

Town of Hudson, NH

Hudson Boulevard July 2019





BUILD - Benefit Cost Analysis

Executive Summary

This Better Utilizing Investments to Leverage Development (BUILD) Discretionary Grant Application is being requested by the Town of Hudson, New Hampshire for construction of the new "Hudson Boulevard". The Benefit Cost Analysis (BCA) was completed in accordance with the 2018 Benefit Cost Analysis Guidance for Discretionary Grant Programs. This project will construct a new two-lane roadway, connecting NH Route 3A with NH Route 111 in Hudson, along the alignment of the proposed Circumferential Highway which was initially proposed in the late 1950's by the New Hampshire Department of Transportation (NHDOT) to provide additional crossings of the Merrimack River and mitigate congestion in downtown Hudson and downtown Nashua.

The Merrimack River forms a major barrier in southern New Hampshire, separating the eastern part of the state from the central and western portion. Commuter traffic and goods need to move across southern New Hampshire between the Derry-Salem area along Interstate 93 to the east and the Nashua/Hudson area along the F.E. Everett Turnpike to the west. The Merrimack River flows north/south between the two areas and forces all east-west traffic to cross the river at only two locations in the region: the Taylor Falls/Veterans Memorial Bridges between downtown Hudson and downtown Nashua; and the Sagamore Bridge between southern Hudson and southern Nashua. The result of high traffic volumes on the Taylor Falls Bridge is congestion in downtown Hudson and on NH Route 3A and in downtown Nashua. The congestion during the peak travel hours in the downtown core is causing traffic to divert onto local roads in Hudson. This diversion of traffic is causing intersections and roadways to exhibit poor Levels of Service.

To the maximum extent possible given the available data, this formal BCA is prepared in accordance with this BUILD grant application and reflects quantifiable economic benefits. It covers all five of the primary long-term impact areas identified in the BUILD grant application guidelines. Table 1 shows the Project Summary Matrix.

The construction of the two-lane "Hudson Boulevard" roadway results in a Benefit-Cost Ratio (BCR) of 1.37, with a BCR of 0.70 at a 7 percent discount rate, and a BCR of 1.02 at a 3 percent discount rate.

Current Status/Baseline & Problem to be Addressed	Change to Baseline/Altern atives	Type of Impacts	Population Affected by Impacts	Economic Benefits	Summary of Results	Page Referenc e in BCA
High levels of traffic congestion on the bridges crossing the Merrimack River.	Construct a new Two-lane roadway connecting NH Route 3A with NH Route 111 in Hudson.	Reduction in commuter traffic on narrow and windy residential roads. Ease safety concerns in	Local, state, regional commercial, and recreational users.	Monetized value of travel time savings for both peak hour commutes	Travel Time Savings: \$30,167,650	×
		impacted by the increase in local traffic.		Monetized value of crash reductions.		
Poor Levels of Service & heavy traffic on local roads in Hudson.		Improved Levels of Service for local roads & intersections in Hudson.	The general public in the form of reduced travel delays		\$40,029,606	6
		Improved safety for the traveling public.	compared with current conditions.	Improved access to commercial, and retail uses which are the basis of the local economy.	Qualitative description of expected Improvement s (Non- monetized)	9-10

Table 1 – Project Summary Matrix

General Assumptions

Real Discount Rate

In an effort to avoid forecasting future inflation rates and the need to grow future values for benefits and costs accordingly, all benefits and cost were valued in current year dollars. Future values are deflated to reflect current values, even in the case where cost is expressed in future year values. The use of current dollar values requires the use of a real discount rate for present value discounting.

In accordance with the US DOT 2018 Benefit Cost Guidelines for Discretionary Grant Program Applicants, a real discount rate of 7% was used for this analysis.¹ In addition, a 3% real discount rate was used for sensitivity analysis.

Evaluation Period

The evaluation period of benefits and cost of a project are typically for a period that includes the construction of the project and the operational period which is 20-50 years on average. For this project, the analysis period includes the project development stage with the construction anticipated to begin in 2021 and be completed in 2026 with a 15-year operational life because this matches the current Nashua Regional Planning Commission Traffic Forecasting model as noted below. Therefore, the BCA calculates all benefits and costs until 2041 Design Year. As a simplifying assumption, all benefits and costs are assumed to occur at the end of each year.

Forecasting Traffic Growth Assumptions

A Traffic Assessment of the operational characteristics, speeds and travel times in the project area were observed from 2009 to 2018.^{2,3} An additional Assessment was also conducted for the crash occurrences in the project area from 2013 to 2019.⁴ This Traffic Assessment looked at the existing operations and the future No-Build and Build conditions for the area between NH Route 3A at the Sagamore Bridge and NH Route 111 just west of Hudson Park Drive in Hudson. For this assessment, the build condition assumed the construction of "Hudson Boulevard" would improve operations within the project study area. The results of this analysis are shown in the Appendix. The Traffic Assessment assumed an opening year of 2020 and a 20-year design life (2040) consistent with NHDOT Design Guidelines for roadway improvement projects.

The NRPC conducted a Traffic Assessment in 2009⁵ in which they analyzed Signalized and Non-Signalized Intersections in Hudson during peak hours and reported the Level of Service for these congested intersections. The NRPC updated this assessment in 2018⁶ with current collected peak hour traffic data at various congested intersection within the project impact area and reported these volumes and Level of Services. Discussions with the Nashua Regional Planning Commission

¹ White House Office of Management and Budget, Circular A-94 Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Program (October 29, 1992).

² Hudson CTAP Discretionary Project Report 2009

³ Hudson Boulevard Traffic Analysis, Nashua Regional Planning Commission, 2018.

⁴ Hudson Police Department Crash Data 2013-2019.

⁵ Hudson CTAP Discretionary Project Report 2009.

⁶ Hudson Boulevard Traffic Analysis, Nashua Regional Planning Commission, 2018.

indicated that the observations and analysis provided in their 2018 study were still acceptable to be used within this year's application to represent future year volumes⁷. Since the Regional Traffic Model does not provide data for the traffic volume data for every year between 2018 and 2041, it was necessary to calculate this data for use in the BCA. The Traffic Analysis report prepared by the Nashua Regional Planning Commission (NRPC) was used to provide the existing traffic volumes for 20178 and established the traffic volumes for the 2041 Build and No-Build scenarios using the Regional Traffic Model. These traffic volumes were then used as the basis for calculating the yearly change in volumes under the No-Build & Build conditions to obtain the 2026 opening year traffic volumes and the traffic volumes between the 2026 opening year and 2041 design year.

Daily and Annual Traffic Assumptions

The NRPC maintains on an ongoing program of data collection using automatic traffic recorder counts. This data is entered into the NRPC's Regional Transportation Model which utilizes TransCAD modeling software to estimate the impact of future changes to land use and the highway network on roadway volumes. Since this project involves numerous state and local roadways it was necessary to determine a way to quantify the volume of traffic affected by the construction of the proposed Hudson Boulevard. While the Traffic Assessment provides an estimated change in the amount of traffic volumes that would use the proposed Hudson Boulevard in the 2041 Build condition, it does not provide an estimate of the volumes of traffic that will use the proposed Hudson Boulevard between the 2026 opening year and the 2041 design year. Therefore, it was necessary to calculate the volume of traffic that would use the new roadway between 2026 and 2041 utilizing the ratio of average traffic on the new roadway to the total volume of traffic in the network in 2041 and applying that to each of the intervening years. These calculations are provided in the Appendix.

Travel Routes

The proposed Hudson Boulevard will connect NH Route 3A at the intersection of Sagamore Bridge Road with NH Route 111 just west of Hudson Park Drive. Three separate travel routes were identified as the current, most used routes to get from these same two points within the Town of Hudson. Travel time runs along these three corridors during congested and free flow conditions were observed over several days using Google Maps to get a representative sample of travel times through the project area. These were compared to the travel time run values calculated by the Regional Model to allow for calibration of the model. With the model calibrated, the future travel times along these three routes for the 2041 "No-Build" and the "Build" conditions were determined and compared to the 2041 Build travel time run values for Hudson Boulevard. The results showed that using Hudson Boulevard resulted in a shorter travel time of approximately 6.5 minutes over the three existing preferred travel routes. All of the information for the travel times runs is provided in the Hudson Boulevard Traffic Assessment prepared by NRPC which is included in the Appendix.

⁷ Letter from NRPC, 2019

Benefit Cost Analysis Introduction

Downtown Hudson experiences one of the highest levels of traffic congestion in the region. This is due in large part to the capacity constraints of the two existing bridges across the Merrimack River. Long delays at the Taylor Falls/Veteran's Memorial Bridges has resulted in increased traffic diversion to the Sagamore Bridge resulting in heavy traffic on other roads in south and east Hudson including NH Route 3A, Wason Road, and Kimball Hill Road.

Traffic across the Taylor Falls/Veterans Memorial Bridges has been stable at approximately 37,000 annual average daily trips. Traffic on the Sagamore Bridge between southern Hudson and southern Nashua has been rapidly increasing in recent years. In 1992, approximately 25,000 annual average daily trips crossed the Merrimack River via the Sagamore Bridge. By 2016 this traffic volume had increased to approximately 49,000 annual average daily trips, an increase of 49% or 1.3% increase per year.⁸

The Circumferential Highway was planned by the NHDOT as a four-lane divided highway connecting Nashua and Merrimack. The purpose identified for the Circumferential Highway, since it was first proposed in the late1950's, has been to provide additional crossings of the Merrimack River and mitigate congestion in downtown Hudson and downtown Nashua. In the late 1990's the Merrimack River Crossing was constructed with the connection from the F.E. Everett Turnpike Exit 2 ramps to NH Route 3A.

Now the Town of Hudson proposes constructing a two-lane, at grade roadway along the alignment of one barrel of the proposed Circumferential Highway from NH Route 3A to NH Route 111. Traffic forecasting using NRPC's regional traffic model indicates that traffic across the Merrimack River will continue to increase rapidly. Traffic across the Taylor Falls/Veterans Memorial Bridge between downtown Hudson and downtown Nashua is expected to increase from 37,000 vehicles per day (vpd) today to 42,800 vpd by 2041. This is an increase of 15% at a rate of 0.7% per year. The Sagamore Bridge is expected to increase from 49,000 vpd currently to 56,300 by 2041. This is an increase of 16% at a rate of 0.7% per year. It should be noted that these increases will take place despite the development of "Hudson Boulevard" that is expected to be used by approximately 20,000 vpd by 2041.

This Benefit-Cost Analysis (BCA) looks at the project from the standpoint of society as a whole and summarizes the net benefits and net costs based on the criteria in the 2018 BUILD Discretionary Grant Application Guidance.

The analysis presented here addresses quantifiable benefits from travel time savings and crash reductions as a result of construction of a new two-lane roadway which will divert traffic from local roadways for both business and recreational traffic thus reducing traffic volumes and crashes. Several other benefits of the new construction are difficult to quantify, including economic competitiveness, livability, and environmental sustainability.

⁸ Hudson Boulevard Traffic Analysis, Nashua Regional Planning Commission, 2018.

Baseline Assumptions

The BCA focuses on the construction of a new two-lane roadway. The project is evaluated by comparing the existing conditions, which is considered the baseline, and a future scenario where the new roadway is constructed. It is anticipated that if no major capital improvements are made, the traffic on these local routes will continue to rise resulting in excessive congestion, operational issues, and safety concerns that may eventually lead to loss in economic competitiveness for the Town of Hudson as businesses will relocate elsewhere. The BCA uses information from other sources which are referenced or included in the Appendix as required.

Benefits and Costs Estimation

Estimation of Benefits for Highway

The following section provides a detailed explanation and computation of the benefits to automobile and truck users within the project influence area. For the purpose of estimating benefits, it is assumed that the construction of "Hudson Boulevard" will begin in 2021 with completion in 2026.

Determining Travel Data

The following section provides information about traffic volume estimates that were utilized for the Benefit-Cost Analysis. These traffic volume estimates provide the basis for the benefits and costs associated with the construction of "Hudson Boulevard".

The traffic data complied during the Traffic Assessment for the proposed "Hudson Boulevard" Project outlines the operational improvements expected as part of the project and serves as the basis for this BCA. Two separate Reports were used as the basis; the original "Hudson CTAP Discretionary Project Report"⁹ in 2009 and an updated report "Hudson Boulevard Traffic Analysis"¹⁰ prepared by the NRPC in 2018 depicting existing operational conditions and includes a future analysis for the 2041 Design Year. This traffic data was adjusted as noted in the section titled; Forecasting Traffic Growth Assumptions of this BCA.

The truck percentages used in the Traffic Assessment were derived from the turning movement counts conducted along the NH Route 3A at the intersection of Pelham Road in March of 2017. The percentage of trucks at this intersection was applied to the daily traffic volumes as noted below. The Daily truck percentages used in this analysis are shown in Table 2.

Table 2 – Estimated Heavy Vehicle Distribution

Analysis Period	Automobile Traffic	Truck Traffic
Daily	99.27%	0.73%

⁹ Hudson CTAP Discretionary Project Report 2009.

¹⁰ Hudson Boulevard Traffic Analysis, Nashua Regional Planning Commission, 2018.

The average annual traffic volumes for the 2018 base year and the 2041 future design year volumes are shown in Table 3.

	2018 Base Year	2041 Design Year
	Annual Traffic	Annual Traffic
Total Traffic	370,174	357,658
Car Traffic	367,472	355,047
Truck Traffic	2,702	2,611

Table 3 – Present and Future Year Traffic Volumes

Estimating Daily Travel Time Savings

The travel data for this project was developed for two specific conditions. The first is the "No-Build" condition and the second is the "Build" condition.

The Traffic Assessment¹¹ provides data for the observed vehicle speeds and times for the existing conditions and the modeled vehicle speeds and times for the future 2041 No-Build and Build conditions. This project will result in changes to the total Vehicle Hours Traveled (VHT) within this project influence area, so there are anticipated savings associated with change in VHT. For this analysis, an average peak period congested vehicle trip time of 15.8 mins was used for the existing daily peak traffic rate and average peak period vehicle times of 18 mins and 11.5 mins were used for the 2041 future no-build and build conditions, respectively. Therefore, using an overall 6.5-minute improvement in trip time through the corridor during the peak hours, vehicles can be expected to experience an average total time savings of approximately 61,000 hours per year based solely on single vehicle occupancy.

The first step in determining the Travel Time Savings is to determine the expected make-up of the daily traffic. Based on data provided by the US DOT it is assumed that 78.6% of the automobile travel is for personal use and the remaining 21.4% of automobile travel is for business use. On average vehicle occupancy is 1.68¹² occupants for vehicle for all trips.¹³ These values result in an affected population that is actually greater than the peak hour traffic volumes because vehicles include more than one person and each person's time must be accounted for in the calculation of the Travel Time Savings. Therefore, the percentage of the peak hour traffic volume is multiplied by 1.68 to estimate the total affected persons. This volume of affected persons is then multiplied by the corresponding value of time to arrive at the total Travel Time Savings.

The second step is to determine the value of each person's time. The automobile value in 2017⁹ dollars for business travel is \$26.50 and the automobile value in 2017 dollars for personal travel is \$14.80. For truck travel, it was assumed that 100% is of the truck traffic is for business use with a value of \$28.60 in 2017 dollars. These rates were applied to the total affected volume to compute

¹¹ Hudson Boulevard Traffic Analysis, Nashua Regional Planning Commission, 2018.

¹² Federal Highway Administration Highway Statistics 2016, Table VM1.

¹³ The Value of Travel Time Savings: Department Guidance for Conducting Economic Evaluations Revision 2 – US Department of Transportation, Washington DC, 2016.

the total travel time savings on a yearly basis as shown in the Appendix. In the analysis, cumulative travel time savings are estimated to be approximately \$30,167,650.

Crash Reduction Benefits

Determining the reduction in crashes as a result of the proposed improvements first requires the determination of the current and future average annual crash rates within the project limits. For this project that included looking at crashes at the major, or most congested, intersections within one of the three most common existing travel routes between NH Route 3A and NH Route 111. Crash history data for the project area was collected for a seven-year period between 1/12013 and 5/23/2019 from Hudson Police Department records.¹⁴ To determine the average annual crash rate by crash type, the total crashes were divided by the number of years the data was collected. The existing average crash rate for the project area was calculated to be 45.7 crashes per year involving property damage only (PDO) and 9.4 crashes per year involving injuries. There was one fatal crash during the review time period within the influence area of the project. This data was used to forecast the anticipated increases in the crashes over the analysis period under the No-Build conditions. Since the relative occurrence of crashes is a function of the volume of traffic on a given roadway, the rate of increase of crashes was compared to the increase in traffic volumes over the analysis period to determine the anticipated yearly increase in crash occurrences. This data is provided in the Appendix.

The proposed project will reduce traffic volumes on a number of local roadways including the three most heavily traveled routes between NH Route 3A and NH Route 111 where the majority of the existing crashes occur. It is anticipated that with the expected traffic volume reduction, that there will be a reduction in occurrences of vehicle crashes as the traffic volumes at the congested intersections within the project impact area go down and capacity at this intersection increases. Therefore, the anticipated reduction in crashes was calculated by taking the expected difference between the No-Build traffic volumes and the Build traffic volumes and multiplying that by the average crash rates.

The expected reduction in vehicle crashes is not anticipated to occur at a 1:1 ratio, however, because of the variability in the crash data and the types of roadways, so the ratio was adjusted downward by approximately 33% to account for this variability. These expected crash reductions were then applied to the total volume of traffic traveling through the study area, including the three most heavily traveled routes between NH Route 3A and the new Hudson Boulevard. In this way, the crash reductions are based on the total volume of traffic through the study area, regardless of which roadway the vehicles are traveling on, including the new Hudson Boulevard. Because the crash rates are applied to the total volume before any reductions in overall crashes are taken, any anticipated crashes that may occur on the new roadway are already accounted for. The benefit of a reduction in crashes each year was calculated based on the type of crash and summarized as a yearly savings. In the analysis, the cumulative crash reduction savings is estimated at approximately \$40,029,606. All data is provided in the Appendix.

¹⁴ Hudson Police Department Crash Data 2013-2018.

Non-Monetized Benefits

In addition to the quantifiable monetized benefits above, the project also generates some benefits that are tangible, but difficult to quantify. Below is a description of some of these benefits.

Economic Competitiveness:

The Sagamore Bridge is the only crossing over the Merrimack River that provides direct access to the F.E. Everett Turnpike which serves as a vital link between commuters and a wealth of jobs in northern Massachusetts as well as local and regional commercial traffic. One of the largest industries in NH is tourism and this project will provide a safer, more efficient connection between these attractions and their users. Therefore, the proposed improvements will maintain long-term efficiency of the system, travel time reliability for all users, and cost competitiveness of goods.

The Manchester-Boston Regional Airport located 13 miles north of Hudson is the state's largest airport. The Airport is a key transportation facility serving NH and one of the largest economic drivers supporting NH's economy with nearly \$23.7 Million generated in tax revenue for the state of New Hampshire in 2015. It also serves as the central air cargo hub for both UPS and FedEx carriers serving northern New England.¹⁵ Many businesses in the region rely on this cargo hub for the transportation of goods or persons, including educational and healthcare institutions, large retailers, manufacturers, and financial firms. The proposed new roadway will provide a safer, more efficient connection between New Hampshire, Massachusetts, and the region, which is key to maintaining the economic stability and growth of this region.

While the savings associated with a reduction in crashes as a whole was summarized previously, it should also be noted that these savings directly affect the local communities that provide the emergency service response. The savings associated with fewer emergency response calls result in lower taxes for many communities already struggling to maintain low property tax rates. And in a state with no income or sales tax, property taxes are the main source of income for communities. Therefore, lower taxes allow these communities to stay competitive in attracting and retaining businesses and homeowners from both a local and regional perspective. The construction of this connector road is estimated to create more than 150 new short-term jobs associated with the actual construction of the project. In addition, there may be some additional retail activity associated with these workers frequenting local business to eat or shop during the day or prior to coming to work in the morning or going home in the evening.

As one of the fastest growing regions in the state of New Hampshire in terms of new development, the Nashua-Hudson region has seen continued growth in new and emerging technology businesses such as Defense Contractor BAE Systems and Benchmark Electronics looking to be close to Massachusetts. Reducing traffic volumes and improving vehicle safety in these areas helps ensure that these businesses will continue to grow and thrive here.

Quality of Life:

Constructing this new roadway will result in improved operations at intersections and improved

¹⁵ 2015 NH State Airport System Plan, New Hampshire Department of Transportation. Individual Airport Summary Report Manchester-Boston Regional Airport, 2015.

safety along many existing roadways which all have a positive impact on travel through this area for both business and personal endeavors including work, shopping, school, medical treatment and recreational activities. Currently, no hospital exists within the Town of Hudson, so access to the two hospitals located in Nashua is critical to the health and well-being of its residents. Both hospitals are located along NH Route 111, but each is difficult to reach at certain times of the day due to congestion on the Taylor Falls/Veterans Memorial Bridges which carries NH Route 111 west over the Merrimack River. The new Hudson Boulevard would provide an alternate route for commuters that would be much quicker during the morning and afternoon peak hour thus reducing the travel demand on Taylor Falls/Veterans Memorial Bridge by as much as 10%, providing a much-needed congestion relief and assuring that Hudson residents and visitors to the region can obtain safe, efficient access to these facilities and obtain excellent medical care.

Numerous homes and subdivisions exist to the west of the proposed connector road, while to the east many large parcels still remain undeveloped. The area to the west is primarily zoned General and Residential 2, while to the east there is some Industrial and Residential 2 zoning with the majority falling under General 1. The following excerpt from the zoning code provides a description of the G-1 District:

General-One (G-1). The G-1 District includes all areas not specifically zoned as being within an R-1, R-2, B, or I District located outside the right-of-way of the Circumferential Highway as depicted on the Town Zoning Map. The District is designed to permit a wide diversity of land uses at a density appropriate to the rural nature of the area, the natural constraints of the land and the lack of infrastructure. Uses permitted in this District are the same as those permitted in the G District. [Added 3-13-2001 by Amdt. No. 3]¹⁶

Locating the proposed Hudson Boulevard in this area will provide access to this substantial area of land currently zoned G-1 through the existing roadway network. If this proposed roadway is developed, the town may want to re-evaluate the existing zoning and allowable uses to ensure that the appropriate framework is in place to guide desired growth in this area. It is likely that land will become more attractive and land values may rise with the development of the connector road. In addition, the Nashua Regional Planning Commission has identified close to 6 million square feet of commercial and industrial development on larges tracks of contiguous undeveloped or underdeveloped land that would be unlocked with the construction of Hudson Boulevard, which would result in the creation of over 6,000 new jobs, new business and investment opportunities and additional tax revenues for the town.¹⁷ The benefits of these potential investments are not easily quantifiable but are real economic boosts. Additional information is provided in the Appendix.

Environmental Sustainability:

Bridges are proposed at all wetlands that appear to be significant to the ecosystem of the project area. The installation of new state of the art stormwater quality treatment facilities will ensure continued water quality within the Merrimack River watershed. Any new structure or drainage

¹⁶ Town of Hudson, NH Charter; Part I, Chapter 334, Article IV, Section 334-18, District G [Amended 3-13-2001 by Amdt. No. 3]

¹⁷ Potential Economic Impacts, Nashua Regional Planning Commission Letter, Nashua, NH, July 2018

features will be designed using the latest high intensity rainfall data from Cornell University and incorporate resiliency features to ensure the longevity of the assets even under the most severe weather events.

Estimation of Cost for Bridges and Highway

The following section provides a detailed explanation and computation of the construction costs and operation and maintenance costs of the project. When estimating costs, it was assumed that the construction of "Hudson Boulevard" will begin in 2021 with final project completion in 2026. It is assumed that the realization of construction cost will begin in 2021. Operation and maintenance costs occur annually while construction costs are only incurred during the relevant construction period.

Construction Costs

A detailed cost estimate is shown in Appendix A. The estimate shows costs of each segment of the connector road between the major cross roads. The cost estimate is provided in 2017 dollars. The estimated cost to construct Hudson Boulevard is \$49.5 M. With an additional \$1.5 M over the lifetime of the roadway and associated bridges. For a total cost of \$51.0 M.

It should also be noted that the Town does not own the existing Right-of-Way. This land was previously purchased by NHDOT with Turnpike funds. NHDOT considers unused Right-of-Way surplus land and periodically sells parcels when they are no longer useful to the agency. The Town of Hudson will need to reach an agreement with NHDOT regarding the use of this land and should anticipate that some compensation to the NHDOT will be required.

Operation and Maintenance Costs

Once constructed, the proposed roadway will incur future roadway and bridge maintenance cost in order to maintain a state of good repair. Based on current NHDOT practice the bridge maintenance schedule will consistent of annual cleaning of the bridge decks and superstructures. In addition, the bridges will go a schedule of membrane and deck repairs at the 20 and 40-year mark with a complete deck replacement at 60 years, however these large-scale repairs are beyond the timeframe of the BCA, so they are not shown.

Based on current NHDOT practice, the highway pavement structure will receive crack repairs at year 5 and year 15 with a $1\frac{1}{2}$ inch pavement overlay at year 10. These costs have been included in the BCA.