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Benefit-Cost Analysis Memorandum

Lake Lure STRONG Bridge Project

Prepared for North Carolina Department of Transportation

June 29, 2026

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1. Executive Summary

A benefit-cost analysis (BCA) for the Lake Lure Safe Transportation for Regional Opportunity and Network Good Repair (STRONG) Bridge Project (the "Project" hereafter) was prepared for North Carolina Department of Transportation (NCDOT), to support an application to the 2026 Bridge Investment Program (BIP). The BCA was conducted in accordance with the U.S. Department of Transportation's (USDOT's) Benefit-Cost Analysis (BCA) Guidance for Discretionary Grant Programs (December 2025) using the USDOT BIP BCA Tool v.1.1.2. This BCA compares the expected benefits and costs of undertaking the Project (the "Build" scenario) to the "No Build" baseline scenario, to estimate the Project's net benefits. Table 1 provides an overview of the baseline scenario, the Project (build scenario), and all estimated benefits.

The Project will replace two aging bridges in Rutherford County, North Carolina, near Lake Lure. Bridge 800052 (National Bridge Inventory [NBI] 1610052) carries US 64 over Cane Creek south of Lake Lure. Bridge 800343 (NBI 1610343) carries State Route 1314 over Buffalo Creek north of Lake Lure. Both bridges are currently in "Fair" condition but are at imminent risk of a "Poor" rating within the next three years. Both bridges are already load posted.[1]

For the BCA, all values are in 2024 dollars, discounted at 7 percent, consistent with USDOT guidance. The analysis covers a 30-year operating period following the opening of the Project in 2033. The BCA estimates the Project's Net Present Value (NPV) to be $538.1 million and the benefit-cost ratio (BCR) to be 27.4:1. The undiscounted 2024-dollar cost of the Project is $31.5 million, and the 2024-dollar cost (discounted at 7 percent from year of expenditure) is $20.4 million.

As shown in Table 2, the Project provides $558.5 million in total benefits over the analysis period, using a 7 percent discount rate. The benefits consist primarily of travel time savings, operating cost savings, and safety benefits from avoided detours.

[1] US 64 does not show as posted in the NBI. However, signage at the bridge reads "NO THRU TRUCKS. WEIGHT LIMIT 13,000 LBS."

Table 1: Impact Matrix

Current Status/Baseline & Problem to be Addressed	Change to Baseline or Alternatives	Types of Impacts	Affected Population	Economic Benefit (NPV $2024 M) Discounted at 7%
Two aging bridges in Rutherford County, NC, are at imminent risk of falling into a "Poor" rating within the next three years. The bridges, north and south of Lake Lure, are load posted, limiting the amount of weight each vehicle can carry over the structure. Load posting causes costly detours for trucks that weigh more than the posted limit. Further posting and eventual complete closure will increase the cost of these detours for freight, local, and tourist traffic over the analysis period.	Two bridges in Rutherford County, NC, will be replaced with new construction bridges designed to current standards. The Project will eliminate recurring maintenance costs associated with repairs due to deteriorating bridge conditions while improving safety and operational efficiencies. Replacement of these rural bridges will eliminate costly detours for freight, local, and tourist traffic that would be incurred by further load-postings and/or bridge closures. The new bridges will accommodate the safe and efficient movement of freight and local traffic and will have appropriate facilities for bicyclists and pedestrians in a recreation- and tourist-focused area of North Carolina.	**State of Good Repair**		
		Maintenance Cost Savings	NCDOT	$0.6
		Residual Value	NCDOT	$1.4
		Safety and Mobility		
		Safety Benefits from Detours Avoided	Road users	$180.3
		Economic Competitiveness and Opportunity		
		Travel Time Savings from Detours Avoided	Road users	$245.7
		Vehicle Operating Savings from Detours Avoided	Road users	$127.1
		Resiliency and the Environment		
		Noise Savings	Area residents	$0.1
		Emission Savings	Road users and area residents	$3.2

Notes: M = millions

Table 2: Costs and Benefits ($M)

Lake Lure STRONG Bridge Project	US 64	SR 1314	Total
Costs			
Capital Costs	$14.7	$5.6	$20.4
Total Costs	*$14.7*	*$5.6*	*$20.4*
Benefits			
State of Good Repair			
Maintenance Cost Savings	$0.4	$0.1	$0.6
Residual Value	$1.0	$0.4	$1.4
Subtotal	*$1.5*	*$0.5*	*$2.0*
Safety and Mobility			
Safety Benefits from Detours Avoided	$100.5	$79.8	$180.3
Subtotal	*$100.5*	*$79,8*	*$180.3*
Economic Competitiveness and Opportunity			
Travel Time Savings from Detours Avoided	$103.6	$142.1	$245.7
Vehicle Operating Cost Savings from Detours Avoided	$78.6	$48.5	$127.1
Subtotal	*$182.2*	*$190.6*	*$372.8*
Resiliency and the Environment			
Noise Avoided	$0.1	$0.0	$0.1
Emissions Avoided	$2.0	$1.2	$3.2
Subtotal	*$2.1*	*$1.2*	*$3.3*
Total Benefits	$286.3	$272.1	$558.5
Outcome			
Benefit-Cost Ratio	**19.4**	**48.2**	**27.4**
Net Present Value	**$271.6**	**$266.5**	**$538.1**

Note: M = millions

2. Project Description

The Lake Lure STRONG Bridge Project will replace two aging bridges rural Rutherford County, NC. The bridges are located north and south of Lake Lure, are in rural communities, and cross waterways (river, creek, or stream). Additionally, Rutherford County is in the Appalachian Regional Commission (ARC) region, which was established by Congress in 1965 to promote growth and improve the quality of life in the 13 Appalachian States.

Bridge 800052 (NBI 1610052) carries US 64 over Cane Creek south of Lake Lure. Bridge 800343 (NBI 1610343) carries State Route 1314 over Buffalo Creek north of Lake Lure. Both bridges are currently in "Fair" condition but are at imminent risk of a "Poor" rating within the next three years due to the age of each bridge, current state of repair, and traffic, including school buses and freight trucks. Both bridges are already load posted; the weight limit on US 64 is 13,000 pounds (6.5 tons), and the weight limit on SR 1314 is 20 tons for single vehicles and 23 tons for truck tractor semitrailers. Load posting causes costly detours for trucks over the posted limit. Further posting and eventual complete closure will increase the cost of these detours for both freight and local traffic over the analysis period.

The bridges will be replaced with prestressed concrete girder bridges. The scope of each bridge replacement includes structure, roadway, hydraulic modeling, drainage design, erosion control, work zone traffic control, permitting, environmental compliance, utility coordination/relocation, and right of way acquisition. The bridges will be wider and up to current design standards, providing two travel lanes, shoulders, and a multi-use path to accommodate pedestrians and cyclists, as well as the safe movement of freight, local, and tourist traffic.

The replacement of structure 800052 involves approximately 0.3 miles of new location two lane roadway on US 64 / NC 9. The removal and replacement of the aging, functionally obsolete, single span reinforced concrete arch structure with a three-span prestressed concrete girder structure supported on reinforced concrete post and beam bents is the primary component. The bridge end bents (abutments) shall be supported on driven steel H-Pile sections and the bents (piers) shall be supported on drilled shafts. The structure will be constructed on a parallel alignment to the existing bridge to allow traffic to continue to be carried on the existing structure while the new bridge is constructed. This shift in the alignment will require property acquisition, utility relocations, and retaining wall construction to limit the area of right of way to be purchased. The proposed structure shall provide for two travel lanes with appropriate shoulder widths as well as a 10-foot multi-use path to serve pedestrian traffic in the area.

The replacement of structure 800343 involves approximately 0.2 miles of new location two lane roadway on Buffalo Creek Road (SR 1314). The removal and replacement of the three span channel slab bridge on prestressed concrete caps and timber piles with a single span prestressed concrete box beam bridge supported on reinforced concrete caps on driven steel H-Piles is the primary component. The structure will be constructed on a parallel alignment to the existing bridge to allow traffic to continue on the existing structure while the new bridge is constructed. This shift in alignment includes property acquisition and utility relocations. The proposed structure shall provide for two travel lanes with appropriate shoulder widths as well as an 8-foot multi-use path to serve pedestrian traffic in the area.

3. Analysis Framework

The BCA for the Project was conducted using the USDOT's BIP BCA Tool and the Benefit-Cost Analysis Guidance for Discretionary Grant Programs document[2] (USDOT BCA Guidance) as a guide for preferred methods and monetized values. The parameters of the benefits analysis follow the protocols set by the Office of Management and Budget (OMB) "Circular A-94," as well as recommended benefit quantification methods from the USDOT.

The "No Build" or Baseline scenario assumes that the Project would not be built and the purpose of, and need for, the Project would not be met. The Project ("Build" scenario) was compared to the Baseline (No Build) scenario to identify net benefits in the following categories: *State of Good Repair, Safety and Mobility, Economic Competitiveness and Opportunity, and Resiliency and the Environment*.[3]

Benefits and costs were estimated over a 30-year period, beginning the first full year after construction is complete and concluding after 30 full years of operations. Both bridges are expected to begin construction in 2029 and complete construction in 2032; the first full year of benefits will be 2033. A 30-year analysis period is appropriate because the Project will completely replace the subject bridges with new structures.

All dollar values are in 2024 dollars and were discounted to year 2024 at 7 percent.

[2] USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2025. https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance

[3] Benefits categories are consistent with the merit criteria found in the FY 2023 through FY 2026 Bridge Investment Program, Planning and Bridge Project Grant Program NOFO, https://grants.gov/search-results-detail/351567

4. Analysis Inputs

In addition to the default inputs for monetization of benefits and discount rates applied in the BIP BCA Tool, the analysis was also based on specific inputs related to average annual daily traffic (AADT), truck traffic, detours, delay times, and load posting and closure dates.

AADT and Detours

Traffic volumes from 2024 were sourced from the NCDOT online Interactive Traffic Volume Map.[4] The NCDOT Traffic Survey Group collects traffic data statewide to analyze and support planning, design, construction, maintenance, operation and research activities required to manage North Carolina's transportation system. In compliance with standards outlined in the Federal Highway Administration Traffic Monitoring Guide, annual average daily traffic volume maps and reports are published annually, once NCDOT has collected data for the entire state and analyzed and processed the entire set. This data does not have truck counts or percentages. Truck counts were estimated based on the truck percentages shown in the NBI data. Based on low population growth in Rutherford County between 2010 and 2020, no growth rates were applied to 2024 traffic levels. AADTs are the same in the Build and No Build conditions. AADTs, truck counts, and net detour mileage and times are shown in Table 3. Net detour distances and times are shown to only capture the difference between the primary route and the detour route. US 64 has different detours for passenger vehicles and trucks – truck information is shown in parentheses.

Table 3: Bridge AADTs and Detours

Bridge	Age	2024 AADT	2024 Truck Traffic	Net Detour Miles per Vehicle	Detour Roadway Type (Trucks)	Detour Roadway Speed (Trucks)	Net Detour Minutes per Vehicle (Trucks)
US 64[5]	101	2,900	218	24.8 (41.6)	Rural-Local[6] (Rural - Principal Arterial – Interstate)[7]	40 mph (66 mph)	48 (56)
SR 1314[8]	54	2,500	160	12.4	Rural-Local[9]	10 mph	40

Note: The detour route for SR 1314 is on very rural, narrow, mountainous roads. According to NCDOT engineers familiar with the area, the maximum practical speed on these roads is 10 mph and the detour will add 40 minutes per trip. While there is not a separate detour available for trucks, large trucks and emergency service vehicles will particularly struggle on this detour route.

Detour routes are shown in Figure 1 and Figure 2. Even though the net truck detour route for US 64 is much longer in miles, the net detour time is only slightly longer due to the higher speeds achievable on the interstate portion of the truck detour. See footnotes for Google Maps routes.

[4] https://ncdot.maps.arcgis.com/apps/mapviewer/index.html?layers=9a4c0ef17ee2456c8fb745fe85de6baf
[5] https://maps.app.goo.gl/iN6B9rxv1EkipC8L6
[6] https://maps.app.goo.gl/gPgpUC1ShrijLq3R6
[7] https://maps.app.goo.gl/19efMHf4nUuif1x98
[8] https://maps.app.goo.gl/kY94fE9q5Yn75uqN9
[9] https://maps.app.goo.gl/x8FbHXNyk7CHD5mH9

Figure 1: US 64 Detour Routes

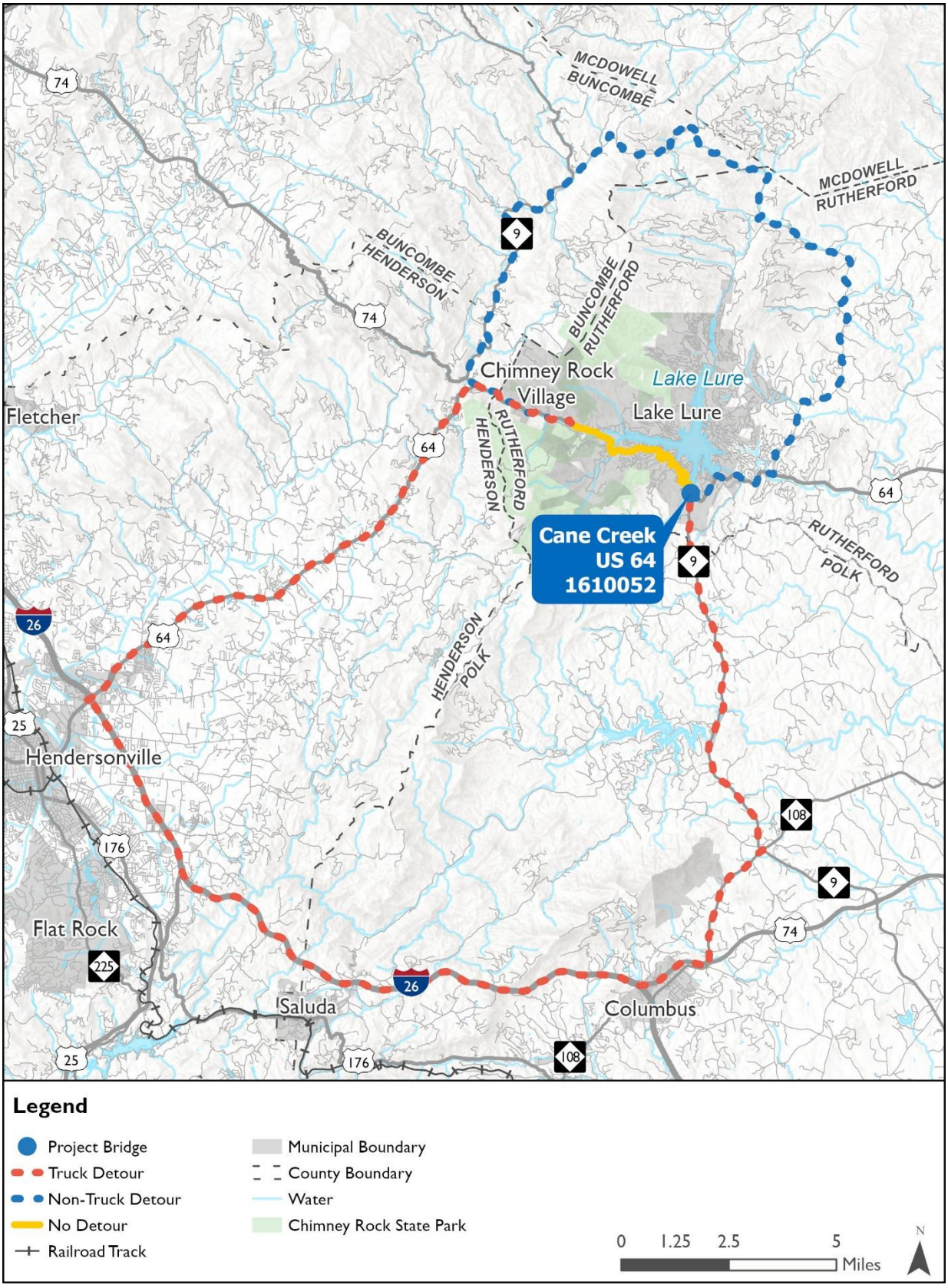
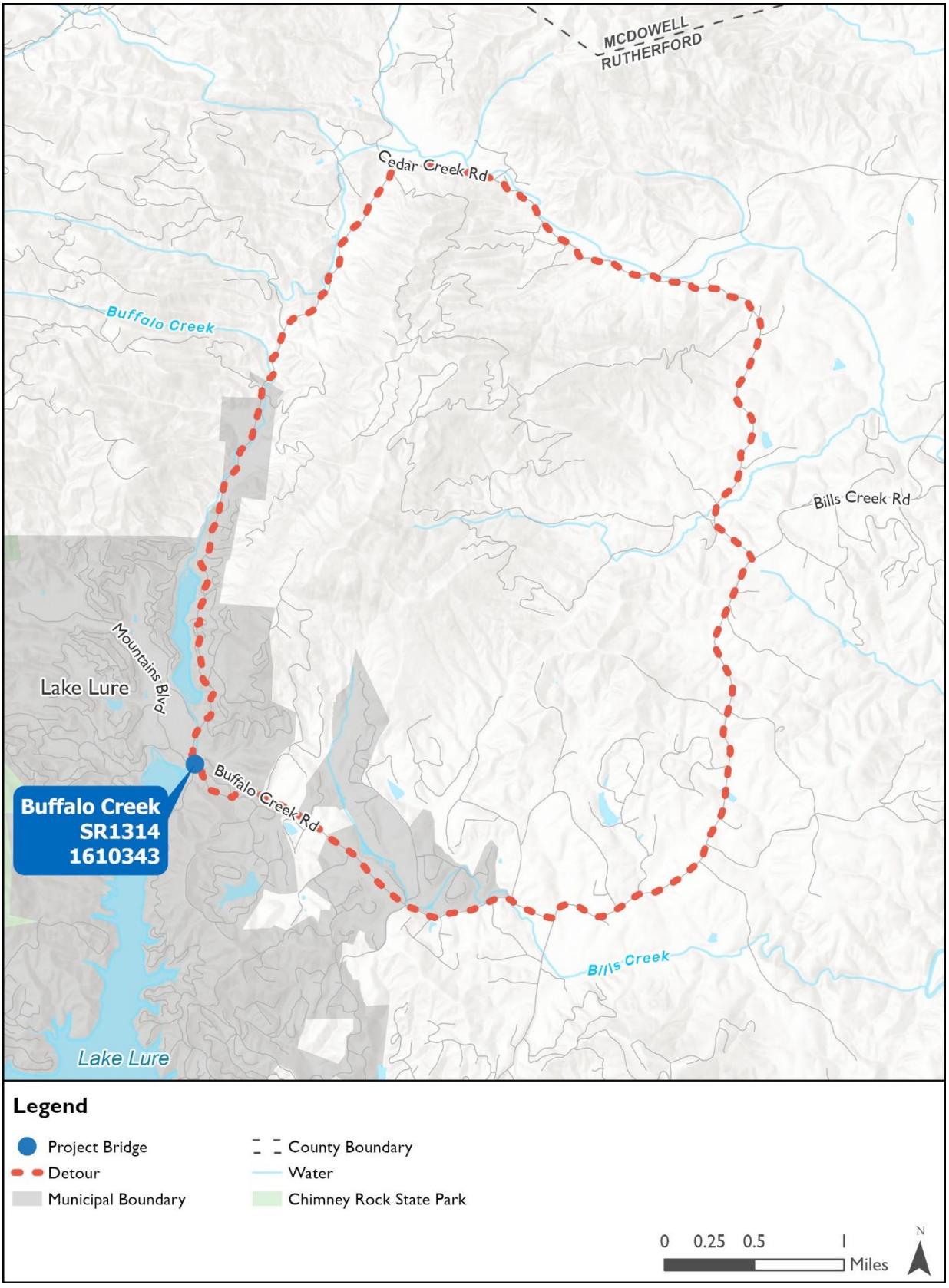


Figure 2: SR 1314 Detour Route



Delays during Construction

During the construction period, both bridges will remain open as the new bridge is constructed next to the existing bridge. Delays during construction will be minimal; all existing lanes will remain open, but the speed limit will decrease due to the construction zone. Delays during construction were assumed to be 5 minutes per vehicle on SR 1314 and 15 minutes per vehicle on US 64; these estimates were developed by NCDOT traffic engineers who are familiar with the roadway networks in Rutherford County. Delays during construction will occur 180 days per year in 2029 and 2032 and all of 2030 and 2031 based on the expected construction schedules.

No Build Load Postings and Closure Dates

The benefits of this Project are based on avoided detours from avoided load postings and complete bridge closures. Therefore, the projected load postings and closure dates are an important part of the analysis. Load postings within the BIP BCA Tool are based on the percentage of truck and bus traffic that will be diverted, with the suggested values of 50% of truck and bus traffic diverting at Level 1 and 100% of truck and bus traffic diverting at Level 2.

Posting and closure dates are based on the NCDOT Bridge Deterioration Model. NCDOT utilizes a probabilistic bridge deterioration framework developed based on research conducted at the University of North Carolina at Charlotte, shifting from older deterministic curves to advanced survival analysis techniques and Markov chain models. These models calculate Transition Probability Matrices (TPMs) to predict how long structural components will take to degrade to lower NBI ratings. Rather than assuming a linear rate of decay, NCDOT's Bridge Management System (BMS) applies survival analysis to historical inspection data. This yields probabilistic models that accurately predict when a bridge or culvert element will require maintenance or replacement based on its age and condition. The deterioration rates and transition probabilities are adjusted to account for real-world factors, including structure and material type (e.g., steel, prestressed concrete, reinforced concrete); geographical and environmental conditions; and traffic loading.[10]

Years when each bridge reach Level 1 posting, Level 2 posting, and complete closure are shown in Table 4. Both bridges have already reached Level 1 postings. Note that the US 64 bridge has been posted with a lower operating rating than what is listed in the NBI.

Table 4: Load Postings and Closure Dates

Bridge	Level 1 - 50% Truck Posted Date	Level 2 - 100% Truck Posted Date	Complete Closure Date
US 64	2025	2034	2040
SR 1314	2025	2030	2033

[10] https://connect.ncdot.gov/projects/research/RNAProjDocs/2014-07FinalReport.pdf

5. Benefits

This Project would result in benefits for the following categories: *State of Good Repair, Safety and Mobility, Economic Competitiveness and Opportunity, and Resiliency and the Environment*. The methodologies used to estimate the benefits of the Project are described in the following sections, along with the associated results. The benefits presented in this memo reflect the benefits for the two bridges in total.

State of Good Repair

The Project would construct two new bridges to replace aging structures in Rutherford County. Full reconstruction will result in maintenance cost savings compared to the existing bridges. Maintenance currently consists of biannual inspections and repairs including asphalt repair and patching and maintenance and repair of barrier rail, deck, superstructure, and wing walls. In the Build scenario, inspections will still be required but maintenance and repair costs are expected to be minimal due to the condition and design of the new structures. Average annual Build and No Build maintenance costs are shown in Table 5. No Build maintenance costs include the biannual costs of inspections and the costs of repairs in alternating years.

Table 5: Build and No Build Maintenance

Bridge	No Build Maintenance	Build Maintenance
US 64	$11,000/ $161,000	$5,000
SR 1314	$11,000/ $121,000	$5,000

These values are inputs into *Table 12. O&M Costs for Construction and Operation Periods* in the BIP workbook.

Maintenance cost savings under the Build scenario total $0.6 million in 2024 dollars, discounted at 7 percent.

The Project would result in benefits beyond the 30-year period of analysis because the useful life of the Project exceeds this time span. Under Section 6.3 of the BCA Guidance, a residual value is allowable because the Project involves full reconstructions, not capacity expansions. The useful life of each bridge included in the Project is estimated at 75 years based on engineering judgment of the professional engineers who are conducting the design. These values are used to depreciate the assets to the end of the analysis period using straight-line depreciation. The remaining value of this cost is discounted from the final year of the 30-year analysis period (2062).

The residual value of the Project is $1.4 million in 2024 dollars, discounted at 7 percent.

Safety and Mobility

The Build scenario will reduce VMT by avoiding detours due to posted and closed rural bridges. The reduction in VMT will reduce roadway accidents. Default external safety values are $0.105 per VMT for passenger vehicles and $0.03 per VMT for trucks.

Safety benefits from the Project due to detours avoided are at $180.3 million in 2024 dollars, discounted at 7 percent.

In addition to reduced detours, the new bridges will be wider and will be constructed to modern safety standards, which will reduce accidents. Historical accident reports over the 10 years from May 1, 2016 through April 30, 2026 were obtained from the NCDOT Traffic Engineering Accident Analysis System and are summarized in KABCO format in Table 6.

Table 6: Historical Accidents

Bridge	10-year Accidents			
	K	ABC	O	Total
US 64	0	2	4	6
SR 1314	0	0	2	2
Total	**0**	**2**	**6**	**8**

The potential reduction in accidents due to safer design was not quantified for this BCA.

Economic Competitiveness and Opportunity

The reduction in VMT from avoiding detours will result in travel time savings for passengers and truck drivers. Default travel time values are $21.80 per hour for passengers and $37.20 per hour for truck drivers. Default occupancy for passenger vehicles is 1.52 people per vehicle.

Travel time savings from avoided detours are $245.7 million in 2024 dollars, discounted at 7 percent.

The reduction in VMT from avoiding detours will reduce vehicle operating costs for drivers. Default operating cost values are $0.56 per VMT for passenger vehicles and $1.23 per VMT for commercial trucks.

Vehicle operating cost savings from avoided detours are $127.1 million in 2024 dollars, discounted at 7 percent.

Resiliency and the Environment

Reductions in VMT due to avoided delays and detours will lead to lower emissions. Default external emission values are $0.013 per VMT for passenger vehicles and $0.038 per VMT for buses and trucks.

The emissions savings from detours avoided are $3.2 million in 2024 dollars, discounted at 7 percent.

Reductions in VMT due to avoided delays and detours will lead to lower noise externalities. Default external noise values are $0.0002 per VMT for passenger vehicles and $0.0039 per VMT for buses and trucks.

The noise savings from detours avoided (included as Other Environmental in the BIP BCA Tool) are $0.1 million in 2024 dollars when discounted at 7 percent.

6. Cost Analysis

Capital costs for the Project will be incurred between 2029 and 2032. The costs of the Project were provided in 2026 dollars by McAdams[11] engineers and adjusted to 2024 dollars within the Construction Materials Producer Price Index.[12] Total costs and construction years for each bridge are shown in Table 7.

Table 7: Capital Costs

Bridge	Total Cost (2026$)	Construction Years	Discounted Cost (2024$)
US 64	$ 24,145,882	2029-2032	$14,731,748
SR 1314	$ 9,252,543	2029-2032	$5,644,861
Total	**$33,398,425**	**2029-2032**	**$20,376,609**

The total capital costs for the Project are $20.4 million in 2024 dollars, discounted at 7 percent.

[11] https://mcadamsco.com/
[12] https://fred.stlouisfed.org/series/WPUSI012011#

7. BCA Results

The analysis results in a total Project BCR of 27.4:1 when discounted at a rate of 7 percent. Table 8 provides a summary of the BCA results for each bridge and the Project as a whole. As shown, each bridge is also cost-effective on its own.

Table 8: Costs and Benefits ($M)

Lake Lure STRONG Bridge Project	US 64	SR 1314	Total
Costs			
Capital Costs	$14.7	$5.6	$20.4
Total Costs	*$14.7*	*$5.6*	*$20.4*
Benefits			
State of Good Repair			
Maintenance Cost Savings	$0.4	$0.1	$0.6
Residual Value	$1.0	$0.4	$1.4
Subtotal	*$1.5*	*$0.5*	*$2.0*
Safety and Mobility			
Safety Benefits from Detours Avoided	$100.5	$79.8	$180.3
Subtotal	*$100.5*	*$79,8*	*$180.3*
Economic Competitiveness and Opportunity			
Travel Time Savings from Detours Avoided	$103.6	$142.1	$245.7
Vehicle Operating Cost Savings from Detours Avoided	$78.6	$48.5	$127.1
Subtotal	*$182.2*	*$190.6*	*$372.8*
Resiliency and the Environment			
Noise Avoided	$0.1	$0.0	$0.1
Emissions Avoided	$2.0	$1.2	$3.2
Subtotal	*$2.1*	*$1.2*	*$3.3*
Total Benefits	$286.3	$272.1	$558.5
Outcome			
Benefit-Cost Ratio	**19.4**	**48.2**	**27.4**
Net Present Value	**$271.6**	**$266.5**	**$538.1**

Note: M = millions