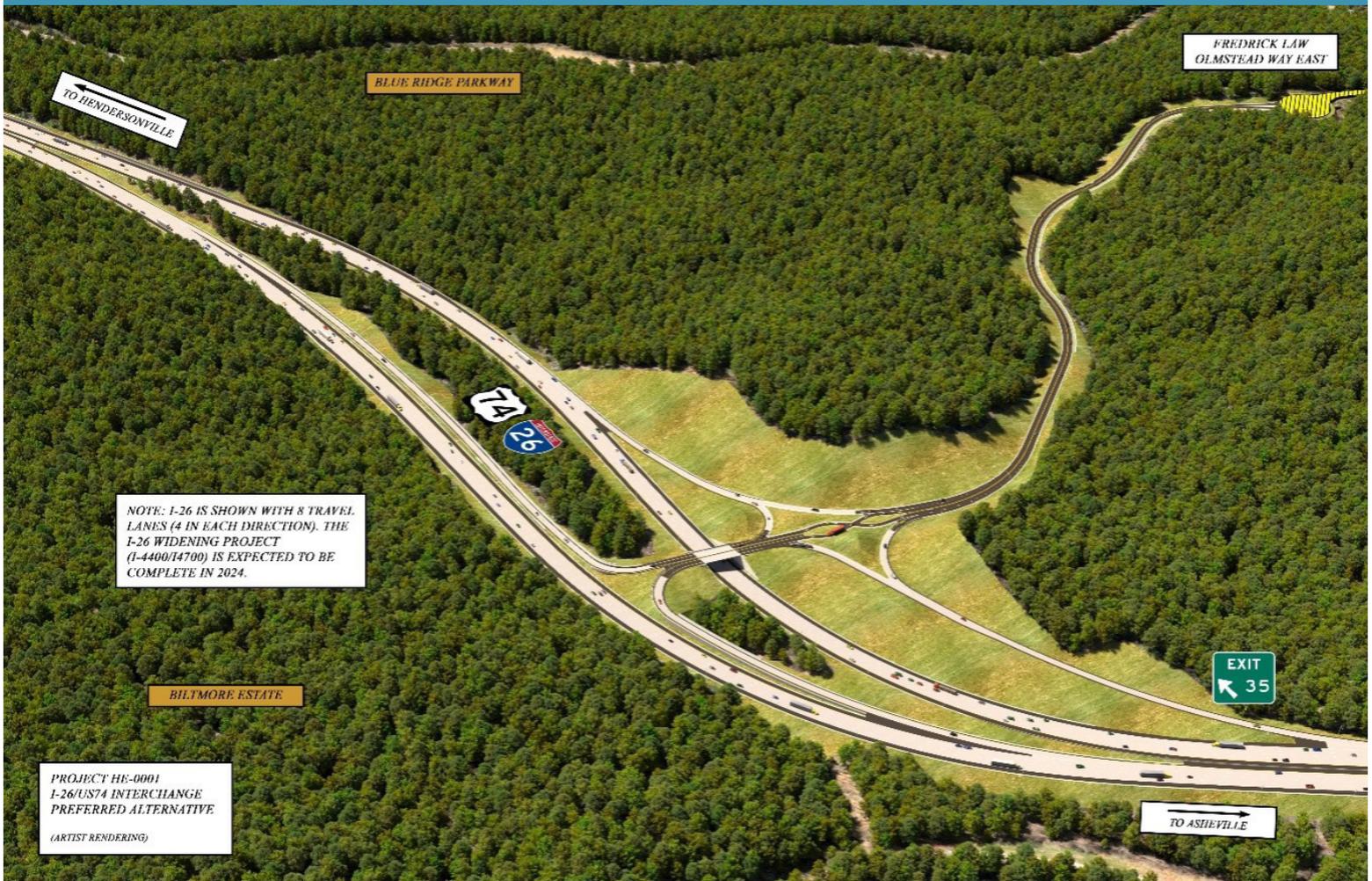


# GROUND TO SKY PROJECT



## Benefit-Cost Analysis Narrative

**MPDG FFY 2023 and 2024  
GRANT APPLICATION  
AUGUST 2023**



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Supplemental information, including letters of support and appendices, may be accessed:  
<https://connect.ncdot.gov/resources/MPDG2023-126DIV13/Pages/default.aspx>

## Benefit-Cost Analysis Narrative

### 1.0 Introduction & Summary

The North Carolina Department of Transportation (NCDOT) proposes to add a new I-26 interchange (future Exit 35) and a connector road from the interchange to tie into an existing privately funded, and now publicly owned road, East Frederick Law Olmsted Way (East FLOW). NCDOT is leveraging this public-private partnership to increase network connectivity in southern Buncombe County. The proposed interchange will add another connection from I-26 to NC 191 (Brevard Road), which will increase mobility and access to jobs at the Pratt & Whitney Manufacturing Plant and recreational resources on the Blue Ridge Parkway and French Broad River. This transportation-economic development initiative symbolizes dynamic rural partnering.

This document summarizes the benefit-cost analysis (BCA) for the MPDG Grant Program application for the NCDOT Ground to Sky Project (G2S). Project costs as described in the application are for the design and construction of the new I-26 interchange and accompanying structures, roads, utilities, and other elements.

The project benefits are primarily associated with improved access to support and complement emerging land uses, regional economic impact, and new job creation; none are a direct part of the BCA. Because this is a new interchange that follows major I-26 expansion to eight lanes, and because the interchange and improved connectivity itself increases vehicle trips, these benefits are limited to relatively modest mileage and travel time savings, plus lesser contributions from crash reduction and residual value. The net present value (NPV, i.e., direct benefits minus costs) is estimated at about \$30.14 million, and the benefit-cost ratio (BCR) is 1.59.

This document is accompanied by an Excel file (BCA Calculations) containing input values, assumptions, and calculations. The analysis follows the procedures and parameters of USDOT's Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2023 update.

The remainder of this document includes:

- Section 2, describing the current, No-Build, and Build conditions;
- Section 3, outlining various assumptions used for the analysis;
- Section 4, summarizing the project costs as presented in the application and used as input for the BCA; and
- Section 5, the benefits estimate.

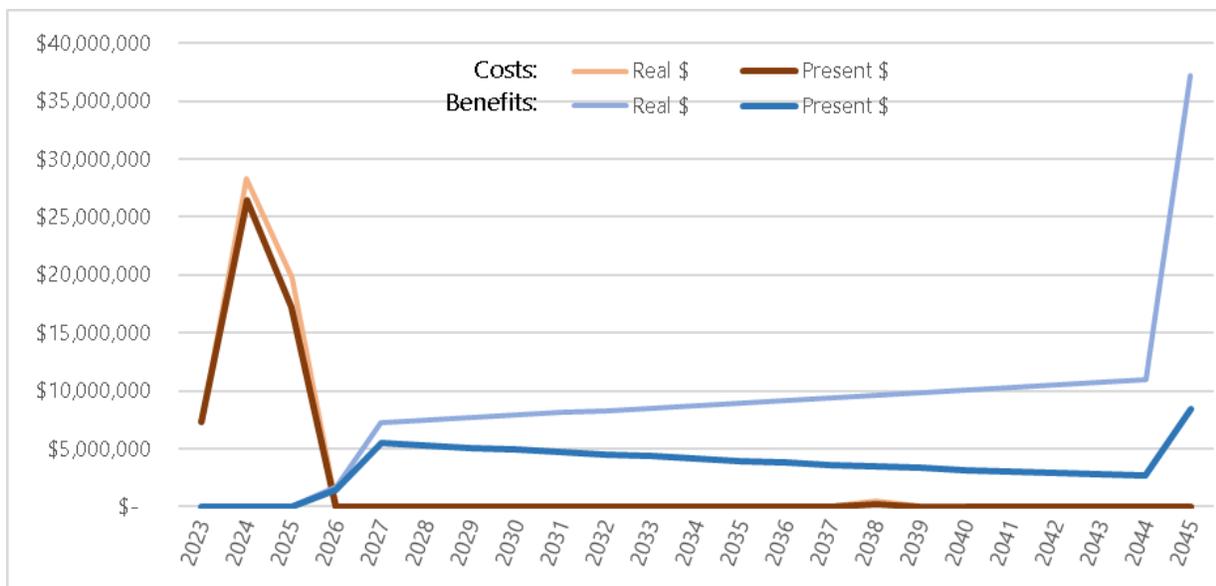
The BCA results are summarized in *Table 1*. Cost breakdowns are listed in the application and in the accompanying BCA Calculations file. Nominal (generally 2023) dollars are adjusted to real 2021 dollars, and all the future values are discounted to present values (and are explained in detail in the assumption section of the BCA Calculation spreadsheet).

**Table 1: BCA Summary**

<b>Costs (Economic, Real 2021\$, Discounted)</b>	\$ 51,180,354
<b>Benefits (Economic, Real 2021\$, Discounted)</b>	\$ 81,320,846
<b>Net Present Value (NPV)</b>	\$ 30,140,492
<b>Benefit-Cost Ratio (B/C or BCR)</b>	1.59

This BCA assumes conservative estimates of benefits and provides a range of anticipated values, as explained in the remainder of this memo. *Figure 1* shows both total costs and total benefits over time.

**Figure 1. Summary of Total Costs and Benefits over Time**



### Sensitivity Testing

Most input assumptions allow a range of possible values, constituting the sensitivity analysis. For example, the analysis allows for most costs to vary  $\pm 10\%$ , and the expected resurfacing around 2038 to vary  $\pm 20\%$  given uncertainty with timing, condition, and costs of materials and labor. With the variety of parameters allowed to vary, the values are randomized within their given ranges, and a B/C is recalculated 10,000 times.

In the accompanying BCA Calculations file, anywhere a number or note is shown in a dark orange color means it is related to sensitivity testing, and users can see how it works by altering cell M8 on the Summary tab. The median B/C of the 10,000 runs is 1.578, close to the mean of 1.589 and the base estimate of 1.59.

### 2.0 Current Conditions, No-Build, Build

G2S is intended to increase network connectivity to the Biltmore Farms and Pratt & Whitney parcels, which are located between the French Broad River, the Blue Ridge Parkway, and I-26. To support development on this otherwise isolated parcel, Biltmore Farms, LLC built a new connection to NC 191. The privately built East FLOW included a five-lane bridge over the French Broad River and two-lane road to the Pratt & Whitney Manufacturing Plant. Therefore, the development parcel has already been opened to development, and a new network connection to NC 191 has been made. Another major transportation infrastructure improvement in this area is the widening of I-26 from a four lane to eight lane facility, currently under construction. See *Figure 2*.

### No-Build Scenario

In the No-Build Scenario, the East FLOW connection from NC 191 to Pratt & Whitney will add traffic to the already heavily trafficked NC 191 corridor. Congestion and delays on NC 191

would worsen over time and limit the economic and quality of life benefits attributable to the Pratt & Whitney jobs. Under the No-Build Scenario, there is no direct interstate connection to I-26 so commuters and delivery drivers would have to rely on exits north and south of the study area and the signalized route on NC 191.



**Figure 2.** Through partnership with Biltmore Farms, LLC, Pratt & Whitney, and the State of North Carolina, G2S completes a critical transportation connection to benefit safe and efficient access to economic opportunity in southern Buncombe County.

## Build Scenario

The G2S Build Scenario would add a new interchange on I-26 and a connector road to East FLOW where it will tie into the existing roundabout at the Pratt & Whitney Manufacturing Plant driveway. The East FLOW extension (i.e., connector road) will incorporate the existing East FLOW typical section, including a two-lane roadway with auxiliary lanes at intersection approaches and a separated sidewalk to the control of access (C/A) limits for I-26.

## 3.0 Traffic Operations and Crash Analysis

### Traffic

The analysis uses the project Traffic Forecast Report (April 2022), which provided 2021 and 2045 Build and No-Build traffic volume data. The report was based on the French Broad River Metropolitan Planning Organization Travel Demand Model (2015/2045 FBRMPO TDM v1.1),

which account for traffic growth from the development with and without the interchange. The analysis includes the rational assumption that the addition of the interchange (a) changes traffic patterns, especially shifting trips from NC 191 to I-26, and (b) decreases distance and time traveled due to better access.

The assumptions for vehicle miles traveled (VMT) and vehicle hours traveled (VHT) were calculated based on the Traffic Forecast volumes for East FLOW in 2021 and 2045 Build Scenario (refer to *Figures 9–12*). The assumption was made that this traffic would be broken into existing users of NC 191 and NC 146 (Long Shoals Road) and new users. The number of new users was estimated at 800 vehicles per day (VPD), based on the employment commitment for the Pratt and Whitney Manufacturing Plant. This number, and the associated benefits could be much larger based on the multiple shift schedule of the 24-hour plant. The 800 new users were subtracted from the total volume to calculate the existing users. Additionally, it was assumed that two-thirds of the traffic on East FLOW would use Exit 33 (NC 191) and one third of traffic would use Exit 37 (NC 146) in a No-Build Scenario. Distance savings and travel time savings for the new and existing users were calculated using Google Maps. *Table 2* summarizes the distance and time saving values; *Figures 3–8* show the distance and time assumptions for each roadway segment.

**Table 2:** *Build and No-Build Vehicle Miles and Travel Time Summary Table*

Route	Distance (Miles)			Time (Minutes)		
	Build	No-Build	Difference	Build	No-Build	Difference
NC 191 to Exit 33	1.2	2.2	+1	2	5	-3
NC 191 to Exit 37	1.5	2.4	+0.9	3	4	-1
Pratt & Whitney to Exit 33	1	3.5	+2.5	2	8	-6
Pratt & Whitney to Exit 37		3.9	+2.9		7	-5



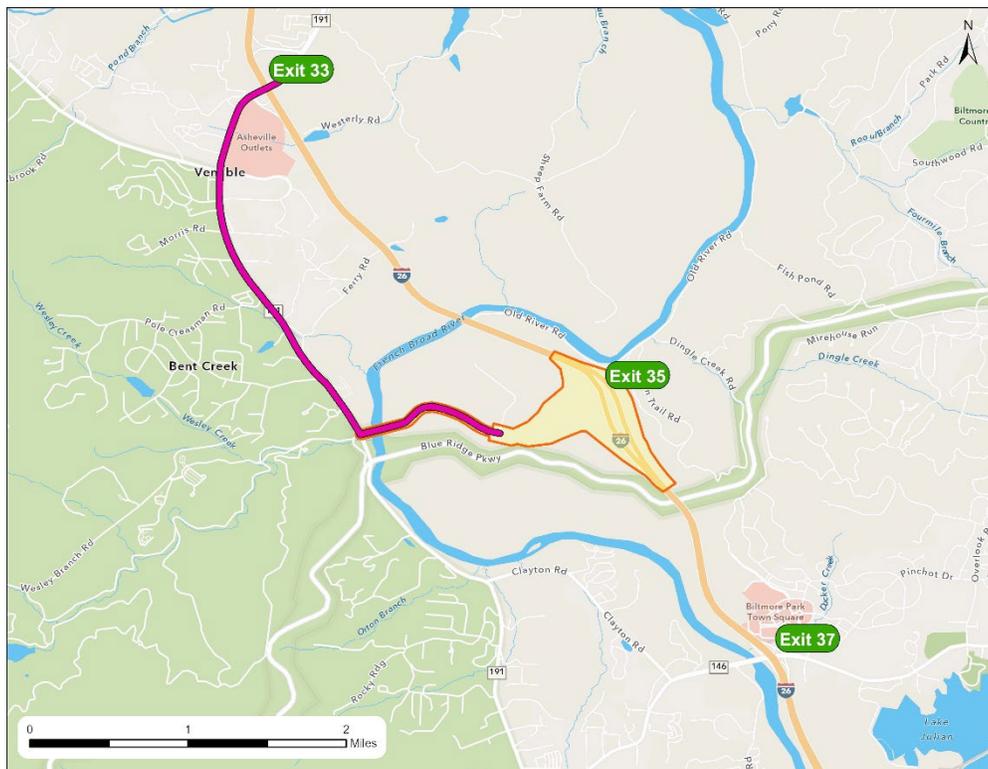
Figure 3. NC 191 Build Scenario—Existing users who can now use Exit 35.



Figure 4. NC 191 No-Build Scenario—Users who must use Exit 33 to access the Pratt and Whitney Manufacturing Plant.



**Figure 5.** NC 146 Build Scenario—Users who can now use Exit 35.



**Figure 6.** NC 191 No-Build Scenario—Existing users who must use Exit 33 to access I-26.



Figure 7. NC 146 No-Build Scenario—Existing users who must use Exit 37 to access I-26.



Figure 8. Build Scenario—New users can use Exit 35 to access the Pratt & Whitney facility.

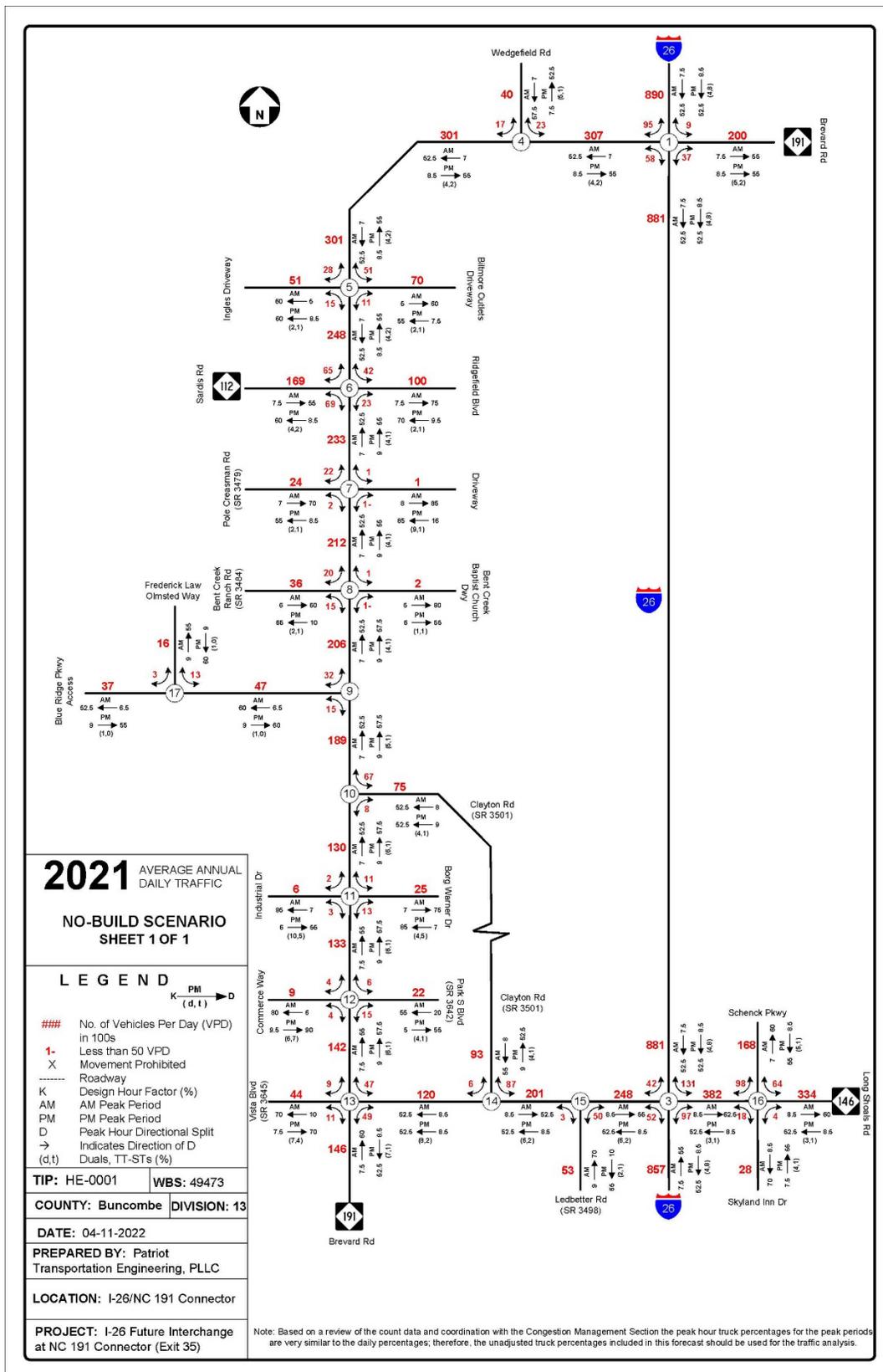


Figure 9. 2021 No-Build Scenario. Source: Traffic Forecast Report (April 2022)

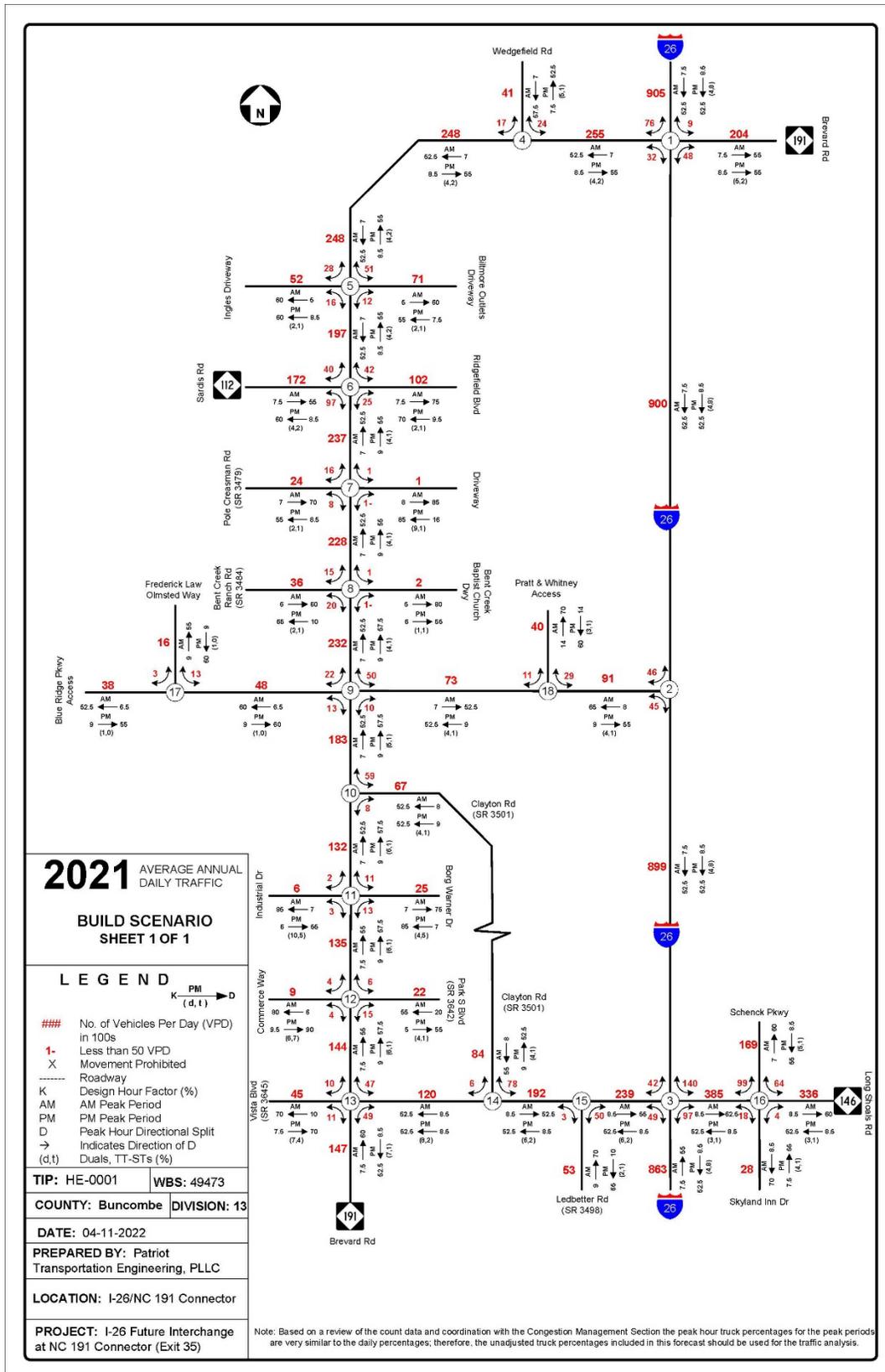


Figure 10. 2021 Build Scenario. Source: Traffic Forecast Report (April 2022)

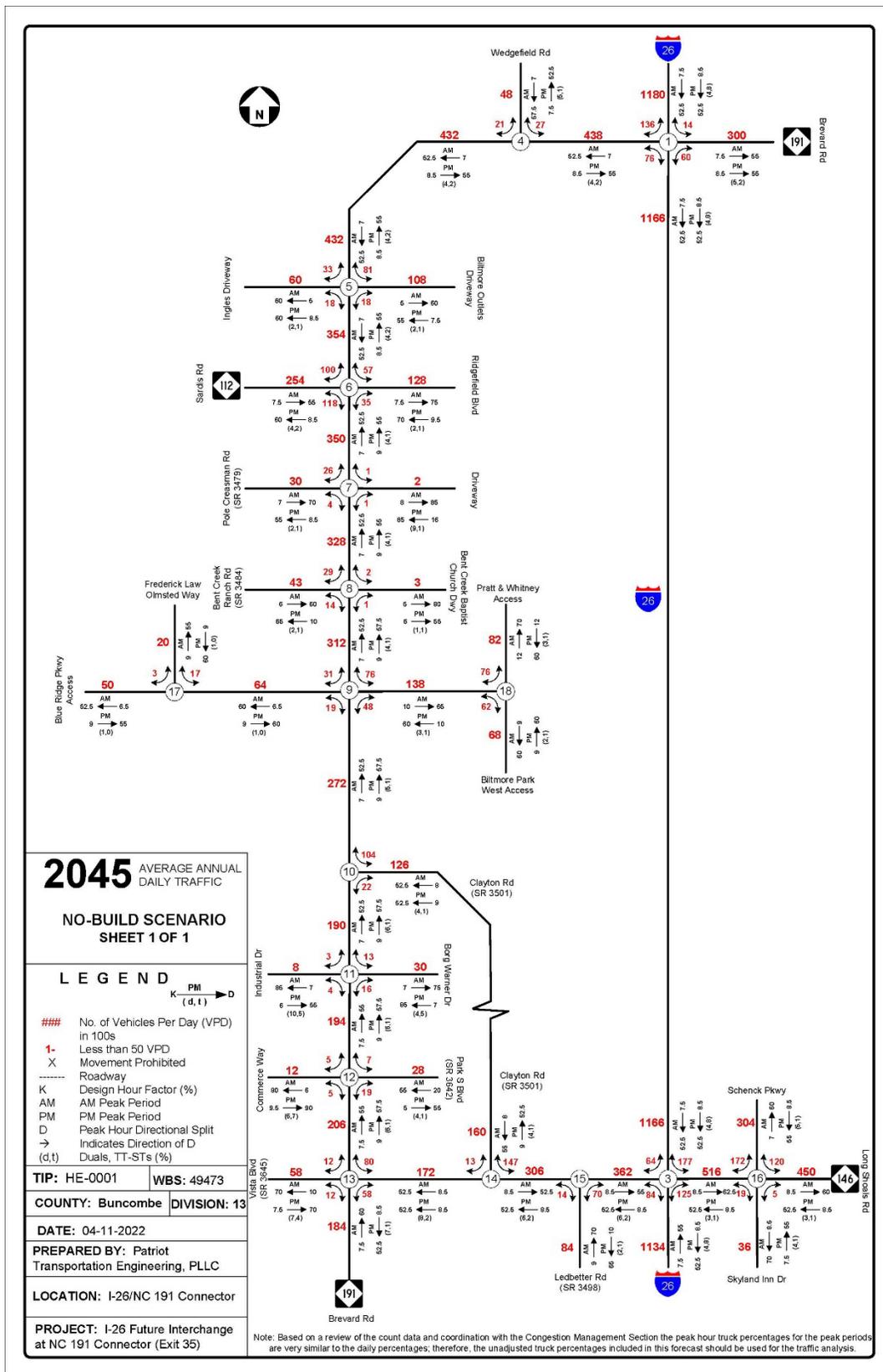


Figure 11. 2045 No-Build Scenario. Source: Traffic Forecast Report (April 2022)

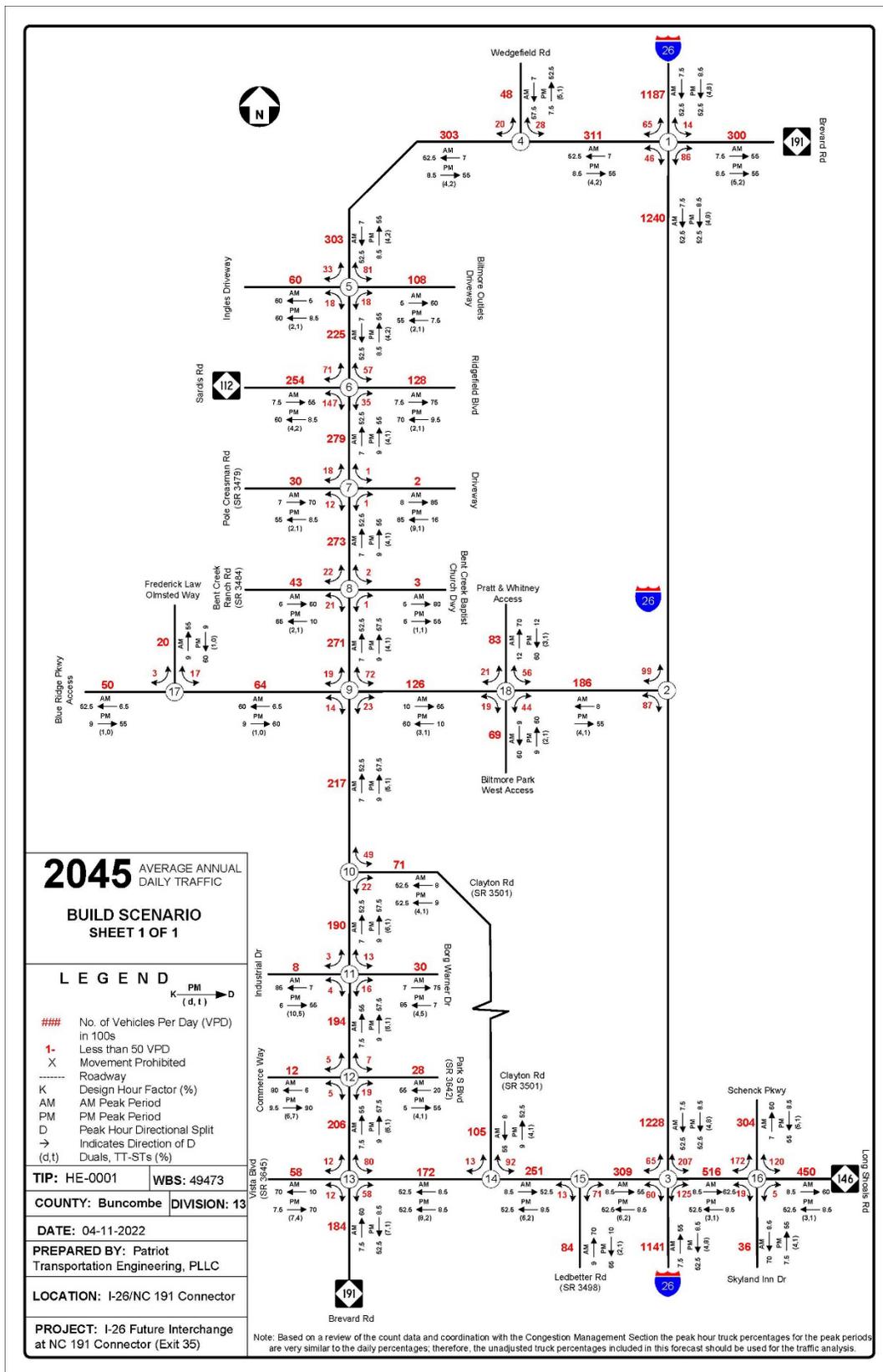


Figure 12. 2045 Build Scenario. Source: Traffic Forecast Report (April 2022)

## Crashes

NCDOT has completed crash analyses for segments and intersections in the project area including the following:

- I-26 from Bridges #100235 & 100238 (over Pond Rd) to 2,000 feet south of NC 146
- NC 191 from Hampton/Petco Driveway (Wedgefield Blvd) to Pine Lane/I-26
- NC 146 from SR 3501 (Clayton Rd) to Skyland Inn Dr/Schenck Pkwy
- NC 191 at Blue Ridge Parkway Access
- NC 191 at SR 3501

Each crash analysis includes a summary rate expressed as equivalent property damage only (EPDO) crashes per 100 million vehicle miles traveled (MVMT). The USDOT BCA guidance provides a 2021-dollar value of \$4,800 per EPDO. An example summary for the NC 191 segment is shown in *Table 3* and estimates for all five locations are on the Assumptions tab of the BCA Calculations file.

**Table 3: Example Crash Analysis Summary (NC 191)**

Vehicle Exposure Statistics		
	Annual ADT = 19200	
	Total Length = 0.449 (Miles)	0.723 (Kilometers)
	Total Vehicle Exposure = 15.74 (MVMT)	25.33 (MVKT)
Crash Rate	Crashes Per 100 Million Vehicle Miles	Crashes Per 100 Million Vehicle Kilometers
Total Crash Rate	755.96	469.73
Fatal Crash Rate	0.00	0.00
Non-Fatal Crash Rate	190.58	118.42
Night Crash Rate	120.70	75.00
Wet Crash Rate	88.94	55.26
EDPO Rate	2166.24	1346.04

## 4.0 Analysis Assumptions

### Inflation

All dollar values are expressed in 2021 dollars. Nominal dollar values from different years are adjusted to real (2021) dollar values using the gross domestic product (GDP) implicit price deflator. The US Bureau of Economic Analysis and the Congressional Budget Office provide historical and forecast values for this purpose, and adjustment factors are included in the USDOT's BCA guidance for many years. The proposed project costs are estimated in the current 2023 dollars, so for the BCA these are adjusted to 2021 dollars (explained in detail in the BCA Calculation spreadsheet).

## Discounting

Discount rates in economic analyses account for the time value of money, which is separate from inflation. Per USDOT guidance, the real discount rate to apply is 7% per year for future costs and benefits. Intermediate calculations are shown in nominal dollars (typically 2023), real 2021 dollars, and then discounted dollars. The Excel file includes a table of adjustment factors in the Assumptions tab and graphs illustrating these.

## Analysis Period

The analysis period is 22 years from 2023 to 2045 (23 years with 2023 as year zero). The BCA guidance suggests 20-25 years for projects like this one. The project construction begins in earnest in 2023, and the future traffic forecast is set in 2045. Benefits do not begin to accrue until 2026, the year of opening. The core Pratt & Whitney economic expansion and jobs build out is targeted for 2029.

## Other Assumptions

### Induced Demand

This project supports the land development in the region, so new trips are implicit in the traffic modeling results that are used as inputs. Diversion between I-26, NC 191, and other connection segments are included in the model results. No new additional benefits are drawn from outside the analysis area.

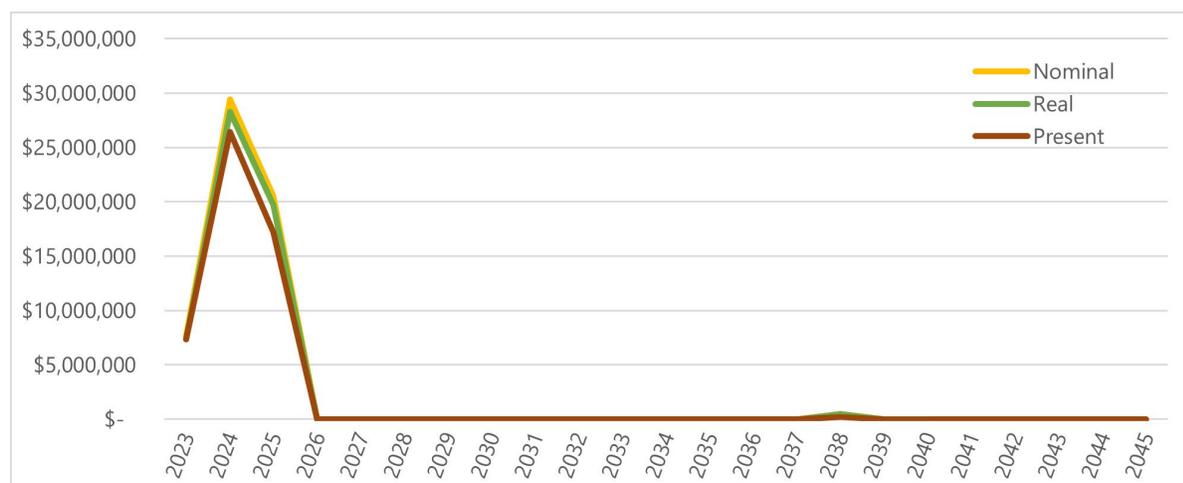
### Independent Utility

This analysis captures the full costs required to attain the benefits included in the analysis. In addition to the proposed costs outlined in the proposal, the BCA includes additional costs for completed environmental and preliminary engineering work and a full pavement resurfacing around 2038.

## 5.0 Project Costs

### Capital Costs

Figure 13. Summary of Costs over Time



Project costs are described in the proposal and assigned to years of expenditure commensurate with the project schedule and are summarized in *Figure 13*. Costs are estimated in nominal 2023 dollars, deflated to real 2021 dollars, and discounted to present values.

Remaining Project design costs are 40% in 2023, and the other 60% are in 2024. Construction costs are placed 10% in 2023, 50% in 2024, and 40% in 2025.

Costs in the BCA include:

- \$57.2 million for total project costs, including about \$2.9 million for effort already spent on this project (per USDOT BCA guidance to include this sunk cost as an exception to the rule) for preliminary design and environmental work.
- An estimated \$500 thousand for a full resurfacing around 2038.
- Annual operations and maintenance (O&M), which is accounted for as a disbenefit per BCA guidance. Ongoing operations and maintenance costs are accounted for as disbenefits rather than costs.

### O&M Cost and Residual Value

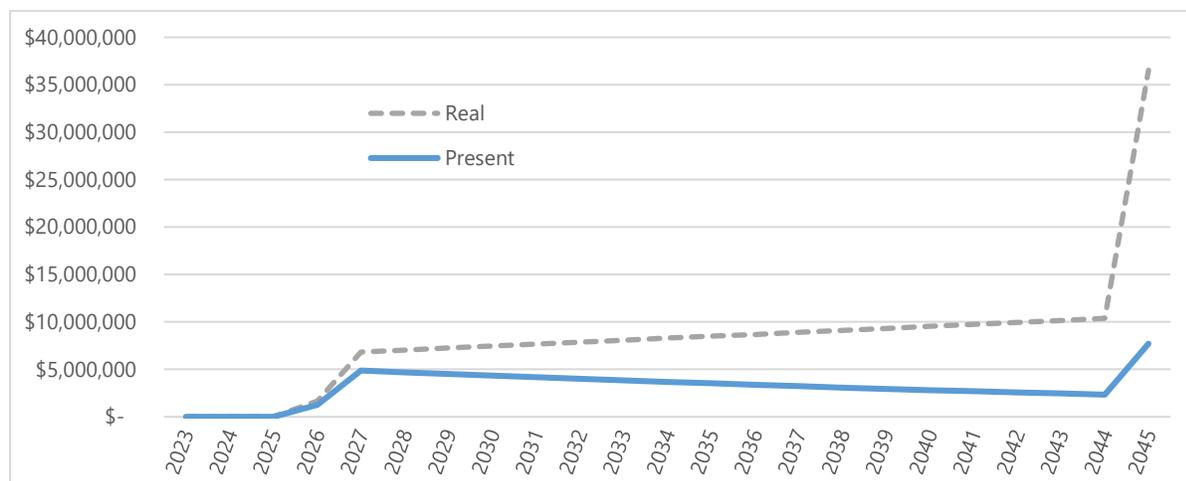
The USDOT BCA guidance is clear that operations and maintenance (O&M) cost changes are to be accounted for in the numerator of the B/C. Because this project adds new infrastructure where there was none before, net O&M increases and is thus a disbenefit. These costs include electrical and communications, roadside vegetation management, and surface maintenance. The first five years are estimated to add \$10 thousand per year, increasing to \$25 thousand per year through 2035, then \$50 thousand per year thereafter.

Residual value—also accounted for as a benefit—at the end of the analysis period (2045) assumes a 60-year service life for the roadway and a 65-year service life for structures. NCDOT typically assumes 60 to 75 years for service life of new infrastructure as included in this project.

## 6.0 Project Benefits

Quantifiable and monetized direct project benefits for BCA include decreases in miles traveled, travel time savings, crash reduction (safety improvement), and residual value (*Figure 14*).

**Figure 14.** Summary of the quantified benefits over the analysis period. The summary values are shown in Table 1 (page 1) of this document and in the accompanying BCA Calculation file.



Operating cost savings and travel time savings are based on the traffic analysis described in Section 3. As seen in the forecast volumes (*Figures 9–12* above), traffic patterns change with the new I-26 interchange, particularly a shift from NC 191 to I-26. I-26 being expanded to eight lanes just prior to this project means no assumption of interstate congestion reduction on I-26. However, the benefits occur because of the distance and time savings of traffic more directly

accessing I-26 at future Exit 35. Increased ongoing O&M is deducted as a disbenefit and combined with residual value in *Figure 15* for illustration (O&M disbenefit is much smaller than residual value).

All benefits in 2026, the year of opening, are reduced to one-quarter because the facility is scheduled to be fully open later in the year.

### Vehicle Miles & Operating Costs

Vehicle miles traveled (VMT) has a direct impact on vehicle operating costs (VOCs). To estimate the actual user operating cost benefits generated by the project, this BCA estimates the change (increase or decrease) comparing vehicular travel distance in the No-Build and Build scenarios. Traffic volume counts for the project were multiplied by the route distances to either Exit 33 or Exit 37 in the No-Build Scenario or future Exit 35 in the Build Scenario to obtain the VMT under the No-Build and Build scenarios. The difference between the two calculated VMTs represents the miles saved. The traffic analysis shows a decrease in net VMT with the improved accessibility to I-26. Using assumptions of VOCs provided in the USDOT BCA guidance, the overall VOCs savings is estimated to be \$ 51.22 M (2021\$).

### Travel Time Savings

Assumptions of time and occupancy are drawn from the USDOT BCA guidance. These are shown in the accompanying BCA Calculations file along with the heavy truck percentage in the area. Decreases in travel distance under the Build Scenario would result in a decrease in travel time for users. This analysis estimated the marginal change in travel time for users in the No-Build Scenario who would have to use either Exit 33 or Exit 37 with users who would be able to access I-26 more quickly at future Exit 35. The traffic analysis shows there would be travel time savings based on traffic having more direct access to I-26, with overall time savings estimated at \$110.87 M (2021\$).

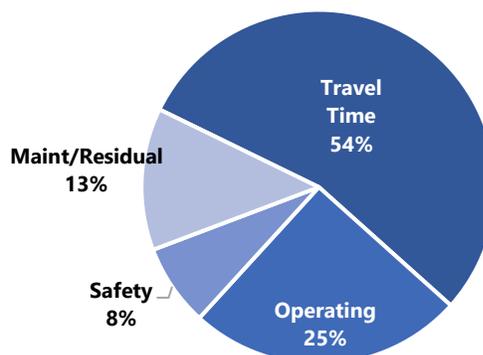
The Interchange Access Report (IAR) shows that with the reduced projected volumes on NC 191, there is also reduced congestion and delay. The Level of Service (LOS) either remains constant or is improved at all intersections. Notable improvements are at NC 191 and Blue Ridge Parkway Access, which improves from LOS D to C, and NC 191 and I-26 eastbound ramps, which improve from LOS E to C.

### Safety

Safety benefits for this project accrue from a reduction in risk exposure resulting from trips diverted from higher crash locations (e.g., NC 191) to lower crash locations (e.g., I-26). The EPDO approach was introduced above in the baseline section, and the rates are summarized on the Assumptions tab of the accompanying BCA Calculations file.

There are no targeted crash reduction tactics included in this project, so the baseline crash rates are taken as fixed. The net change in EPDO estimated at 2021 and 2045 is interpolated through the analysis period, but reductions are fixed at zero in the first three years until the new facility is fully opened.

**Figure 15. G2S Benefits Breakdown**



In addition, because (a) not all locations in the affected network have a crash analysis included, and (b) the crash rates are based on existing data prior to the construction of the I-26 widening project, the overall crash reduction is assumed to be 10%. With uncertainty this assumption is set to vary from 0% (no change in crashes) to 20%. The reduction in crashes is estimated to equal \$15.22 M (2021\$) in quantified benefits.

## Benefits Summary and Other Qualitative Benefits

BCA strives to quantify only first order (direct) impacts, not other economic impacts such as those known to emerge in the area from jobs, property values, and so forth. Nonetheless, there exist other potential benefits that are not necessarily quantified:

### Infrastructure Resiliency, Reliability, & Redundancy

I-26 is one of North Carolina's Strategic Transportation Corridors<sup>1</sup>. *North Carolina's 2020 Climate Risk Assessment and Resilience Plan*<sup>2</sup> and *NCDOT 2021 Resilience Strategy Report*<sup>3</sup> both include improving transportation infrastructure resilience, particularly for major storms, flooding, and landslides. The addition of a new interchange on I-26 would improve connectivity and redundancy, i.e., alternate route options, both of which are part of NCDOT's targeted efforts to improve resilience and maintain essential travel on the State's highway network.

Unpredictable travel time can be monetized in utility functions along with delay, safety, and other costs. However, because this project follows on the widening of I-26, claims of improved travel time reliability are less about general congestion. Travel reliability will improve during instances of full closures just up or downstream of the new interchange and connector road where the improved connectivity and alternate routes will reduce long queues, secondary crashes, and uncertain travel time.

### Emergency Response

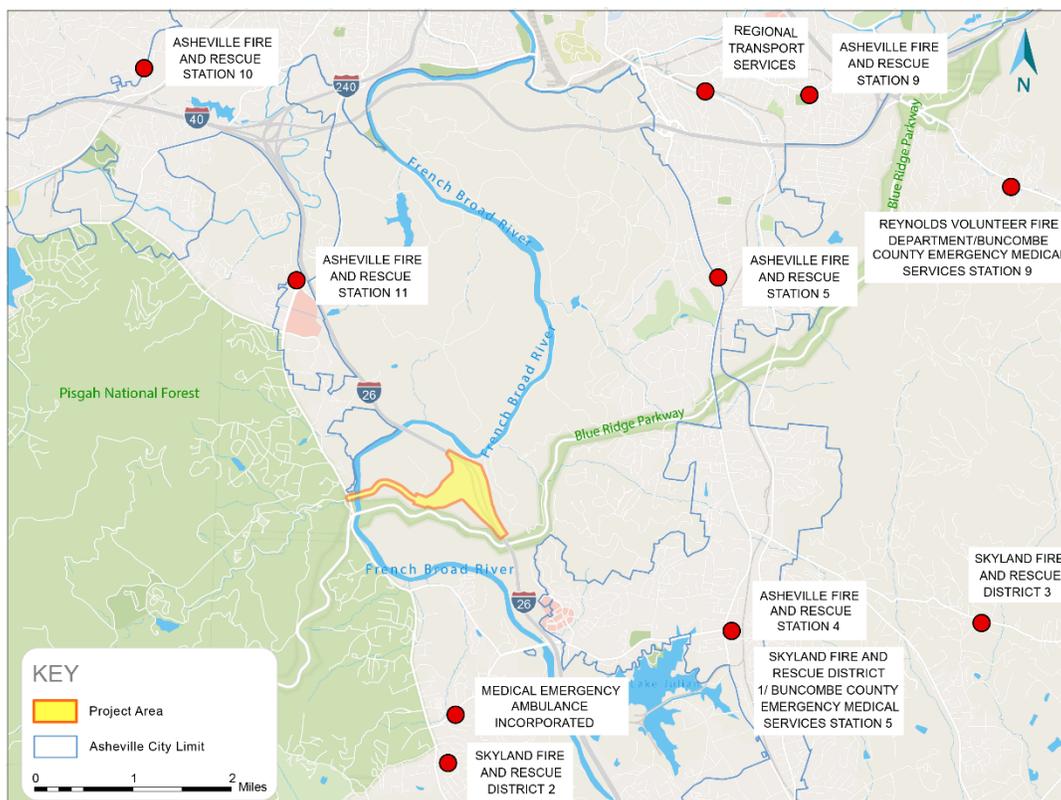
Police, fire, emergency medical services, and other first responders will gain new route options with an additional interchange between exits 33 and 37 on I-26. *Figure 16* illustrates the proximity of fire/EMS stations to the project area. The team assessed travel times from nearby stations to the project area in accordance with the USDOT and FEMA guidance. In part because of data limitations, and because the project area has multiple stations of roughly equal travel distances – both in the No-Build and Build Scenarios – quantified economic benefit is not included here. Nonetheless, the project area is currently primarily served by the Asheville/Skyland Fire-Rescue Biltmore Forest Valley Springs Station, and response time for that station may be reduced up to three minutes depending on location of an incident.

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<sup>1</sup> <https://connect.ncdot.gov/projects/planning/STC%20Documents/STC%20Map.pdf>

<sup>2</sup> <https://files.nc.gov/ncdeq/climate-change/resilience-plan/2020-Climate-Risk-Assessment-and-Resilience-Plan.pdf>

<sup>3</sup> <https://files.nc.gov/ncdeq/climate-change/resilience-plan/agency-reports/Department-of-Transportation-2021-Resilient-Strategy-Report.pdf>



**Figure 16.** *G2S provides a connection that will improve emergency service access and enhance survivability. Skyland Fire and Rescue (located at bottom of map) has requested a needed turnaround in this area.*

## Wellness and Quality of Life

In addition to improvements to post-crash care that will enhance survivability through expedient access, as discussed in **Criterion #1: Safety**, G2S will improve quality of life through access to better jobs. Based on the Climate and Economic Justice Screening tool, this project is not in an area meeting their definition for disadvantaged populations. However, with the improved network connection and direct access to I-26, access to good-paying jobs at the Pratt & Whitney Manufacturing Plant will benefit nearby disadvantaged areas, 25 of which are located within 20 miles of the project area. Three nearby disadvantaged communities about 5 miles away in Asheville qualify because of income level, high school education, and lack of transportation resources.

G2S not only connects people and jobs, but also improves access to outdoor recreational resources, such as the Blue Ridge Parkway and French Broad River, which encourage exercise and healthy living. Further, the project will serve as the spine for Biltmore Park West, envisioned to be an active mixed-use community, including sidewalks and possible trail and greenway connections similar to Biltmore Park located to the southeast.

## Repurposed Right of Way and Work Zone Impacts

The G2S project is minimizing right-of-way and work zone impacts. I-26 is currently being widened from two lanes to four lanes in each direction of travel. The G2S project will repurpose existing right-of-way by building a left exit/entrance interchange within the existing I-26 median.

This design avoids impacts to the National Historic Landmark (NHL) Biltmore Estate and the French Broad River floodplain and adjacent jurisdictional wetlands. Additionally, a total of approximately 11-acres of right-of-way will be donated by Biltmore Farms, LLC, for the construction of the connector road. Based on recent (2023\$) comparable acquisition costs from NCDOT a \$20,000 per acre cost is assumed. As a result, this donated property would be valued at approximately \$218,816. This value likely underestimates the real property value, so while it is included in the accompanying BCA Calculations file, it is further discussed as a qualifiable benefit because the benefit is likely larger than the quantifiable dollar amount.

NCDOT is trying to reduce costs and construction time by utilizing the same contractor building the I-26 Widening Project to fulfill this project. Work zone conditions are typically considered a disbenefit. This project is utilizing existing work zone conditions on I-26 which will likely result in reduced costs and an accelerated construction schedule because the project can avoid rework where the projects' overlap, garner material buying power within a larger project, and eliminate mobilization time and costs. Additionally, since this portion of I-26 is already under work zone conditions, I-26 users will not have to adjust again, hopefully reducing perceived traffic delays and crashes.

### **State of Good Repair**

This project improves the state of good repair not of the new infrastructure itself but of the highway system and freight network. The project also lessens additional burden, wear, and tear on the existing roads in the area, offsetting maintenance and resurfacing.

### **Agglomeration Economies**

While not quantified for this project, the project benefits the regional economy given its new connections among communities, jobs, and other economic activities. The application narrative lays out the benefits related to this category.

## **7.0 Summary of Results**

The benefits from the G2S Project are quantified in terms of travel time savings, decreased operating costs, safety improvements, and residual value. Travel time savings result in the largest share of benefits, with 54% of total benefits being a result of improved travel times in the Build Scenario when compared to the No-Build Scenario. The proposed interchange also produces vehicle operating and maintenance cost savings of approximately 25% of the Build Scenario benefits. These benefits emanate from the reduction of VMT on a per trip basis that results in reduced overall travel costs for passenger cars and trucks in the Build Scenario. The proposed interchange is expected to result in a reduced crash rate. The safety benefits comprise about 8% of the G2S Project's overall benefits. The G2S project will also have a residual value at the end of the operating period since the new facilities service life extends beyond the analysis period. Of the Build Scenario benefits, the residual asset value encompasses 13% of the total benefits.

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AUGUST 2023**

# **GROUND TO SKY PROJECT**



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