossings over the South Fork and Catawba rivers, an interchange with I-485, and associated multimodal infrastructure. The analysis is only as accurate as the validity of the underlying assumptions and parameters. The purpose of this BCA is not to provide an absolute measure of the project's costs and benefits, but rather to demonstrate the relative direction of anticipated benefits and costs.

Benefits to society that are not easily quantified (but are nonetheless tangible and relevant to the discussion of the project's utility) are described qualitatively in the unquantified benefits section of this memorandum. For benefits that are quantifiable, but difficult to compare to the Baseline scenario, an effort is made to be conservative in benefit estimation, using lower values within acceptable ranges to avoid overstating the potential benefits of the build scenario. In all instances, every effort is made to calculate only net benefits and to avoid double counting of benefits and the inclusion of transfers in the analysis (perceived benefits gained by one group that come at a cost to another group).

4.2 Analysis Period

The BCA was completed for a 30-year analysis period starting in 2022 and covering the five-year construction of the project. This analysis period was used to capture the benefits of the project while staying within USDOT guidance. Thirty-years is an appropriate analysis period because the project involves "the initial construction or full reconstruction of highways or similar facilities" and the 30-year analysis period also aligns with design year forecasting. This sequence assumes three years of planning, design, and right of way acquisition with construction beginning in 2025 and the project open by 2030. This results in a 22-year operating period of benefits following completion of the project. It is noted that any delays to the start of construction or lengthening of the construction period would result in a smaller amount of project benefits considered in this BCA². The chosen construction schedule is a reasonable timeline given the typical federal requirements to obligate and expend awarded funds within a given number of years.

It is recognized that sufficient planning may not be completed by 2025 in order for the Catawba Crossings project to secure funding and be operational by 2030. A revision to the analysis period – in this case, delaying opening to a year further in the future – would likely result in a net neutral impact on the magnitude and relative performance of the BCA results. The reasoning behind this is that a delayed opening would result in fewer operational years during which benefits are tabulated, creating a reduced *positive* impact in the BCA calculations. At the same time, this would also result in project costs accruing in further out years; when discounted, these costs would have a reduced *negative* impact on the BCA calculations.

In similar fashion, many of the underlying assumptions related to BCA costs and inflation are influenced by current economic conditions which demonstrate higher than typical costs for the construction industry; a delay in the project schedule provides time for construction costs to normalize, further reducing the *negative* impact on the BCA.

² Per federal guidelines, the analysis period should typically be no longer than 30 years. Delays to start of construction or lengthening of the construction schedule would not affect the analysis periods but would affect the operating period and the cumulative benefits from project opening to the end of the analysis period.

Overall, the chosen project time frame allows the analysis to be conducted in a manner that is consistent with the currently approved methodologies and funding priorities of the likely federal funding programs that could support this type of investment in transportation infrastructure. While it is recognized that the specific year that a funding application may be pursued and the year that the project may open are uncertain, the BCA still provides an accurate relative indication of the positive benefits of the project in comparison to its negative outcomes and costs. As details on the timing and costs of the Catawba Crossings project become more clearly defined, an update to this Benefit-Cost Analysis should be considered.

4.3 BCA Spreadsheet Walkthrough

4.3.1 Tab A – Inputs

The BCA spreadsheet included as supporting documentation to this analysis begins with an Inputs tab (Tab A) containing key information about the project. The most significant inputs in this analysis that are used to inform the BCA consist of the analysis period, travel time monetization factors, travel time factors, and daily traffic estimates.

Travel time savings were monetized using standard BCA values of \$17.90 per hour for all vehicle travel and \$30.80 per hour for commercial vehicle operators per USDOT Guidance.

The opening and design year annual average daily traffic along the new Catawba Crossings alignment was estimated at 29,000 vehicles per day (vpd) in 2030 and 37,400 vpd in 2045 per the transportation forecast report³ and technical memorandum⁴ that were prepared for the Catawba Crossings Feasibility Study. A 2.69 percent annual growth rate was developed and used to calculate the forecasted AADT along the Catawba Crossings alignment for every year between 2030 and 2045. The AADT was assumed to be constant for all years of the analysis period after 2045.

Annual travel time savings were based on the average of eight travel time routes (four inbound to I-485 and four outbound from I-485) for the no-build and build scenarios as reported in the transportation technical memorandum. A forecasted travel time savings of 15 minutes in the opening year and 10 minutes in the horizon year was assumed and travel time savings for all other years were developed using a growth equation between the opening and horizon year. An additional five minutes of local travel time savings was assumed for trips that did not travel the full distance between NC 279 and I-485, but that would otherwise benefit from the new alignment.

A similar process was used to develop the average distance savings (assumed to be 8.18 miles) for the eight travel time routes.

³ *Catawba Crossings Traffic Forecast Report*. Kimley-Horn. September 2020.

⁴ *Catawba Crossings Transportation Technical Memorandum*. Kimley-Horn. April 2021.

4.3.2 Tab B – Output Table

The Output Table tab (Tab B) contains the high-level annualized summary table presented earlier in this memorandum and reports the undiscounted and discounted costs and benefits for each major merit criteria.

4.3.3 Tab C – Summary

The Summary tab (Tab C) includes the detailed costs and benefits timeline and calculates the BCA results.

4.3.4 Tab D – Cost Estimate

The analysis is based on an assumed project delivery schedule. Construction is anticipated to begin in 2025. Project opening, or the first year of project benefits, is anticipated to be 2030. 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 because this project assumes a new roadway alignment with minimal interaction with existing network routes (i.e., limited road closures or detouring are anticipated). As such, work zone and other temporary impacts were excluded from the analysis. The project costs were developed based on individual construction line items, with percentage contingencies for preliminary engineering, contingencies, CEI, and other factors. Project costs were developed using 2021 year of expenditure dollars and then discounted back to 2019 dollars and then further discounted by 7 percent per USDOT BCA guidelines. Based on the delivery schedule, the project costs in 2019 dollars will be \$296.7M undiscounted and \$172.8M using a 7 percent discount rate.

4.3.5 Tab E – Construction & Residual

Many of the components of the project have service lives beyond the analysis period, so the residual capital value is calculated for the Build Alternative. This residual value is applied as a benefit in the BCA using linear depreciation. The residual was calculated assuming:

- Structures and ROW Items: 75-year service life and 100-year service life, respectively
- Drainage and Public Utility Items: 50-year service life

All costs and benefits were estimated in year of expenditure dollars, converted to constant 2019 dollars, to be consistent with recommended monetized values provided in the Department of Transportation's *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*. Costs were still discounted back to year 2019 to return a present value. The total benefit associated with the residual values in 2019 dollars was \$100.8M undiscounted, or \$11.6M at a 7 percent discount. To be conservative, soft costs associated with construction like engineering costs and mobilization are given no residual values.

4.3.6 Tab F – Maintenance Cost

There will be additional maintenance and inspection costs associated with maintaining the newly constructed roadway and bridge crossings in a state of good repair. A rural bridge study by NCDOT⁵

⁵ <https://connect.ncdot.gov/resources/GREATER-Rural-Bridge-Program/Documents/A01%20BCAMemo.pdf>

estimated the per mile operating and maintenance costs for a bridge less than 44 years old to be \$8,000 in 2017 dollars. This was escalated to 2019 dollars, doubled to represent additional costs borne to urban bridges due to higher traffic volumes, and then applied to the assumed length of the bridges. Additionally, minor (every 5 years) and major (every 10 years) rehabilitations costs were estimated at 2 percent and 5 percent, respectively, of total structural element construction costs.

Roadway operating and maintenance costs per centerline mile were estimated based on source data from the Victoria Transport Policy Institute⁶.

The total disbenefit associated with operating and maintenance, including minor and major rehabilitation of infrastructure assets, in 2019 dollars was assumed to be -\$19.9M undiscounted and -\$4.3M discounted at a 7 percent discount.

4.3.7 Tab G – Safety

The quantitative safety measures include impacts to injury, fatality, and property damage only (PDO) crashes. The cost savings from reducing injury crashes are much greater than those from reducing PDO crashes because of the societal cost associated with injuries. The safety analysis was based on the time range (2015 to 2020), study area, and roadway segments identified in the *Transportation Technical Memorandum*. Accordingly, there was a total of 112 crashes on NC 279, 855 crashes on NC 273, 939 crashes on US 74/US 29, and 2,530 crashes on I-85 considered in the analysis.

Per the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2021, the total average monetized value of each crash category was used. The Build Alternative improves the safety along key roadways in the project area by reducing the number of vehicles and thus reducing crash likelihood along roadway segments, at intersections, and at the interchange.

Over the 30-year analysis period, the roadway improvements are projected to reduce the expected number of crashes by 218 crashes. The total safety benefits for all four segments were monetized based on the severity probability of a collision along each roadway. Cumulatively, in 2019 dollars, this was valued at \$71.9M undiscounted or \$18.4M at a 7 percent discount.

4.3.8 Tab H – Travel Time

The travel time benefits of the project were calculated using forecasted peak period and peak hour travel time data pulled from the Transportation Technical Memorandum.

The NCDOT intersection analysis utility (IAU) spreadsheet was used to convert the AADT volumes from the traffic forecast into peak-hour intersection turning-movement volumes. The 2020 no-build traffic forecast volumes were based on historic AADT data and turning movement counts collected between 2017 and 2019. The 2020 no-build traffic volumes are intended to represent volumes that would have been expected in 2020 without the impacts associated with the COVID-19 pandemic. The build travel-time estimate was developed by using the Metrolina Regional Model (MRM19v1.0). The model was obtained from Charlotte DOT Regional Travel Modeling and Analysis Section in June 2020.

⁶ <https://www.vtppi.org/>

Travel time savings were monetized using standard BCA values of \$17.90 per hour for all vehicle travel, and \$30.80 per hour for commercial operators. Commercial truck traffic was assumed to account for 8.69 percent of all traffic based on the NCDOT Annual Vehicle Classification Report from 2019. To calculate all-day travel time savings, peak hour travel time was assumed to account for 70 percent of the total congested travel time. This is a dynamic assumption that can be modified in the BCA spreadsheet to assess the sensitivity of the results to travel time savings. The BCA resulted in a net travel time savings for commercial and non-commercial trips of \$443.5M in 2019 dollars, or \$114.1M at a 7 percent discount rate.

4.3.9 Tab I – Hospital Access

Residents on the west side of the proposed Catawba Crossings Project, specifically in lower Gaston County, are potentially impacted by the amount of time it takes to cross the river and access Charlotte-area hospitals during an emergency. Per the Federal Emergency Management Agency (FEMA) standards, a 1-mile increase in distance to emergency services increases the likelihood of community deaths due to Acute Myocardial Infarction (AMI) by 6.12 percent and the likelihood of community deaths due to unintentional injuries by 4.76 percent. As such, the current travel time and distance for lower Gaston County residents' results in a higher likelihood of death from a life-threatening injury or AMI compared to the travel time and distance with the Catawba Crossings Project in place. The number of deaths per year due to AMI, and the number of deaths per year due to unintentional injuries were calculated using equations 48 and 49 described in the *Benefit Cost Sustainment and Enhancement Baseline Standard Economic Value Methodology Report (July 2016)*.

The amount of time to get patients to and from lower Gaston County during an emergency is also critical. The average travel time cost savings for emergency travel was calculated by converting the vehicle miles traveled (VMT) to peak hour travel time which was then used to calculate total travel time savings.

It is recognized that a new hospital is planned to be in the Belmont Area, off Interstate 85 in Gaston County, and will include a 66-bed hospital, a 16-room emergency department, a labor and delivery unit, operating rooms, a medical office building and a parking deck. This new hospital and medical campus will likely serve a significant portion of the emergency room visits of Gaston County residents. The facility is currently scheduled to be open in 2023. To account for this facility, it was assumed that 60 percent of emergency room visits from Gaston County would be served by the new Belmont facility (or by other existing medical facilities west of the Catawba River). The remaining 40 percent of emergency room visits would be served by Charlotte area hospitals and thus would benefit from the reduced travel distance/time that would result from Catawba Crossings Project. The total benefit in 2019 dollars associated with providing a new roadway alignment and an additional crossing over the Catawba River and minimizing acuity levels and reducing emergency room travel time delays was \$260.1M undiscounted and approximately \$66.5M at a 7 percent discount rate.

4.3.10 Tab J – Environmental

An overall reduction in travel time and more consistent travel speeds based on reduced congestion in the Build Alternative will result in emissions reductions. Emissions reductions were calculated based on VMT savings. Average in-use emission rates for both passenger cars and heavy-duty trucks from EPA

documentation were used for VOCs, NOx and PM2.5. Average in-use Carbon Dioxide emissions rates for passenger cars were from EPA documentation⁷ while Carbon Dioxide emissions rates for heavy duty vehicles were calculated using EPA documentation⁸ and FHWA Statistics on heavy duty vehicles⁹. Sulfur Dioxide emissions rates for both passenger cars and heavy-duty trucks were based on a University of Nebraska-Lincoln study.¹⁰ All sources are identified and documented in the BCA spreadsheet. Damage costs for pollutant emissions from USDOT guidance were used to calculate the savings in the Build Alternative. The project results in over 1.1M metric tons of emissions saved over the analysis period. The benefit associated with the emissions reduction as well as the reduction in other pollutants in 2019 dollars was \$216.3M (approximately \$81.5M at a 7 percent discount rate).¹¹

4.3.11 Tab K – Real Estate

The Build Alternative will increase the accessibility that residents of Gaston County and York County, SC communities have to the City of Charlotte. As considered in this analysis, this will result in a one-time increase in property values on the western side of the project in Gaston County only. The property value benefits of the project were calculated by applying a 3 percent premium to available property value data provided by Gaston County within a two-mile radius of the project vicinity. To be conservative, no property value increases were assumed for York County, South Carolina; these benefits were excluded from the analysis to minimize the potential of double counting travel time related benefits (assuming that the reduction in travel time would be the primary factor that would increase property values in York County).

A year 2000 case study¹² was reviewed for the Neuse River Bridge (an old four-lane swing bridge in North Carolina's Inner Banks Region, replaced with a new four-lane fixed-span bridge structure in a new location). The project greatly improved access between two counties and added capacity to an already stressed system – similar to the goals of the Catawba Crossings Project. The case study found that at the county and local levels median property values increased by 32 and 50 percent after the bridge was replaced.

It is noted however that not all this growth can be directly attributed to the bridge and transportation improvements; still, this is an indicator that additional connectivity could have an impact on property values. For the purposes of this analysis, to be conservative, a value of 3 percent was chosen as a nominal expected increase in property values that could be reasonably argued to be directly related to the roadway and bridge improvements.

Property value increases were not applied to Mecklenburg County, considering the assumption that the River District development area is expected to develop regardless of the status of this project and would likely be the largest driver of property value increases in the area. The project results in a one-time property value increase of approximately \$25.6M in 2019 dollars, or \$12.2M at a 7 percent discount rate.

⁷ EPA Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks - Emission Facts, 2008

⁸ EPA Average In-Use Emissions from Heavy-Duty Trucks - Emission Facts, 2008

⁹ HDDV: <https://scholarworks.rit.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=10212&context=theses>

¹⁰ [Alahmad, Moe. Greenhouse Gas Emissions Data for the Transportation Sector in Nebraska.](#)

¹¹ Per federal guidelines, CO2 cost savings were discounted at 3 percent

¹² https://planningtools.transportation.org/290/view-case-study.html?case_id=87

4.3.12 Tab L – Air Freight Resiliency

The reduced congestion on regional roadways and the increase in river crossings will increase the potential viability of truck-air freight movements. For the purposes of this analysis, it was assumed that a one-time 3 percent increase in outbound air tonnage at Charlotte Douglas International Airport would result based on this improved connectivity.

This increase was applied to the opening year of the project only and based on a review of the Centralia Council of Governments Freight Mobility Plan¹³ and the forecasted truck-freight outbound cargo values.

It was noted in the study that, “though small in volume, airborne freight has by far the highest value per ton of any mode.” The mobility plan recognized connectivity of trucking routes as a key issue.¹⁴ Despite the current challenges, outbound freight cargo is anticipated to grow by 350 percent as a factor of increased demand, increased capacity, and increased/enhanced transportation network connectivity.

The 3 percent value used in this analysis is a nominal factor in comparison to this 350 percent growth and a conservative assumption of the value that improved direct connectivity between truck and air services will bring to Charlotte Douglas International Airport. It is noted that the 3 percent value was arrived at through sensitivity testing.

The year 2020 cargo loads were reviewed from monthly activity reports¹⁵ and a 40 to 60 percent split of outbound and inbound freight was assumed. Per ton freight values were developed based on a review of *Appendix D: Freight Forecasts of the Greater Charlotte Regional Freight Mobility Plan*.

The total benefit associated with improved freight capabilities at Charlotte Douglas International Airport was \$232.9M undiscounted and approximately \$110.7M in 2019 dollars when discounted at 7 percent.

4.3.13 Tab M – Agricultural Access

The project benefits agricultural properties in Gaston and Mecklenburg counties by allowing trucks to take more direct routes to and from markets and allowing farm equipment and products to move more efficiently between farms. The agricultural access benefit quantifies the increase in farm efficiency that can be realized with an improved transportation network.

As found in the Soybean Checkoff funded analysis, “Farm to Market: A Soybean’s Journey,” 100 percent of the soybean deliveries from the farm to the elevator occur via truck, or to a much lesser extent, grain wagon. Therefore, if trucking is inefficient, farmers will be inefficient, and profitability will decline.”

Based on 2017 statewide average total farm production expenses, converted to 2019 dollars, a 2.5 percent reduction in farm expenses is assumed to be attributable to the reduced congestion and travel time. It is assumed that the project will benefit 5 percent of the farms in the nearby counties of Gaston, Mecklenburg, and York (South Carolina).

¹³ <https://centralia.org/wp-content/uploads/2020/07/Greater-Charlotte-Regional-Freight-Mobility-Plan-2016.pdf>

¹⁴ (“Intermodal connectivity allows the freight system to operate more efficiently by increasing the mode choices and speed at which goods move throughout the region and issues with routes and infrastructure to rail yards, airports, and industry clusters. Improving these connections will increase the velocity of freight, reduce transportation costs, and positively impact freight-reliant industries. In the study area, intermodal facilities are connected to the larger highway system in high congestion conditions”)

¹⁵ <https://cltairport.mediaroom.com/media#activity>

Multiplying the average expense savings by the number of farms results in the total annual agriculture access benefits. The annual reduction in expenses was held constant throughout the analysis period. This improved efficiency allows farmers to be more profitable, supporting rural incomes. In total, the project results in agricultural access benefits of \$9.2M undiscounted and \$2.3M in 2019 dollars when discounted at 7 percent.

4.3.14 Tab N – Economic Output

The economic output analysis was not included in the BCA but was used as a secondary analysis of the benefits resulting from temporary spending, earning, and employment. Construction of the project and an injection of new federal money in the region is anticipated to create short-term spending, earning, and employment gains. To quantify these benefits, the aggregate North-Carolina-specific Region Input-Output Modeling System (RIMS II), Type II multipliers for the construction industry were obtained from the Bureau of Economic Analysis. These multipliers provide an estimate of the total economic gains in all industries in the region per dollar of expenditure for specific industries. These multipliers were applied to the total anticipated federal expenditure. Assuming a 25 percent federal investment, the project results in the creation of 1,261 jobs, an economic output of \$168.2M, and earnings of \$58.5M in 2019 dollars.

4.4 Other Issues in Benefits Estimation

4.4.1 Induced Trips

When a considerable change in access and user-convenience for an individual mode takes place, there can be “new service” induced: trips generated. This means that a completely new trip is made due to that new service (i.e., not a transfer from other modes or other locations) being offered.

4.4.2 Agglomeration Benefits

An improvement in travel accessibility generates increased opportunities in business and the labor market. Improvement in travel time and convenience from the Baseline scenario to the Build scenario creates a greater field of opportunities from a larger geographic catchment for the same cost of travel. Increasing accessibility between labor markets and industries results in:

- Agglomeration economies include business time savings, improved reliability, and increased output in imperfectly competitive markets.
- Improved labor market conditions are created from the fact that as generalized costs fall, firms and workers in their existing locations will be closer to each other, and the locations become more accessible, which results in:
 - More people choosing to work because of commuting travel time savings.
 - Some people choosing to work longer hours because they spend less time commuting.
 - Some people changing to a higher paid and a more productive job, as better transportation improves the accessibility of firms and workers.
- Greater tax revenues from increased business and employment.

4.4.3 Unquantified Benefits

Several factors were not quantified as part of the analysis but provide additional benefits beyond those quantified above. Some unquantified factors are:

- **Short Term Economic Impact:** Project construction creates temporary quality jobs during construction, increasing wages in the local economy and providing economic benefits to local suppliers and contractors.
- **Fuel Consumption:** Mode shift from SOVs to active transportation modes will result in less fuel consumption travelers. Each 1% shift from automobile to active travel typically reduces fuel consumption 2-4% based on case study research.
- **Improved Equity:** The combined benefits will allow different populations (children, elderly, and economically, socially, or physically disadvantaged people) to fairly use and share in public resources by increasing accessibility, connectivity, and affordability. More than 50% of older Americans who do not drive stay home on a given day because they lack transportation options.
- **River District business productivity** – increased employment, profits and employee incomes related to enhance accessibility and mobility.
- **Reduced Passenger Delays** – Reduction in passenger delays and associated productivity costs due to reduced travel time to and from Charlotte Douglas International Airport.

5 Summary

The results of the BCA conducted for the Catawba Crossings Project 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 the project benefits outweigh the project costs. The larger the BCR and NPV, the greater the expected benefits of the project. The BCR provides the amount of benefit per unit cost, which can be useful for determining 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 7 percent discount. As can be seen in the table, there are substantial benefits associated with the Catawba Crossings Project.

Table 2: Benefit-Cost Ratio and Net Present Value Summary

	Undiscounted	7 percent discount
Benefits	\$1,340,371,857	\$412,952,408
Costs	-\$296,712,837	-\$172,757,901
BCR	4.52	2.39
Net Present Value	\$1,043,659,020	\$240,194,508

6 Attachment – BCA Spreadsheet Excerpts

Project Information

Project Catawba Crossing: S NewHope Road (NC 279) to Steele Creek Road (NC 160)- Add new crossing
 Grant Federal Funding

Project Schedule

Base Year 2019
 Project Start 2022
 Construction Start 2025
 Construction Years 5
 Project Use Start 2030
 Years of Operations 23
 Total Analysis Period 30 years
 Days / year 261 weekday analysis
 Discount Rate 7%
 Percent of benefit at End of Construction 100% Note: this is normally 100%
 Years until full benefits 1
 Year of full benefits 2031

Guidance Source

Primary Guidance Source USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2021

Costs and Other Inputs

Value	Note	Source
In-Vehicle Travel Time: All	\$17.90 per hour	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2021
Commercial Vehicle Operators Travel Time: Truck Drivers	\$30.80 per hour	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2021
Non-commercial vehicle occupants	1.67	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2021. Passenger vehicles (all travel).
Commercial vehicle occupants	1	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2021. Assume 1 driver per truck.

Time Savings

Value	Note	Source
Percentage trucks	8.7% %	https://www.arcgis.com/
Peak % of Total Congestion	70.0% %	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 1 Distance (NB/EB)	11.50 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 2 Distance (NB/EB)	14.50 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 3 Distance (NB/EB)	11.60 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 4 Distance (NB/EB)	10.30 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 1 Distance to 485 Outer Loop (NB/EB)	21.00 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 2 Distance to 485 Outer Loop (NB/EB)	22.50 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 3 Distance to 485 Outer Loop (NB/EB)	8.00 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Route 4 Distance to 485 Outer Loop (NB/EB)	6.90 miles	Transportation Technical Memorandum. Kimley-Horn. April 2021.
Average No Build Length (Inner Loop)	13.00 miles	
Average Build Length (Inner Loop)	10.95 miles	
Average No Build Length (Outer Loop)	21.75 miles	
Average Build Length (Outer Loop)	7.45 miles	
Distance Savings (Inner Loop)	2.05 miles	
Distance Savings (Outer Loop)	14.30 miles	
2025 No Build Total Travel time (Inner Loop)	30.575 minutes	
2025 Build Total Travel Time (Inner Loop)	21.375 minutes	
2045 No Build Total Travel time (Inner Loop)	30.575 minutes	
2045 Build Total Travel Time (Inner Loop)	21.375 minutes	
Average Travel Time Savings (Inner Loop)	9.2 minutes	
2025 No Build Total Travel time (Outer Loop)	35.15 minutes	
2025 Build Total Travel Time (Outer Loop)	14.925 minutes	
2045 No Build Total Travel time (Outer Loop)	35.15 minutes	
2045 Build Total Travel Time (Outer Loop)	14.925 minutes	
Average Travel Time Savings (Outer Loop)	20.225 minutes	
Average Travel Time Savings (Local Routes)	5 minutes	Assumption

AADT

	Value	Note	Source
AADT Forecast			
Existing AADT			
Construction Year	2030		Transportation Technical Report
Construction Year AADT	29,000		Assume 1.69% average area growth 2015 to 2045 (based on travel demand model)
Design Year	2045		Transportation Technical Memorandum. Kimley-Horn. April 2021.
Design Year AADT	37,400		Transportation Technical Memorandum. Kimley-Horn. April 2021.
Total Alignment Length	6.5 miles		Transportation Technical Memorandum. Kimley-Horn. April 2021.
Bridge length	0.64 mile		Transportation Technical Memorandum. Kimley-Horn. April 2021.

Calendar Year	Project Use		Average Travel Time (minutes)				Average Distance (Mile)			Benefits realized	Project AADT on Catawba Crossing				
	Project Year	Year	No Build	Build	Build Local Travel Savings	Total Travel Savings	No Build	Build	Savings		Calendar Year	Project Year	Total	Existing	Induced
2022	1	0	0	0	0	0	0	0	0	0%	2022	1	0	0	0
2023	2	0	0	0	0	0	0	0	0	0%	2023	2	0	0	0
2024	3	0	0	0	0	0	0	0	0	0%	2024	3	0	0	0
2025	4	0	32.8625	18.15	5	20	17.38	9.20	8.18	0%	2025	4	0	0	0
2026	5	0	33	18	5	19	17.38	9.20	8.18	0%	2026	5	0	0	0
2027	6	0	32	18	5	19	17.38	9.20	8.18	0%	2027	6	0	0	0
2028	7	0	32	18	5	19	17.38	9.20	8.18	0%	2028	7	0	0	0
2029	8	0	32	18	5	19	17.38	9.20	8.18	0%	2029	8	0	0	0
2030	9	1	32	18	5	19	17.38	9.20	8.18	100%	2030	9	29,000	0	29,000
2031	10	2	31	18	5	18	17.38	9.20	8.18	100%	2031	10	29,560	0	29,560
2032	11	3	31	18	5	18	17.38	9.20	8.18	100%	2032	11	30,120	0	30,120
2033	12	4	31	18	5	18	17.38	9.20	8.18	100%	2033	12	30,680	0	30,680
2034	13	5	31	18	5	18	17.38	9.20	8.18	100%	2034	13	31,240	0	31,240
2035	14	6	31	18	5	17	17.38	9.20	8.18	100%	2035	14	31,800	0	31,800
2036	15	7	30	18	5	17	17.38	9.20	8.18	100%	2036	15	32,360	0	32,360
2037	16	8	30	18	5	17	17.38	9.20	8.18	100%	2037	16	32,920	0	32,920
2038	17	9	30	18	5	17	17.38	9.20	8.18	100%	2038	17	33,480	0	33,480
2039	18	10	30	18	5	16	17.38	9.20	8.18	100%	2039	18	34,040	0	34,040
2040	19	11	29	18	5	16	17.38	9.20	8.18	100%	2040	19	34,600	0	34,600
2041	20	12	29	18	5	16	17.38	9.20	8.18	100%	2041	20	35,160	0	35,160
2042	21	13	29	18	5	16	17.38	9.20	8.18	100%	2042	21	35,720	0	35,720
2043	22	14	29	18	5	16	17.38	9.20	8.18	100%	2043	22	36,280	0	36,280
2044	23	15	28	18	5	15	17.38	9.20	8.18	100%	2044	23	36,840	0	36,840
2045	24	16	28.26	18	5	15	17.38	9.20	8.18	100%	2045	24	37,400	0	37,400
2046	25	17	28	18	5	15	17.38	9.20	8.18	100%	2046	25	37,400	0	37,400
2047	26	18	28	18	5	15	17.38	9.20	8.18	100%	2047	26	37,400	0	37,400
2048	27	19	28	18	5	15	17.38	9.20	8.18	100%	2048	27	37,400	0	37,400
2049	28	20	28	18	5	15	17.38	9.20	8.18	100%	2049	28	37,400	0	37,400
2050	29	21	28	18	5	15	17.38	9.20	8.18	100%	2050	29	37,400	0	37,400
2051	30	22	28	18	5	15	17.38	9.20	8.18	100%	2051	30	37,400	0	37,400

Possible Societal Benefits for Consideration	Key Benefits Quantified	Total Benefits	Present Value (7% Discount Rate)
Economic Competitiveness			
Travel Time Savings	Reduced driving distance and associated reduced travel time	\$443,502,921	\$114,132,270
Real Estate	Property Value increases in Belmont area due to increased Highway Connectivity and River Crossing	\$25,604,193	\$12,164,368
Air Freight Resiliency	Increase in Truck-Air Outbound freight at Charlotte Douglass due to reduced congestion	\$232,920,000	\$110,658,614
Agricultural Access	Increase in Farm productivity / reduction in farm expense directly related to equipment and crop transportation expenses	\$9,181,293	\$2,346,644
Safety			
Crash Savings	Reduction in injury and PDO crashes	\$71,872,328	\$18,369,828
Environmental Sustainability			
Peak Hour Vehicle Emissions	CO2, VOC, NOx, PM2.5 reductions	\$216,295,786	\$81,533,312
Other			
Access to Hospitals and Emergency Services	Reduced Travel time and Morbidity due to more direct access to Charlotte Area Hospitals	\$260,133,082	\$66,491,550
Residual Value	Residual value of assets at the end of the analysis period	\$100,790,033	\$11,564,762
Maintenance Costs	Cost of regular maintenance and inspection of assets	-\$19,927,779	-\$4,308,940
Total Benefits		\$1,340,371,857	\$412,952,408
Total Costs		-\$296,712,837	-\$172,757,901
Benefit / Cost Ratio		4.52	2.39

	Undiscounted	7% discount
Benefits	\$1,340,371,857	\$412,952,408
Costs	\$296,712,837	\$172,757,901
BCR	4.52	2.39
NPV	\$1,043,659,020	\$240,194,508

Calendar Year	Project Year	Costs		
		Construction	Total Costs	Present Value (7% Discount Rate)
2022	1	\$0	\$0	\$0
2023	2	\$0	\$0	\$0
2024	3	\$0	\$0	\$0
2025	4	\$44,506,926	\$44,506,926	\$29,656,844
2026	5	\$59,342,567	\$59,342,567	\$36,955,569
2027	6	\$74,178,209	\$74,178,209	\$43,172,393
2028	7	\$74,178,209	\$74,178,209	\$40,348,031
2029	8	\$44,506,926	\$44,506,926	\$22,625,064
2030	9	\$0	\$0	\$0
2031	10	\$0	\$0	\$0
2032	11	\$0	\$0	\$0
2033	12	\$0	\$0	\$0
2034	13	\$0	\$0	\$0
2035	14	\$0	\$0	\$0
2036	15	\$0	\$0	\$0
2037	16	\$0	\$0	\$0
2038	17	\$0	\$0	\$0
2039	18	\$0	\$0	\$0
2040	19	\$0	\$0	\$0
2041	20	\$0	\$0	\$0
2042	21	\$0	\$0	\$0
2043	22	\$0	\$0	\$0
2044	23	\$0	\$0	\$0
2045	24	\$0	\$0	\$0
2046	25	\$0	\$0	\$0
2047	26	\$0	\$0	\$0
2048	27	\$0	\$0	\$0
2049	28	\$0	\$0	\$0
2050	29	\$0	\$0	\$0
2051	30	\$0	\$0	\$0
Total		\$296,712,837	\$296,712,837	\$172,757,901

Calendar Year	Project Year	Residual Value	Maintenance	Safety	Travel Time	Hospital Access	Environmental CO2	Environmental Non CO2	Property Values	Air Freight Resiliency	Agricultural Access
2022	1	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2023	2	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2024	3	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2025	4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2026	5	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2027	6	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2028	7	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2029	8	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2030	9	\$0	-\$49,984	\$3,266,924	\$20,489,172	\$11,827,547	\$3,273,092	\$4,360,310	\$25,604,193	\$232,920,000	\$417,331
2031	10	\$0	-\$51,334	\$3,266,924	\$20,530,649	\$11,827,199	\$3,390,990	\$4,444,509	\$0	\$0	\$417,331
2032	11	\$0	-\$52,724	\$3,266,924	\$20,558,707	\$11,826,852	\$3,510,960	\$4,528,708	\$0	\$0	\$417,331
2033	12	\$0	-\$54,155	\$3,266,924	\$20,573,345	\$11,826,505	\$3,633,002	\$4,612,907	\$0	\$0	\$417,331
2034	13	\$0	-\$2,361,144	\$3,266,924	\$20,574,564	\$11,826,157	\$3,814,919	\$4,697,106	\$0	\$0	\$417,331
2035	14	\$0	-\$57,149	\$3,266,924	\$20,562,364	\$11,825,810	\$3,942,142	\$4,781,305	\$0	\$0	\$417,331
2036	15	\$0	-\$58,713	\$3,266,924	\$20,536,744	\$11,825,463	\$4,071,437	\$4,865,505	\$0	\$0	\$417,331
2037	16	\$0	-\$60,325	\$3,266,924	\$20,497,705	\$11,825,115	\$4,202,805	\$4,949,704	\$0	\$0	\$417,331
2038	17	\$0	-\$61,984	\$3,266,924	\$20,445,247	\$11,824,768	\$4,336,245	\$5,033,903	\$0	\$0	\$417,331
2039	18	\$0	-\$6,980,236	\$3,266,924	\$20,379,369	\$11,824,420	\$4,471,758	\$5,118,102	\$0	\$0	\$417,331
2040	19	\$0	-\$65,455	\$3,266,924	\$20,300,071	\$11,824,073	\$4,609,342	\$5,202,301	\$0	\$0	\$417,331
2041	20	\$0	-\$67,268	\$3,266,924	\$20,207,355	\$11,823,726	\$4,748,999	\$5,286,500	\$0	\$0	\$417,331
2042	21	\$0	-\$69,136	\$3,266,924	\$20,101,219	\$11,823,378	\$4,956,819	\$5,370,699	\$0	\$0	\$417,331
2043	22	\$0	-\$71,061	\$3,266,924	\$19,981,663	\$11,823,031	\$5,101,657	\$5,454,898	\$0	\$0	\$417,331
2044	23	\$0	-\$2,378,556	\$3,266,924	\$19,848,688	\$11,822,684	\$5,248,566	\$5,539,097	\$0	\$0	\$417,331
2045	24	\$0	-\$75,084	\$3,266,924	\$19,702,294	\$11,822,336	\$5,397,548	\$5,623,296	\$0	\$0	\$417,331
2046	25	\$0	-\$77,186	\$3,266,924	\$19,702,294	\$11,822,336	\$5,466,748	\$5,623,296	\$0	\$0	\$417,331
2047	26	\$0	-\$79,352	\$3,266,924	\$19,702,294	\$11,822,336	\$5,535,947	\$5,623,296	\$0	\$0	\$417,331
2048	27	\$0	-\$81,582	\$3,266,924	\$19,702,294	\$11,822,336	\$5,605,146	\$5,623,296	\$0	\$0	\$417,331
2049	28	\$0	-\$7,000,422	\$3,266,924	\$19,702,294	\$11,822,336	\$5,743,545	\$5,623,296	\$0	\$0	\$417,331
2050	29	\$0	-\$86,246	\$3,266,924	\$19,702,294	\$11,822,336	\$5,812,745	\$5,623,296	\$0	\$0	\$417,331
2051	30	\$100,790,033	-\$88,683	\$3,266,924	\$19,702,294	\$11,822,336	\$5,812,745	\$5,623,296	\$0	\$0	\$417,331
Total		\$100,790,033	-\$19,927,779	\$71,872,328	\$443,502,921	\$260,133,082	\$102,687,157	\$113,608,630	\$25,604,193	\$232,920,000	\$9,181,293

Total Benefits	Present Value (7% Discount Rate)
\$0	\$0
\$0	\$0
\$0	\$0
\$0	\$0
\$0	\$0
\$0	\$0
\$0	\$0
\$0	\$0
\$302,108,585	\$144,339,141
\$43,826,269	\$20,332,120
\$44,056,759	\$19,215,858
\$44,275,860	\$18,163,843
\$42,235,859	\$16,374,168
\$44,738,728	\$16,275,828
\$44,924,691	\$15,396,381
\$45,099,260	\$14,568,490
\$45,262,433	\$13,789,332
\$38,497,668	\$11,268,846
\$45,554,588	\$12,366,561
\$45,683,566	\$11,717,938
\$45,867,234	\$11,141,504
\$45,974,444	\$10,567,609
\$43,764,735	\$9,603,317
\$46,154,647	\$9,521,003
\$46,221,744	\$9,019,787
\$46,288,778	\$8,548,950
\$46,355,746	\$8,106,543
\$39,575,306	\$6,810,645
\$46,558,681	\$7,327,524
\$147,346,276	\$18,497,021
\$1,340,371,857	\$412,952,408

DETAILED COST ESTIMATE

Assumed Inflation Rate

Description	YOE \$	YOE Year	Base Year \$	Lifespan	Cost Year
Clearing and Grubbing	\$ 6,407,500.00	2021	\$6,039,683.29	No residual	all
Borrow	\$ 26,084,000.00	2021	\$24,586,671.69	No residual	all
Unclassified Excavation	\$ 24,314,000.00	2021	\$22,918,276.93	No residual	all
		2021	\$0.00	No residual	all
Drainage:		2021	\$0.00	No residual	all
4 lane divided c&g	\$ 4,790,500.00	2021	\$4,515,505.70	50 year	all
2 lane ramp	\$ 214,500.00	2021	\$202,186.82	50 year	all
2 lane y-lines	\$ 57,500.00	2021	\$54,199.26	50 year	all
		2021	\$0.00	No residual	all
Subgrade Stabilization	\$ 959,700.00	2021	\$904,609.29	No residual	all
Fine Grading	\$ 1,229,400.00	2021	\$1,158,827.41	No residual	all
		2021	\$0.00	No residual	all
New Pavement	\$ 17,571,200.00	2021	\$16,562,541.24	No residual	all
Monolithic Island	\$ 119,195.20	2021	\$112,352.91	No residual	all
4" Concrete Sidewalk	\$ 2,824,735.20	2021	\$2,662,583.84	No residual	all
2'-6" C&G	\$ 1,330,509.90	2021	\$1,254,133.19	No residual	all
1'-6" C&G	\$ 1,340,540.00	2021	\$1,263,587.52	No residual	all
		2021	\$0.00	No residual	all
Erosion Control	\$ 1,054,000.00	2021	\$993,496.09	No residual	all
		2021	\$0.00	No residual	all
Traffic Control	\$ 2,680,000.00	2021	\$2,526,157.04	No residual	all
Thermo and Markers	\$ 268,000.00	2021	\$252,615.70	No residual	all
		2021	\$0.00	No residual	all
Proposed Structures		2021	\$0.00	No residual	all
Duals - 1@1690 x 49, 1@1690 x52	\$ 51,546,673.10	2021	\$48,587,683.19	75 Year Life Span	all
Duals - 1@2186 x 61, 1@2186x64	\$ 43,053,270.00	2021	\$40,581,836.18	75 Year Life Span	all
Single - 1@390x114	\$ 5,380,993.80	2021	\$5,072,102.74	75 Year Life Span	all
Single - 1@216x173	\$ 6,042,779.28	2021	\$5,695,899.03	75 Year Life Span	all
Proposed Approach Slabs		2021	\$0.00	75 Year Life Span	all
Duals - 1@25 x 49, 1@25 x52	\$ 63,125.00	2021	\$59,501.37	75 Year Life Span	all
Duals - 1@25 x 61, 1@25x64	\$ 78,125.00	2021	\$73,640.31	75 Year Life Span	all
Single - 1@25x114	\$ 71,250.00	2021	\$67,159.96	75 Year Life Span	all
Single - 1@25x173	\$ 108,125.00	2021	\$101,918.18	75 Year Life Span	all
TOTAL CONSTRUCTION COSTS	\$197,589,621.48		\$186,247,168.89		
Misc. & Mob (15% Strs&Util)	\$15,951,651.18	2021	\$15,035,961.14	75 Year Life Span	all
Misc. & Mob (45% Functional)	\$ 41,060,376.14	2021	\$38,703,342.57	50 Year	all
E. & C. 15%	\$ 38,198,000.00	2021	\$36,005,278.54	No residual	all
TOTAL Construction Cost	\$292,800,000.00		\$276,000,000.00		
Right of way	\$19,116,000	2021	\$18,018,663.40	ROW	all
Utility	\$2,867,000	2021	\$2,702,422.47	75 Year Life Span	all
Total Project Cost	\$314,783,000.00		\$296,712,837.02		

	Initial Costs	Contingency	Total
No residual	\$117,240,815	\$0	\$117,240,815
50 Year	\$43,475,234	\$0	\$43,475,234
75 Year Life Span	\$117,978,125	\$0	\$117,978,125
ROW	\$18,018,663	\$0	\$18,018,663
Total	\$296,712,837	\$0	\$296,712,837

Annual Construction Costs		% start	% end	% all
2025	\$44,506,926	0%	0%	15%
2026	\$59,342,567	0%	0%	20%
2027	\$74,178,209	0%	0%	25%
2028	\$74,178,209	0%	0%	25%
2029	\$44,506,926	0%	0%	15%
2030	\$0	0%	0%	
Total	\$296,712,837	0%	0%	100%

Construction Costs (Cost)			Present Value
Calendar Year	Project Year	Project Cost	(7% Discount Rate)
2022	1	\$0	\$0
2023	2	\$0	\$0
2024	3	\$0	\$0
2025	4	\$44,506,926	\$29,656,844
2026	5	\$59,342,567	\$36,955,569
2027	6	\$74,178,209	\$43,172,393
2028	7	\$74,178,209	\$40,348,031
2029	8	\$44,506,926	\$22,625,064
2030	9	\$0	\$0
2031	10	\$0	\$0
2032	11	\$0	\$0
2033	12	\$0	\$0
2034	13	\$0	\$0
2035	14	\$0	\$0
2036	15	\$0	\$0
2037	16	\$0	\$0
2038	17	\$0	\$0
2039	18	\$0	\$0
2040	19	\$0	\$0
2041	20	\$0	\$0
2042	21	\$0	\$0
2043	22	\$0	\$0
2044	23	\$0	\$0
2045	24	\$0	\$0
2046	25	\$0	\$0
2047	26	\$0	\$0
2048	27	\$0	\$0
2049	28	\$0	\$0
2050	29	\$0	\$0
2051	30	\$0	\$0
Total		\$296,712,837	\$172,757,901

	Residual	75 year	
	Calculation	50 year lifespan	lifespan
	Construction Cost	\$43,475,234	\$117,978,125
	Design Service Life (years)	50	75
	Analysis Period (years)	30	30
	Residual ratio at end of analysis (linear depreciation)	0.400	0.600
	Residual Value at end of analysis	\$17,390,094	\$70,786,875
			\$18,018,663
			100
			30
			0.700

Construction Costs (Cost)				Residual Value (Benefit)						
Calendar Year	Project Year	Project Cost	Present Value (7% Discount Rate)	Calendar Year	Project Year	30 Year Lifespan	75 Year Lifespan	ROW + ROW Contingency	Total Benefit	Present Value (7% Discount Rate)
2022	1	\$0	\$0	2022	0		\$0	\$0	\$0	\$0
2023	2	\$0	\$0	2023	1		\$0	\$0	\$0	\$0
2024	3	\$0	\$0	2024	2		\$0	\$0	\$0	\$0
2025	4	\$44,506,926	\$29,656,844	2025	3		\$0	\$0	\$0	\$0
2026	5	\$59,342,567	\$36,955,569	2026	4		\$0	\$0	\$0	\$0
2027	6	\$74,178,209	\$43,172,393	2027	5		\$0	\$0	\$0	\$0
2028	7	\$74,178,209	\$40,348,031	2028	6		\$0	\$0	\$0	\$0
2029	8	\$44,506,926	\$22,625,064	2029	7		\$0	\$0	\$0	\$0
2030	9	\$0	\$0	2030	8		\$0	\$0	\$0	\$0
2031	10	\$0	\$0	2031	9		\$0	\$0	\$0	\$0
2032	11	\$0	\$0	2032	10		\$0	\$0	\$0	\$0
2033	12	\$0	\$0	2033	11		\$0	\$0	\$0	\$0
2034	13	\$0	\$0	2034	12		\$0	\$0	\$0	\$0
2035	14	\$0	\$0	2035	13		\$0	\$0	\$0	\$0
2036	15	\$0	\$0	2036	14		\$0	\$0	\$0	\$0
2037	16	\$0	\$0	2037	15		\$0	\$0	\$0	\$0
2038	17	\$0	\$0	2038	16		\$0	\$0	\$0	\$0
2039	18	\$0	\$0	2039	17		\$0	\$0	\$0	\$0
2040	19	\$0	\$0	2040	18		\$0	\$0	\$0	\$0
2041	20	\$0	\$0	2041	19		\$0	\$0	\$0	\$0
2042	21	\$0	\$0	2042	20		\$0	\$0	\$0	\$0
2043	22	\$0	\$0	2043	21		\$0	\$0	\$0	\$0
2044	23	\$0	\$0	2044	22		\$0	\$0	\$0	\$0
2045	24	\$0	\$0	2045	23		\$0	\$0	\$0	\$0
2046	25	\$0	\$0	2046	24		\$0	\$0	\$0	\$0
2047	26	\$0	\$0	2047	25		\$0	\$0	\$0	\$0
2048	27	\$0	\$0	2048	26		\$0	\$0	\$0	\$0
2049	28	\$0	\$0	2049	27		\$0	\$0	\$0	\$0
2050	29	\$0	\$0	2050	28		\$0	\$0	\$0	\$0
2051	30	\$0	\$0	2051	29	\$17,390,094	\$70,786,875	\$12,613,064	\$100,790,033	\$11,564,762
Total		\$296,712,837	\$172,757,901			\$17,390,094	\$70,786,875	\$12,613,064	\$100,790,033	\$11,564,762

Bridge Action	Cost
Annual Operating and Maintenance	\$ 25,600 per mile
Annual Inspection Cost	\$ 5,000
5-year Minor Rehab	\$ 2,305,514
10-year major rehab	\$ 4,611,028
Length	0.640 miles
Cost of Maintenance pre-2028	\$ 16,384 per year
New Alignment length	6.5 miles
Roadway O&M (per mile)	\$ 4,400

Source: <https://connect.ncdot.gov/resources/GREATER-Rural-Bridge-Program/Documents/A01%20BCAMemo.pdf>
 Assume rural bridge O&M cost escalated up to 2019 base year and to account for higher traffic volumes

Assume minor rehab is 2 percent of construction costs
 Assume major rehab is 4 percent of construction cost

0.12238654

Victoria Transport Policy Institute <https://www.vtpi.org/>

Calendar Year	Project Year	Project Use Year	Contract Year	Bridge Annual O&M	Inspection Costs	Major and Minor Maintenance	Roadway O&M	Total Benefit (-Cost)	
								Total Disbenefit	Present Value (7% Discount Rate)
2022	1	0	0					\$0	\$0
2023	2	0	0					\$0	\$0
2024	3	0	0					\$0	\$0
2025	4	0	0					\$0	\$0
2026	5	0	0					\$0	\$0
2027	6	0	0					\$0	\$0
2028	7	0	1					\$0	\$0
2029	8	0	2					\$0	\$0
2030	9	1	3	\$16,384	\$5,000		\$28,600	-\$49,984	-\$23,747
2031	10	2	4	\$16,876	\$5,000		\$29,458	-\$51,334	-\$22,793
2032	11	3	5	\$17,382	\$5,000		\$30,342	-\$52,724	-\$21,878
2033	12	4	6	\$17,903	\$5,000		\$31,252	-\$54,155	-\$21,002
2034	13	5	7	\$18,440	\$5,000	\$2,305,514	\$32,190	-\$2,361,144	-\$855,787
2035	14	6	8	\$18,994	\$5,000		\$33,155	-\$57,149	-\$19,358
2036	15	7	9	\$19,563	\$5,000		\$34,150	-\$58,713	-\$18,587
2037	16	8	10	\$20,150	\$5,000		\$35,174	-\$60,325	-\$17,848
2038	17	9	11	\$20,755	\$5,000		\$36,230	-\$61,984	-\$17,139
2039	18	10	12	\$21,377	\$5,000	\$6,916,542	\$37,317	-\$6,980,236	-\$1,803,826
2040	19	11	13	\$22,019	\$5,000		\$38,436	-\$65,455	-\$15,808
2041	20	12	14	\$22,679	\$5,000		\$39,589	-\$67,268	-\$15,183
2042	21	13	15	\$23,360	\$5,000		\$40,777	-\$69,136	-\$14,584
2043	22	14	16	\$24,060	\$5,000		\$42,000	-\$71,061	-\$14,009
2044	23	15	17	\$24,782	\$5,000	\$2,305,514	\$43,260	-\$2,378,556	-\$438,247
2045	24	16	18	\$25,526	\$5,000		\$44,558	-\$75,084	-\$12,929
2046	25	17	19	\$26,292	\$5,000		\$45,895	-\$77,186	-\$12,422
2047	26	18	20	\$27,080	\$5,000		\$47,271	-\$79,352	-\$11,935
2048	27	19	21	\$27,893	\$5,000		\$48,690	-\$81,582	-\$11,467
2049	28	20	22	\$28,729	\$5,000	\$6,916,542	\$50,150	-\$7,000,422	-\$919,625
2050	29	21	23	\$29,591	\$5,000		\$51,655	-\$86,246	-\$10,589
2051	30	22	24	\$30,479	\$5,000		\$53,204	-\$88,683	-\$10,176
								-\$19,927,779	-\$4,308,940

#	Segment	No-Build AADT	Diversion due to Ca	Build AADT	Total Crashes		Facility Type	NUMBER OF CRASHES NO BUILD (2015-2020 average)					KABCO			Monetized value (\$2019)
					No-Build	Build		K	A	B	C	O	Level	Description	KABCO Level	
1	NC 279	8000	-10%	8800	112.0	123.2	Urban Freeway	0.4	0.6	1.8	3.8	15.8	O	no injury	O - No Injury	\$3,700
2	NC 273	25000	-10%	27500	855.0	940.5	Urban Freeway	0.2	1.4	7	22.2	140.2	C	possible injury	C - Possible Inju	\$72,500
3	US 74/US 29	25000	20%	20000	939.0	751.2	Urban Freeway	1	1	9.4	42.2	134.2	B	non-incapacitati	B - Non-incapac	\$142,000
4	I-85	140000	5.00%	133000	2,530.0	2,403.5	Urban Freeway	1.2	2	12	73.2	417.6	A	incapacitating	A - Incapacitatir	\$521,300
					4,436.0	4,218.4							K	killed	K - Killed	\$10,900,000
		187.8			217.6									# accidents repo unknown if injur	# Accidents Repr	\$150,200
		126.5														
							Monetized value (\$2019)	\$10,900,000	\$521,300	\$142,000	\$72,500	\$3,700				

	NC 279	NC 273	US 74/US 29	I-85	0	0	187.8
Total Avg monetized value (\$2019)	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$0	\$0	\$0

Calendar Year	Project Year	Project Use Year	Crashes - No Build				Crashes - Build			
			NC 279	NC 273	US 74/US 29	I-85	NC 279	NC 273	US 74/US 29	I-85
2022	1	0	0	0	0	0	0	0	0	0
2023	2	0	0	0	0	0	0	0	0	0
2024	3	0	0	0	0	0	0	0	0	0
2025	4	0	0	0	0	0	0	0	0	0
2026	5	0	0	0	0	0	0	0	0	0
2027	6	0	0	0	0	0	0	0	0	0
2028	7	0	0	0	0	0	0	0	0	0
2029	8	0	0	0	0	0	0	0	0	0
2030	9	1	112	855	939	2,530	123	941	751	2,404
2031	10	2	112	855	939	2,530	123	941	751	2,404
2032	11	3	112	855	939	2,530	123	941	751	2,404
2033	12	4	112	855	939	2,530	123	941	751	2,404
2034	13	5	112	855	939	2,530	123	941	751	2,404
2035	14	6	112	855	939	2,530	123	941	751	2,404
2036	15	7	112	855	939	2,530	123	941	751	2,404
2037	16	8	112	855	939	2,530	123	941	751	2,404
2038	17	9	112	855	939	2,530	123	941	751	2,404
2039	18	10	112	855	939	2,530	123	941	751	2,404
2040	19	11	112	855	939	2,530	123	941	751	2,404
2041	20	12	112	855	939	2,530	123	941	751	2,404
2042	21	13	112	855	939	2,530	123	941	751	2,404
2043	22	14	112	855	939	2,530	123	941	751	2,404
2044	23	15	112	855	939	2,530	123	941	751	2,404
2045	24	16	112	855	939	2,530	123	941	751	2,404
2046	25	17	112	855	939	2,530	123	941	751	2,404
2047	26	18	112	855	939	2,530	123	941	751	2,404
2048	27	19	112	855	939	2,530	123	941	751	2,404
2049	28	20	112	855	939	2,530	123	941	751	2,404
2050	29	21	112	855	939	2,530	123	941	751	2,404
2051	30	22	112	855	939	2,530	123	941	751	2,404
Total										

Calendar Year	Project Year	No Build - Monetized Value					Build - Monetized Value					Benefit	
		NC 279	NC 273	US 74/US 29	I-85	Total	NC 279	NC 273	US 74/US 29	I-85	Total	Total	Present Value (7% Discount Rate)
2022	1	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2023	2	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2024	3	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2025	4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2026	5	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2027	6	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2028	7	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2029	8	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2030	9	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$1,552,092
2031	10	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$1,450,553
2032	11	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$1,355,657
2033	12	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$1,266,969
2034	13	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$1,184,084
2035	14	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$1,106,620
2036	15	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$1,034,224
2037	16	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$966,565
2038	17	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$903,332
2039	18	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$844,235
2040	19	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$789,005
2041	20	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$737,388
2042	21	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$689,147
2043	22	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$644,063
2044	23	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$601,928
2045	24	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$562,550
2046	25	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$525,747
2047	26	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$491,353
2048	27	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$459,208
2049	28	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$429,166
2050	29	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$401,090
2051	30	\$5,262,340	\$6,032,060	\$16,312,140	\$22,678,720	\$50,285,260	\$5,788,574	\$6,635,266	\$13,049,712	\$21,544,784	\$47,018,336	\$3,266,924	\$374,851
Total		\$115,771,480	\$132,705,320	\$358,867,080	\$498,931,840	\$1,106,275,720	\$127,348,628	\$145,975,852	\$287,093,664	\$473,985,248	\$1,034,403,392	\$71,872,328	\$18,369,828

In-Vehicle Travel Time: All	\$17.90 per hour
Commercial Vehicle Operators Travel Time: Truck Drivers	\$30.80 per hour
Non-commercial vehicle occupants	1.67
Commercial vehicle occupants	1.00
Truck %	8.69%
Peak %	70.00%

Calendar Year	Project Year	Travel Time By Period				All Day Travel Time (vehicles)				Travel Time Costs (persons)				Travel Time Savings		
		Peak Hours		Annual		Passenger Vehicle		Trucks		Passenger Vehicle		Trucks		Passenger Vehicle	Trucks	
		No Build	Build	No Build	Build	No Build	Build	No Build	Build	No Build	Build	No Build	Build			
2022	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2024	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	4															
2026	5															
2027	6															
2028	7															
2029	8															
2030	9	3,066	1,755	1,598,461	914,846	1,459,555	835,346	138,906	79,500	\$43,630,470	\$24,971,006	\$4,278,313	\$2,448,605	\$18,659,464	\$1,829,708	
2031	10	3,102	1,788	1,617,511	932,512	1,476,949	851,477	140,562	81,035	\$44,150,442	\$25,453,205	\$4,329,300	\$2,495,888	\$18,697,237	\$1,833,412	
2032	11	3,138	1,822	1,636,113	950,178	1,493,935	867,608	142,178	82,571	\$44,658,193	\$25,935,404	\$4,379,089	\$2,543,172	\$18,722,789	\$1,835,918	
2033	12	3,173	1,856	1,654,267	967,844	1,510,512	883,739	143,756	84,106	\$45,153,723	\$26,417,602	\$4,427,680	\$2,590,455	\$18,736,120	\$1,837,225	
2034	13	3,207	1,890	1,671,974	985,510	1,526,680	899,870	145,295	85,641	\$45,637,032	\$26,899,801	\$4,475,072	\$2,637,738	\$18,737,231	\$1,837,334	
2035	14	3,240	1,924	1,689,233	1,003,176	1,542,439	916,000	146,794	87,176	\$46,108,120	\$27,382,000	\$4,521,266	\$2,685,022	\$18,726,120	\$1,836,244	
2036	15	3,272	1,958	1,706,044	1,020,842	1,557,789	932,131	148,255	88,711	\$46,566,986	\$27,864,199	\$4,566,262	\$2,732,305	\$18,702,788	\$1,833,956	
2037	16	3,303	1,992	1,722,408	1,038,508	1,572,730	948,262	149,677	90,246	\$47,013,632	\$28,346,397	\$4,610,059	\$2,779,589	\$18,667,235	\$1,830,470	
2038	17	3,334	2,026	1,738,323	1,056,174	1,587,263	964,393	151,060	91,782	\$47,448,057	\$28,828,596	\$4,652,657	\$2,826,872	\$18,619,461	\$1,825,785	
2039	18	3,363	2,059	1,753,791	1,073,840	1,601,387	980,524	152,404	93,317	\$47,870,261	\$29,310,795	\$4,694,058	\$2,874,155	\$18,559,466	\$1,819,903	
2040	19	3,392	2,093	1,768,812	1,091,506	1,615,102	996,655	153,710	94,852	\$48,280,244	\$29,792,994	\$4,734,260	\$2,921,439	\$18,487,250	\$1,812,821	
2041	20	3,420	2,127	1,783,384	1,109,172	1,628,408	1,012,785	154,976	96,387	\$48,678,005	\$30,275,192	\$4,773,264	\$2,968,722	\$18,402,813	\$1,804,541	
2042	21	3,447	2,161	1,797,509	1,126,838	1,641,306	1,028,916	156,204	97,922	\$49,063,546	\$30,757,391	\$4,811,069	\$3,016,006	\$18,306,155	\$1,795,063	
2043	22	3,474	2,195	1,811,186	1,144,504	1,653,794	1,045,047	157,392	99,457	\$49,436,866	\$31,239,590	\$4,847,676	\$3,063,289	\$18,197,276	\$1,784,387	
2044	23	3,499	2,229	1,824,415	1,162,170	1,665,874	1,061,178	158,542	100,993	\$49,797,965	\$31,721,789	\$4,883,085	\$3,110,572	\$18,076,176	\$1,772,512	
2045	24	3,523	2,263	1,837,197	1,179,836	1,677,545	1,077,309	159,652	102,528	\$50,146,842	\$32,203,987	\$4,917,295	\$3,157,856	\$17,942,855	\$1,759,439	
2046	25	3,523	2,263	1,837,197	1,179,836	1,677,545	1,077,309	159,652	102,528	\$50,146,842	\$32,203,987	\$4,917,295	\$3,157,856	\$17,942,855	\$1,759,439	
2047	26	3,523	2,263	1,837,197	1,179,836	1,677,545	1,077,309	159,652	102,528	\$50,146,842	\$32,203,987	\$4,917,295	\$3,157,856	\$17,942,855	\$1,759,439	
2048	27	3,523	2,263	1,837,197	1,179,836	1,677,545	1,077,309	159,652	102,528	\$50,146,842	\$32,203,987	\$4,917,295	\$3,157,856	\$17,942,855	\$1,759,439	
2049	28	3,523	2,263	1,837,197	1,179,836	1,677,545	1,077,309	159,652	102,528	\$50,146,842	\$32,203,987	\$4,917,295	\$3,157,856	\$17,942,855	\$1,759,439	
2050	29	3,523	2,263	1,837,197	1,179,836	1,677,545	1,077,309	159,652	102,528	\$50,146,842	\$32,203,987	\$4,917,295	\$3,157,856	\$17,942,855	\$1,759,439	
2051	30	3,523	2,263	1,837,197	1,179,836	1,677,545	1,077,309	159,652	102,528	\$50,146,842	\$32,203,987	\$4,917,295	\$3,157,856	\$17,942,855	\$1,759,439	
Total		74,092	45,714	#####	#####	35,276,534	21,765,091	3,357,278	2,071,390	\$1,054,521,439	\$ 650,623,871	\$103,404,172	\$63,798,819	\$403,897,568	\$39,605,353	

Calendar Year	Project Year	% of Benefits Realized	Passenger		Benefit	
			Vehicle	Trucks	Total	Present Value (7% Discount Rate)
2022	1	0%	\$0	\$0	\$0	\$0
2023	2	0%	\$0	\$0	\$0	\$0
2024	3	0%	\$0	\$0	\$0	\$0
2025	4					
2026	5					
2027	6					
2028	7					
2029	8					
2030	9	100%	\$18,659,464	\$1,829,708	\$20,489,172	\$9,734,258
2031	10	100%	\$18,697,237	\$1,833,412	\$20,530,649	\$9,115,854
2032	11	100%	\$18,722,789	\$1,835,918	\$20,558,707	\$8,531,132
2033	12	100%	\$18,736,120	\$1,837,225	\$20,573,345	\$7,978,698
2034	13	100%	\$18,737,231	\$1,837,334	\$20,574,564	\$7,457,169
2035	14	100%	\$18,726,120	\$1,836,244	\$20,562,364	\$6,965,184
2036	15	100%	\$18,702,788	\$1,833,956	\$20,536,744	\$6,501,407
2037	16	100%	\$18,667,235	\$1,830,470	\$20,497,705	\$6,064,531
2038	17	100%	\$18,619,461	\$1,825,785	\$20,445,247	\$5,653,281
2039	18	100%	\$18,559,466	\$1,819,903	\$20,379,369	\$5,266,416
2040	19	100%	\$18,487,250	\$1,812,821	\$20,300,071	\$4,902,733
2041	20	100%	\$18,402,813	\$1,804,541	\$20,207,355	\$4,561,066
2042	21	100%	\$18,306,155	\$1,795,063	\$20,101,219	\$4,240,289
2043	22	100%	\$18,197,276	\$1,784,387	\$19,981,663	\$3,939,317
2044	23	100%	\$18,076,176	\$1,772,512	\$19,848,688	\$3,657,104
2045	24	100%	\$17,942,855	\$1,759,439	\$19,702,294	\$3,392,646
2046	25	100%	\$17,942,855	\$1,759,439	\$19,702,294	\$3,170,697
2047	26	100%	\$17,942,855	\$1,759,439	\$19,702,294	\$2,963,269
2048	27	100%	\$17,942,855	\$1,759,439	\$19,702,294	\$2,769,410
2049	28	100%	\$17,942,855	\$1,759,439	\$19,702,294	\$2,588,234
2050	29	100%	\$17,942,855	\$1,759,439	\$19,702,294	\$2,418,910
2051	30	100%	\$17,942,855	\$1,759,439	\$19,702,294	\$2,260,663
Total			\$403,897,568	\$39,605,353	\$443,502,921	\$114,132,270

Calendar Year	Project Year	All Day Travel Time (vehicles)				Travel Time Costs (persons)				Total Acuity Savings					
		Distance Savings		Delay Savings		Savings of Reduce Distance to ED at Charlotte Hospital									
		No Build	Build	No Build	Build	No Build	Build	No Build	Build	Deaths per Year AMI	Deaths per Year UI	Deaths per Year AMI	Deaths per Year UI		
2022	1														
2023	2														
2024	3														
2025	4														
2026	5														
2027	6														
2028	7														
2029	8														
2030	9		4	0	9	\$	39,822			0.60	0.48	\$6,574,765	\$5,212,960		
2031	10		4	0	9	\$	39,475			0.60	0.48	\$6,574,765	\$5,212,960		
2032	11		4	0	9	\$	39,127			0.60	0.48	\$6,574,765	\$5,212,960		
2033	12		4	0	9	\$	38,780			0.60	0.48	\$6,574,765	\$5,212,960		
2034	13		4	0	9	\$	38,433			0.60	0.48	\$6,574,765	\$5,212,960		
2035	14		4	0	9	\$	38,085			0.60	0.48	\$6,574,765	\$5,212,960		
2036	15		4	0	9	\$	37,738			0.60	0.48	\$6,574,765	\$5,212,960		
2037	16		4	0	8	\$	37,391			0.60	0.48	\$6,574,765	\$5,212,960		
2038	17		4	0	8	\$	37,043			0.60	0.48	\$6,574,765	\$5,212,960		
2039	18		4	0	8	\$	36,696			0.60	0.48	\$6,574,765	\$5,212,960		
2040	19		4	0	8	\$	36,348			0.60	0.48	\$6,574,765	\$5,212,960		
2041	20		4	0	8	\$	36,001			0.60	0.48	\$6,574,765	\$5,212,960		
2042	21		4	0	8	\$	35,654			0.60	0.48	\$6,574,765	\$5,212,960		
2043	22		4	0	8	\$	35,306			0.60	0.48	\$6,574,765	\$5,212,960		
2044	23		4	0	8	\$	34,959			0.60	0.48	\$6,574,765	\$5,212,960		
2045	24		4	0	8	\$	34,612			0.60	0.48	\$6,574,765	\$5,212,960		
2046	25		4	0	8	\$	34,612			0.60	0.48	\$6,574,765	\$5,212,960		
2047	26		4	0	8	\$	34,612			0.60	0.48	\$6,574,765	\$5,212,960		
2048	27		4	0	8	\$	34,612			0.60	0.48	\$6,574,765	\$5,212,960		
2049	28		4	0	8	\$	34,612			0.60	0.48	\$6,574,765	\$5,212,960		
2050	29		4	0	8	\$	34,612			0.60	0.48	\$6,574,765	\$5,212,960		
2051	30		4	0	8	\$	34,612			0.60	0.48	\$6,574,765	\$5,212,960		
Total		0	86	0	172	0	768,528	0	0	\$ 13	\$ 10	\$0	\$0	\$138,070,061	\$109,472,157

Calendar Year	Project Year	Benefits Adjustment	Adjusted Travel Time Savings		Benefit	
		% of Benefits Realized	Passenger Vehicle	Trucks	Total	Present Value (7% Discount Rate)
2022	1					
2023	2					
2024	3					
2025	4					
2026	5					
2027	6					
2028	7					
2029	8					
2030	9	100%			\$11,827,547	\$5,619,182
2031	10	100%			\$11,827,199	\$5,251,418
2032	11	100%			\$11,826,852	\$4,907,723
2033	12	100%			\$11,826,505	\$4,586,522
2034	13	100%			\$11,826,157	\$4,286,344
2035	14	100%			\$11,825,810	\$4,005,811
2036	15	100%			\$11,825,463	\$3,743,639
2037	16	100%			\$11,825,115	\$3,498,625
2038	17	100%			\$11,824,768	\$3,269,647
2039	18	100%			\$11,824,420	\$3,055,655
2040	19	100%			\$11,824,073	\$2,855,668
2041	20	100%			\$11,823,726	\$2,668,771
2042	21	100%			\$11,823,378	\$2,494,105
2043	22	100%			\$11,823,031	\$2,330,871
2044	23	100%			\$11,822,684	\$2,178,320
2045	24	100%			\$11,822,336	\$2,035,753
2046	25	100%			\$11,822,336	\$1,902,573
2047	26	100%			\$11,822,336	\$1,778,106
2048	27	100%			\$11,822,336	\$1,661,781
2049	28	100%			\$11,822,336	\$1,553,066
2050	29	100%			\$11,822,336	\$1,451,464
2051	30	100%			\$11,822,336	\$1,356,508
Total			\$0	\$0	\$260,133,082	\$66,491,550

In-Vehicle Travel Time: All	\$17.90 per hour
Commercial Vehicle Operators Travel Time: Truck Drivers	\$30.80 per hour
Non-commercial vehicle occupants	1.67
Commercial vehicle occupants	1.00
Truck %	8.69%
Peak %	70.00%

Population	4,800	12000
Deaths Per Year due to AMI	2.4432	
Deaths per year due to unintentional injuries		1.9056
Visits per day	7.315068493	

Assumes 40 percent of community will be served by Charlotte Area Hospitals in the event of an emergency and 60 percent will be served by new Belmont Hospital or other existing medical facilities that serve eastern Gaston county

Source: <https://www.caloes.ca.gov/RecoverySite/Documents/Benefit%20Cost%20Sustainment.pdf>

Savings Type **VMT** VHT or VMT

Average In-Use Emission Rates (grams/mile): 8.613 0.0092 0.202 1740 0.447 0.95 0.012 0.0045 513.5 1.224

Calendar Year	Project Year	VMT Saved		Metric Tons Saved - Truck					Metric Tons Saved - Non-Truck				
		Truck	Non-Truck	NOX	SO2	PM2.5	CO2	VOCs	NOX	SO2	PM2.5	CO2	VOCs
2022	1	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	2	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2024	3	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	4	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2026	5	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2027	6	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2028	7	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2029	8	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2030	9	7,519,663	79,012,712	64.8	0.1	1.5	13,084.2	3.4	75.1	0.9	0.4	40,573.0	96.7
2031	10	7,664,871	80,538,474	66.0	0.1	1.5	13,336.9	3.4	76.5	1.0	0.4	41,356.5	98.6
2032	11	7,810,078	82,064,237	67.3	0.1	1.6	13,589.5	3.5	78.0	1.0	0.4	42,140.0	100.4
2033	12	7,955,285	83,590,000	68.5	0.1	1.6	13,842.2	3.6	79.4	1.0	0.4	42,923.5	102.3
2034	13	8,100,493	85,115,762	69.8	0.1	1.6	14,094.9	3.6	80.9	1.0	0.4	43,706.9	104.2
2035	14	8,245,700	86,641,525	71.0	0.1	1.7	14,347.5	3.7	82.3	1.0	0.4	44,490.4	106.0
2036	15	8,390,907	88,167,288	72.3	0.1	1.7	14,600.2	3.8	83.8	1.1	0.4	45,273.9	107.9
2037	16	8,536,114	89,693,051	73.5	0.1	1.7	14,852.8	3.8	85.2	1.1	0.4	46,057.4	109.8
2038	17	8,681,322	91,218,813	74.8	0.1	1.8	15,105.5	3.9	86.7	1.1	0.4	46,840.9	111.7
2039	18	8,826,529	92,744,576	76.0	0.1	1.8	15,358.2	3.9	88.1	1.1	0.4	47,624.3	113.5
2040	19	8,971,736	94,270,339	77.3	0.1	1.8	15,610.8	4.0	89.6	1.1	0.4	48,407.8	115.4
2041	20	9,116,944	95,796,101	78.5	0.1	1.8	15,863.5	4.1	91.0	1.1	0.4	49,191.3	117.3
2042	21	9,262,151	97,321,864	79.8	0.1	1.9	16,116.1	4.1	92.5	1.2	0.4	49,974.8	119.1
2043	22	9,407,358	98,847,627	81.0	0.1	1.9	16,368.8	4.2	93.9	1.2	0.4	50,758.3	121.0
2044	23	9,552,565	100,373,390	82.3	0.1	1.9	16,621.5	4.3	95.4	1.2	0.5	51,541.7	122.9
2045	24	9,697,773	101,899,152	83.5	0.1	2.0	16,874.1	4.3	96.8	1.2	0.5	52,325.2	124.7
2046	25	9,697,773	101,899,152	83.5	0.1	2.0	16,874.1	4.3	96.8	1.2	0.5	52,325.2	124.7
2047	26	9,697,773	101,899,152	83.5	0.1	2.0	16,874.1	4.3	96.8	1.2	0.5	52,325.2	124.7
2048	27	9,697,773	101,899,152	83.5	0.1	2.0	16,874.1	4.3	96.8	1.2	0.5	52,325.2	124.7
2049	28	9,697,773	101,899,152	83.5	0.1	2.0	16,874.1	4.3	96.8	1.2	0.5	52,325.2	124.7
2050	29	9,697,773	101,899,152	83.5	0.1	2.0	16,874.1	4.3	96.8	1.2	0.5	52,325.2	124.7
2051	30	9,697,773	101,899,152	83.5	0.1	2.0	16,874.1	4.3	96.8	1.2	0.5	52,325.2	124.7
Total		195,926,126	2,058,689,824	1,688	2	40	340,911	88	1,956	25	9	1,057,137	2,520

Damage Costs for Emissions per metric ton					CO2 Build Savings		Non CO2 Build Savings		Total (Benefit) *	
NOX	SO2	PM2.5	CO2	VOCs	Truck	Non-Truck	Truck	Non-Truck	Total	Present Value (7% Discount Rate)
\$16,100	\$42,100	\$755,500	\$53	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$16,400	\$43,000	\$769,000	\$54	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$16,600	\$43,900	\$782,700	\$55	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$16,800	\$44,900	\$796,600	\$56	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$17,000	\$45,500	\$807,500	\$57	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$17,300	\$46,200	\$818,600	\$58	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$17,500	\$46,900	\$829,800	\$59	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$17,700	\$47,600	\$841,200	\$60	\$1,958	\$0	\$0	\$0	\$0	\$0	\$0
\$18,000	\$48,200	\$852,700	\$61	\$1,958	\$798,137	\$2,474,955	\$2,470,947	\$1,889,363	\$7,633,402	\$4,436,103
\$18,000	\$48,200	\$852,700	\$62	\$1,958	\$826,886	\$2,564,103	\$2,518,662	\$1,925,847	\$7,835,499	\$4,351,787
\$18,000	\$48,200	\$852,700	\$63	\$1,958	\$856,141	\$2,654,819	\$2,566,377	\$1,962,332	\$8,039,668	\$4,270,046
\$18,000	\$48,200	\$852,700	\$64	\$1,958	\$885,901	\$2,747,102	\$2,614,091	\$1,998,816	\$8,245,910	\$4,190,808
\$18,000	\$48,200	\$852,700	\$66	\$1,958	\$930,261	\$2,884,658	\$2,661,806	\$2,035,300	\$8,512,025	\$4,151,099
\$18,000	\$48,200	\$852,700	\$67	\$1,958	\$961,284	\$2,980,858	\$2,709,521	\$2,071,784	\$8,723,448	\$4,076,206
\$18,000	\$48,200	\$852,700	\$68	\$1,958	\$992,812	\$3,078,625	\$2,757,236	\$2,108,269	\$8,936,942	\$4,003,581
\$18,000	\$48,200	\$852,700	\$69	\$1,958	\$1,024,846	\$3,177,959	\$2,804,951	\$2,144,753	\$9,152,509	\$3,933,144
\$18,000	\$48,200	\$852,700	\$70	\$1,958	\$1,057,385	\$3,278,860	\$2,852,666	\$2,181,237	\$9,370,148	\$3,864,816
\$18,000	\$48,200	\$852,700	\$71	\$1,958	\$1,090,429	\$3,381,328	\$2,900,380	\$2,217,721	\$9,589,859	\$3,798,518
\$18,000	\$48,200	\$852,700	\$72	\$1,958	\$1,123,979	\$3,485,363	\$2,948,095	\$2,254,206	\$9,811,643	\$3,734,172
\$18,000	\$48,200	\$852,700	\$73	\$1,958	\$1,158,034	\$3,590,965	\$2,995,810	\$2,290,690	\$10,035,499	\$3,671,700
\$18,000	\$48,200	\$852,700	\$75	\$1,958	\$1,208,711	\$3,748,108	\$3,043,525	\$2,327,174	\$10,327,518	\$3,644,512
\$18,000	\$48,200	\$852,700	\$76	\$1,958	\$1,244,029	\$3,857,627	\$3,091,240	\$2,363,658	\$10,556,555	\$3,585,092
\$18,000	\$48,200	\$852,700	\$77	\$1,958	\$1,279,853	\$3,968,714	\$3,138,955	\$2,400,143	\$10,787,664	\$3,527,319
\$18,000	\$48,200	\$852,700	\$78	\$1,958	\$1,316,182	\$4,081,367	\$3,186,669	\$2,436,627	\$11,020,845	\$3,471,121
\$18,000	\$48,200	\$852,700	\$79	\$1,958	\$1,333,056	\$4,133,692	\$3,186,669	\$2,436,627	\$11,090,044	\$3,366,029
\$18,000	\$48,200	\$852,700	\$80	\$1,958	\$1,349,930	\$4,186,017	\$3,186,669	\$2,436,627	\$11,159,244	\$3,265,390
\$18,000	\$48,200	\$852,700	\$81	\$1,958	\$1,366,804	\$4,238,342	\$3,186,669	\$2,436,627	\$11,228,443	\$3,168,950
\$18,000	\$48,200	\$852,700	\$83	\$1,958	\$1,400,552	\$4,342,993	\$3,186,669	\$2,436,627	\$11,366,842	\$3,104,981
\$18,000	\$48,200	\$852,700	\$84	\$1,958	\$1,417,426	\$4,395,318	\$3,186,669	\$2,436,627	\$11,436,041	\$3,015,412
\$18,000	\$48,200	\$852,700	\$84	\$1,958	\$1,417,426	\$4,395,318	\$3,186,669	\$2,436,627	\$11,436,041	\$2,902,527
531,400	1,420,500	25,160,300	2,055	58,740	\$ 25,040,064	\$ 77,647,093	\$ 64,380,946	\$ 49,227,683	\$ 216,295,786	\$ 81,533,312

Emissions Data

Grams to Metric Tons 1,000,000 1 metric ton is equal to 100,000 grams

VHT

Idle Emissions (grams/hr)

Pollutant		LDGV	HDDV	Source
Carbon Dioxide	CO2	2116.8	4560	2 - LDGV; 3 - HDDV
Volatile Organic Compounds	VOCs	2.683	3.455	1
Nitrogen Oxides	NOx	3.515	33.763	1
Particulate Matter	PM2.5	-	1.100	1
Sulfur Dioxide	SO2	-	-	

Sources:

1. EPA Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks Emission Facts, 2008. <https://nepis.epa.gov/E>
2. Which is Greener: Idle, or Stop and Restart? Comparing Fuel Use and Emissions for Short Passenger-Car Stops - Argonne National Labor
3. Idle Emissions from Heavy Duty Diesel Vehicles: Review and Recent Data. Used average of mechanical fuel injection (MFI) and electroni

LDGV = Light-Duty Gas Vehicles

HDDV = Heavy-Duty Diesel Vehicles

VMT

Average In-Use Emission Rates (grams/mile)

Pollutant		Passenger Cars	HDDV	
Carbon Dioxide	CO2	513.5	1740	HDDV: https://scholarworks.rit.edu/cgi/vie
Volatile Organic Compounds	VOCs	1.224	0.447	
Nitrogen Oxides	NOx	0.95	8.613	
Particulate Matter 2.5	PM2.5	0.0045	0.202	
Sulfur Dioxide	SO2	0.012	0.0092	https://engineering.unl.edu/downloads/files

Sources:

HDDV: EPA Average In-Use Emissions from Heavy-Duty Trucks - Emission Facts, 2008

Passenger Cars: EPA Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks - Emission Facts, :

CO2 Emissions (CO2/Gallon)

Gasoline 8887 grams CO2/gallon

Diesel 10180 grams CO2/gallon

Source: 40 CFR 600.114-12, September 2011

Damage Costs for Emissions per metric ton*

Year	NOX	SO2	PM2.5	CO2	VOCs
2020	\$15,700	\$40,400	\$729,300	\$50	\$1,958
2021	\$15,900	\$41,300	\$742,300	\$52	\$1,958
2022	\$16,100	\$42,100	\$755,500	\$53	\$1,958
2023	\$16,400	\$43,000	\$769,000	\$54	\$1,958
2024	\$16,600	\$43,900	\$782,700	\$55	\$1,958
2025	\$16,800	\$44,900	\$796,600	\$56	\$1,958
2026	\$17,000	\$45,500	\$807,500	\$57	\$1,958
2027	\$17,300	\$46,200	\$818,600	\$58	\$1,958
2028	\$17,500	\$46,900	\$829,800	\$59	\$1,958
2029	\$17,700	\$47,600	\$841,200	\$60	\$1,958
2030	\$18,000	\$48,200	\$852,700	\$61	\$1,958
2031	\$18,000	\$48,200	\$852,700	\$62	\$1,958
2032	\$18,000	\$48,200	\$852,700	\$63	\$1,958
2033	\$18,000	\$48,200	\$852,700	\$64	\$1,958
2034	\$18,000	\$48,200	\$852,700	\$66	\$1,958
2035	\$18,000	\$48,200	\$852,700	\$67	\$1,958
2036	\$18,000	\$48,200	\$852,700	\$68	\$1,958
2037	\$18,000	\$48,200	\$852,700	\$69	\$1,958
2038	\$18,000	\$48,200	\$852,700	\$70	\$1,958
2039	\$18,000	\$48,200	\$852,700	\$71	\$1,958
2040	\$18,000	\$48,200	\$852,700	\$72	\$1,958
2041	\$18,000	\$48,200	\$852,700	\$73	\$1,958
2042	\$18,000	\$48,200	\$852,700	\$75	\$1,958
2043	\$18,000	\$48,200	\$852,700	\$76	\$1,958
2044	\$18,000	\$48,200	\$852,700	\$77	\$1,958
2045	\$18,000	\$48,200	\$852,700	\$78	\$1,958
2046	\$18,000	\$48,200	\$852,700	\$79	\$1,958
2047	\$18,000	\$48,200	\$852,700	\$80	\$1,958
2048	\$18,000	\$48,200	\$852,700	\$81	\$1,958
2049	\$18,000	\$48,200	\$852,700	\$83	\$1,958
2050	\$18,000	\$48,200	\$852,700	\$84	\$1,958

Sources

NOX, SO2, PM2.5, CO2 [USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs 2021](#)
 VOC [FHWA TOPS BCA Spreadsheet](#)

Existing property value Value Source <https://gis.gastongov.com/Map/Default.aspx>

\$853,473,100

\$853,473,100

Benefits

Highway Connectivi 3% Assumption, See Case Study:

Total Benefit \$25,604,193 https://planningtools.transportation.org/290/view-case-study.html?case_id=8

Calendar Year	Project Year	Total (Benefit) *	
		Total	Present Value (7% Discount Rate)
2022	0	\$0	\$0
2023	0	\$0	\$0
2024	0	\$0	\$0
2025	0	\$0	\$0
2026	0	\$0	\$0
2027	0	\$0	\$0
2028	0	\$0	\$0
2029	0	\$0	\$0
2030	1	\$25,604,193	\$12,164,368
2031	2	\$0	\$0
2032	3	\$0	\$0
2033	4	\$0	\$0
2034	5	\$0	\$0
2035	6	\$0	\$0
2036	7	\$0	\$0
2037	8	\$0	\$0
2038	9	\$0	\$0
2039	10	\$0	\$0
2040	11	\$0	\$0
2041	12	\$0	\$0
2042	13	\$0	\$0
2043	14	\$0	\$0
2044	15	\$0	\$0
2045	16	\$0	\$0
2046	17	\$0	\$0
2047	18	\$0	\$0
2048	19	\$0	\$0
2049	20	\$0	\$0
2050	21	\$0	\$0
2051	22	\$0	\$0
Total		\$25,604,193	\$12,164,368

Source: Greater Charlotte Regional Freight Mobility Plan

Average Amount of Outbound Freight At Charlotte Douglas per year
 * assumes a 40/60 split of enplanements and deplanements

69965.2 <https://cltairport.mediारoom.com/CLT-Ranks-Sixth-Busiest-Airport-Nationwide>
<https://cltairport.mediारoom.com/media#activity>

Calendar Year	Project Year	Outbound Air Freight					Total (Benefit) *	
		Tons	Value (Million \$)	Value per ton	Tons moved in base	Tons moved due to	Total	Present Value (7% Discount Rate)
2022	0	82000	6091				\$0	\$0
2023	0	82000	6091				\$0	\$0
2024	0	82000	6091				\$0	\$0
2025	0	82000	6091				\$0	\$0
2026	0	85600	6426				\$0	\$0
2027	0	89200	6760				\$0	\$0
2028	0	92800	7095				\$0	\$0
2029	0	96400	7429				\$0	\$0
2030	1	100000	7764	\$77,640	\$7,764,000,000	\$7,996,920,000	\$232,920,000	\$110,658,614
2031	2	104800	8206					
2032	3	109600	8647					
2033	4	114400	9089					
2034	5	119200	9530					
2035	6	124000	9972					
2036	7	131600	10723					
2037	8	139200	11474					
2038	9	146800	12226					
2039	10	154400	12977					
2040	11	162000	13728					
2041	12	167600	14237					
2042	13	173200	14746					
2043	14	178800	15255					
2044	15	184400	15764					
2045	16	190000	16273					
2046	17	190000	16273					
2047	18	190000	16273					
2048	19	190000	16273					
2049	20	190000	16273					
2050	21	190000	16273					
2051	22	190000	16273					
Total							\$232,920,000	\$110,658,614

Number of Farms Statewide (NC)	46418	https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/North_Carolina/cp99037.pdf
Farm Expenses Statewide (\$2019 Dollars)	\$ 14,943,010,530	https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/North_Carolina/cp99037.pdf
Farms in Gaston and Mecklenburg County	738	https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/North_Carolina/cp37071.pdf
Average Expense Cost Statewide	\$ 321,923	https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/North_Carolina/cp37119.pdf
Number of Farms Statewide (SC)	24791	
Farm Expenses Statewide (\$2019 Dollars)	\$ 2,387,031,000	
Farms in York County	1000	
Average Expense Cost Statewide	\$ 96,286	

of Farms Impacted by Bridge Access (Gaston, Mecklenbu 5% Assumption
 Percent of Expense Avoided 2.5% Assumption

Calendar Year	Project Year	Total (Benefit) *	
		Total	Present Value (7% Discount Rate)
2022	0	\$0	\$0
2023	0	\$0	\$0
2024	0	\$0	\$0
2025	0	\$0	\$0
2026	0	\$0	\$0
2027	0	\$0	\$0
2028	0	\$0	\$0
2029	0	\$0	\$0
2030	1	\$417,331	\$198,271
2031	2	\$417,331	\$185,300
2032	3	\$417,331	\$173,178
2033	4	\$417,331	\$161,848
2034	5	\$417,331	\$151,260
2035	6	\$417,331	\$141,365
2036	7	\$417,331	\$132,116
2037	8	\$417,331	\$123,473
2038	9	\$417,331	\$115,396
2039	10	\$417,331	\$107,846
2040	11	\$417,331	\$100,791
2041	12	\$417,331	\$94,197
2042	13	\$417,331	\$88,035
2043	14	\$417,331	\$82,275
2044	15	\$417,331	\$76,893
2045	16	\$417,331	\$71,863
2046	17	\$417,331	\$67,161
2047	18	\$417,331	\$62,768
2048	19	\$417,331	\$58,661
2049	20	\$417,331	\$54,824
2050	21	\$417,331	\$51,237
2051	22	\$417,331	\$47,885
Total		\$9,181,293	\$2,346,644

Project Component	Net New Expenditures (Federal Grant Request)			BEA RIMS II Multipliers: Construction Industry			Economic Impacts		
	YOE \$ (2021)	Assumed Inflation	Base Year \$ (2019)	Output	Earnings	Employment	Output (\$)	Earnings (\$)	Employment
Design & Construction	\$ 78,695,750	3%	\$ 74,178,292	2.2672	0.789	16.994	\$ 168,177,024	\$ 58,526,672	1261
YOE\$ Year	2021								

Source: Calculated using the BEA RIMS II regional economic output, household earnings, and employment multipliers, as identified in RIMS II Multipliers (2012/2018);Table 3.5 Total Multipliers for Output, Earnings
 Calculated using the BEA RIMS II regional economic output, household earnings, and employment multipliers, as identified in RIMS II Multipliers (2012/2018);Table 3.5 Total Multipliers for Output, Earnings, Employment, and Value Added by State 7 - Construction (Type II)