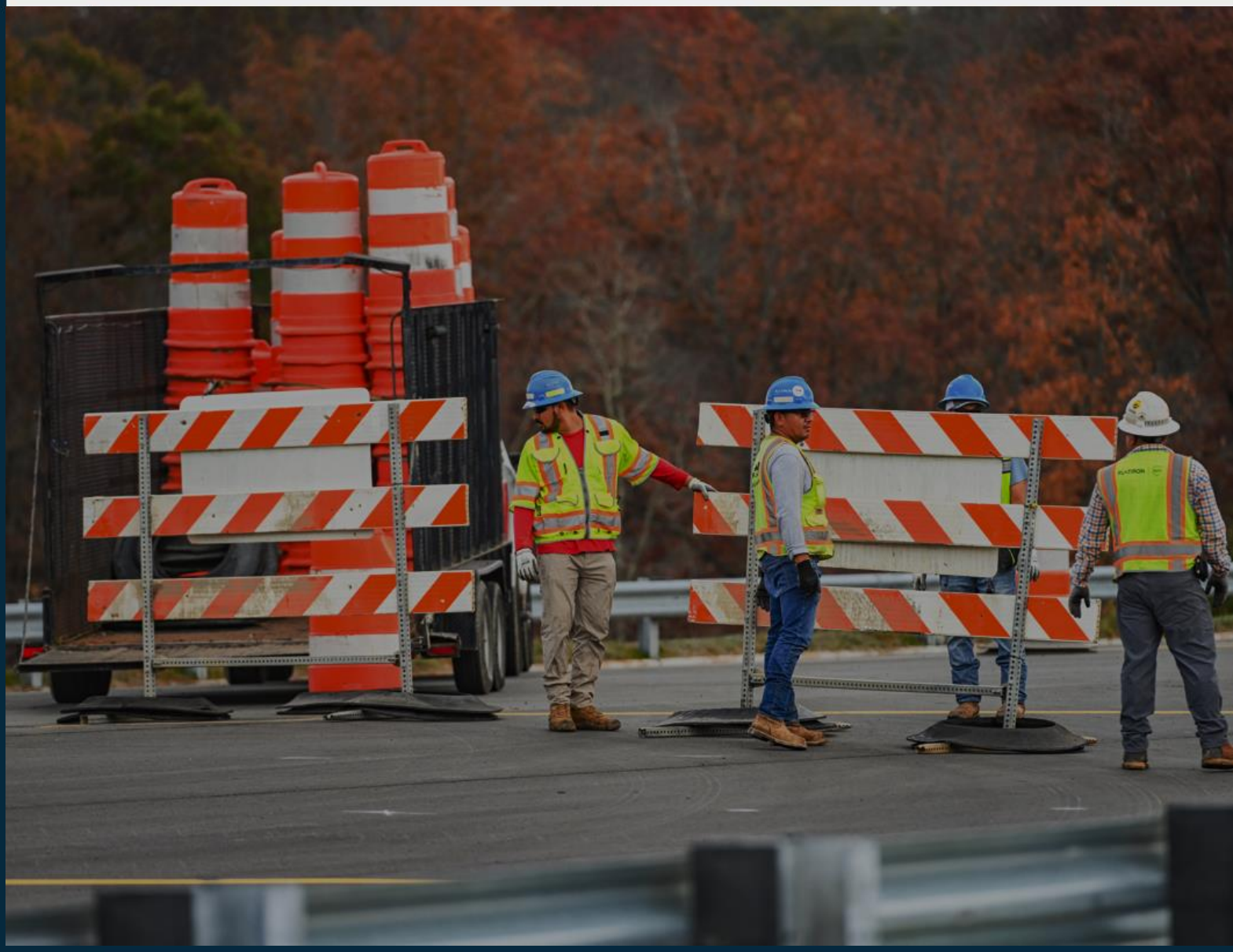
Maintenance Operations and Performance Analysis Report (MOPAR)



2022

Required by G.S. 136-44.3

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1 INTRODUCTION

1.1 ABOUT MOPAR

The state MOPAR integrates the maintenance, rehabilitation and operation of the state highway system into a single management plan that implements state and federal asset management requirements, including primary assets such as those from Session Law 2017-57 Highway Maintenance Improvement Program (HMIP), Session Law 2019-251 Transportation Emergency Reserve use on events declared as emergencies under the Stafford Act (42 U.S.C. §§ 5121 – 5207), as well as a growing range of supplementary statewide transportation assets and priorities such as Governor Cooper's Executive Order 80 (EO80) on clean transportation.

The MOPAR reflects the core principles of asset management, using objective analysis to focus investments on measured condition and performance goals. The Chief Engineer's Office continues to refine and expand the asset management framework, introducing new performance objectives to maintain and expand the network prioritizing key fundamentals – maintaining a customer focused approach, making data-driven decisions, adopting a performance and risk based approach and builds off practices mandated by the US Department of Transportation (USDOT) and Federal Highway Administration (FHWA) requirements, with additional guidance provided by the American Association of State Highway and Transportation Officials (AASHTO) and other industry best practices.

"Asset management is considered an integrated set of processes to minimize the lifecycle costs of infrastructure assets, at an acceptable level of risk, while continuously delivering established levels of service. Asset management is a holistic approach that balances costs, opportunities, and risks against the desired performance of assets"

1.1.1 Federal, State & Department Requirements

Federal Requirements – Moving Ahead for Progress in the 21st Century (MAP-21) Act and Fixing America's Surface Transportation Act (FAST Act) outlines federal asset management requirements addressed in the MOPAR. MAP-21 requires states to adopt national asset management performance measures to establish nationwide consistency for pavement and bridge condition reporting. These performance measures use a condition scale (good, fair, and poor) to quantify pavement lane miles or bridge deck area condition. The Automated Pavement Condition Survey (APCS) and bridge Element Level Inspection (ELI) data incorporate these condition assessment requirements into NCDOT's practice.

State Requirements – The HMIP is required by law under NCGS 136-44.3A which is a five-year program of projects that collectively improves the condition, operation, and

sustainability of the network. In addition, NCGS 136-44.3A requires a Highway Maintenance Improvement Program Needs Assessment. The need and schedule of projects is interactively mapped which has many benefits including the ability to optimize maintenance decisions in the vicinity of planned projects. The HMIP initially only reported on pavement assets but was expanded by S.L. 2017-57 to an integrated management plan to include bridge and general maintenance, beginning in the year 2020.

1.1.2 Department Requirements

The HMIP reflects the highway division asset management strategy, it organizes key activity areas or objectives into categories that align with strategic goals. This structure provides clarity on the strategic goals the Department is working to accomplish (safety, customer service, infrastructure quality, economic growth, reliability, and connectivity), along with transparency of the level of needs and investments in each of the strategic areas.

1.2 Program Overview

1.2.1 Highway Asset Portfolio

The Chief Engineer's Office is responsible for a wide variety of physical assets that increase each year through widening and new location capital projects. Highway infrastructure assets, within state highway boundaries, include over 81,000 miles of pavement; over 13,600 bridges and over 360,000 pipes and culverts, and thousands of other assets such as those shown in **Figure 1**. The most significant assets on the state system, in terms of their cost and extent, are pavement and bridges. However, many other assets are needed to support mobility and improve safety. In many cases, replacement or rehabilitation of roads and bridges includes replacement or upgrades to other structural and functional assets. For instance, reconstructing or replacing a bridge includes the cost of guardrail; and pavement projects often include upgrades to associated drainage, traffic, and safety assets.

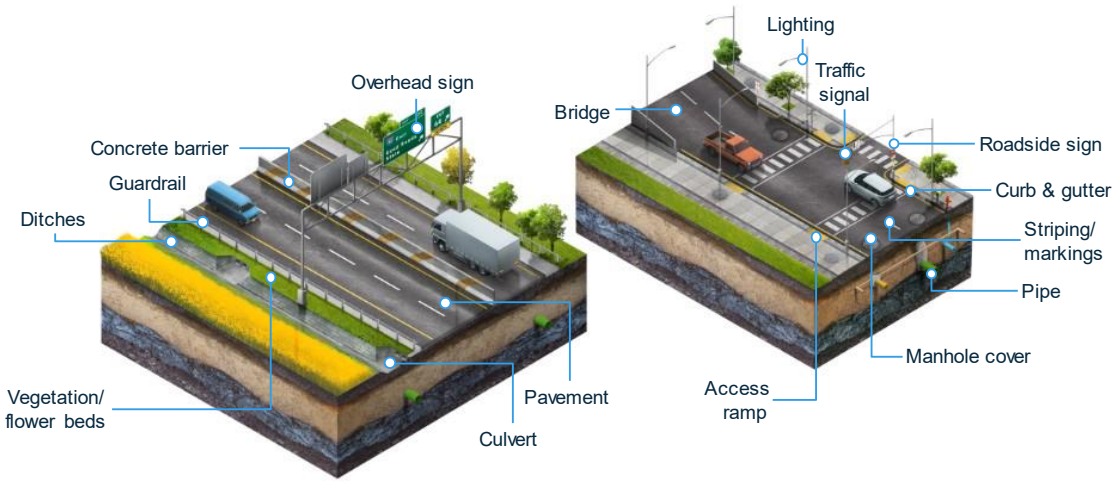


Figure 1 Roadways comprise numerous assets

Additional support facilities, such as weigh stations, maintenance facilities, equipment shops, and transportation materials laboratories and testing facilities, are also included as state assets. Many system components, built in the 1950s, 1960s, and early 1970s, have either reached or are reaching the end of their service life. Asset deterioration is accelerating at a faster rate than in previous decades, because of age and change in traffic demands, often requiring extensive rehabilitation and even full reconstruction.

1.2.2 Growth and Demand

Managing transportation assets involves understanding the demands on the system from changes in the population, economy, travel patterns, mobility choices, technology; and potential shocks and extreme events, like storms. Understanding long-term growth and demand forecasts is critical to planning and prioritizing our investment needs. **Figure 3** shows the forecasted rise in capacity requirements for North Carolina's roadways over the next 30 years.

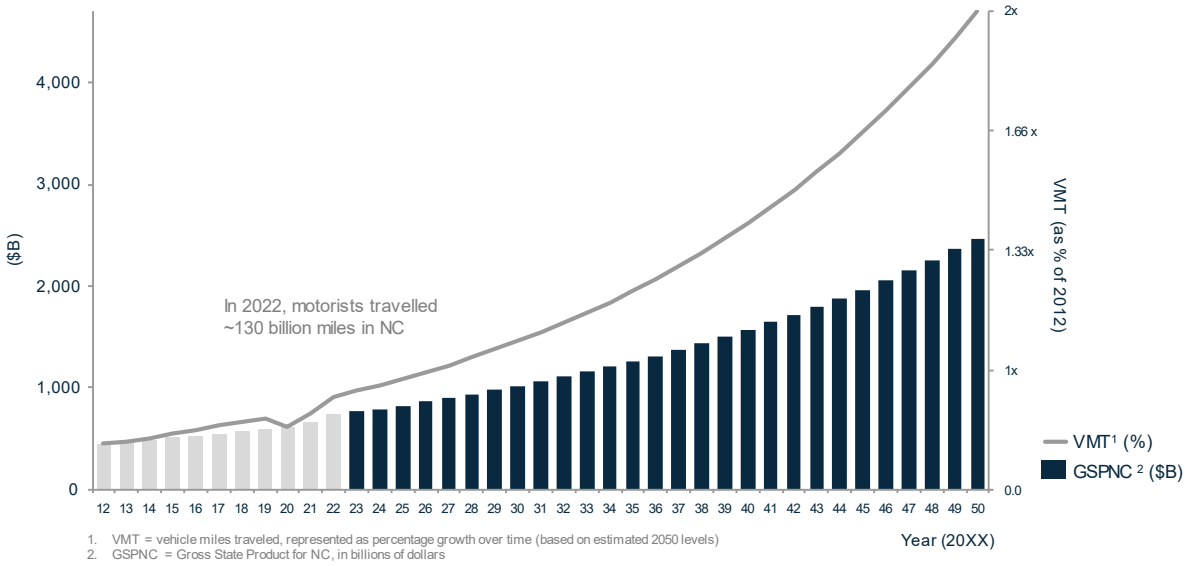
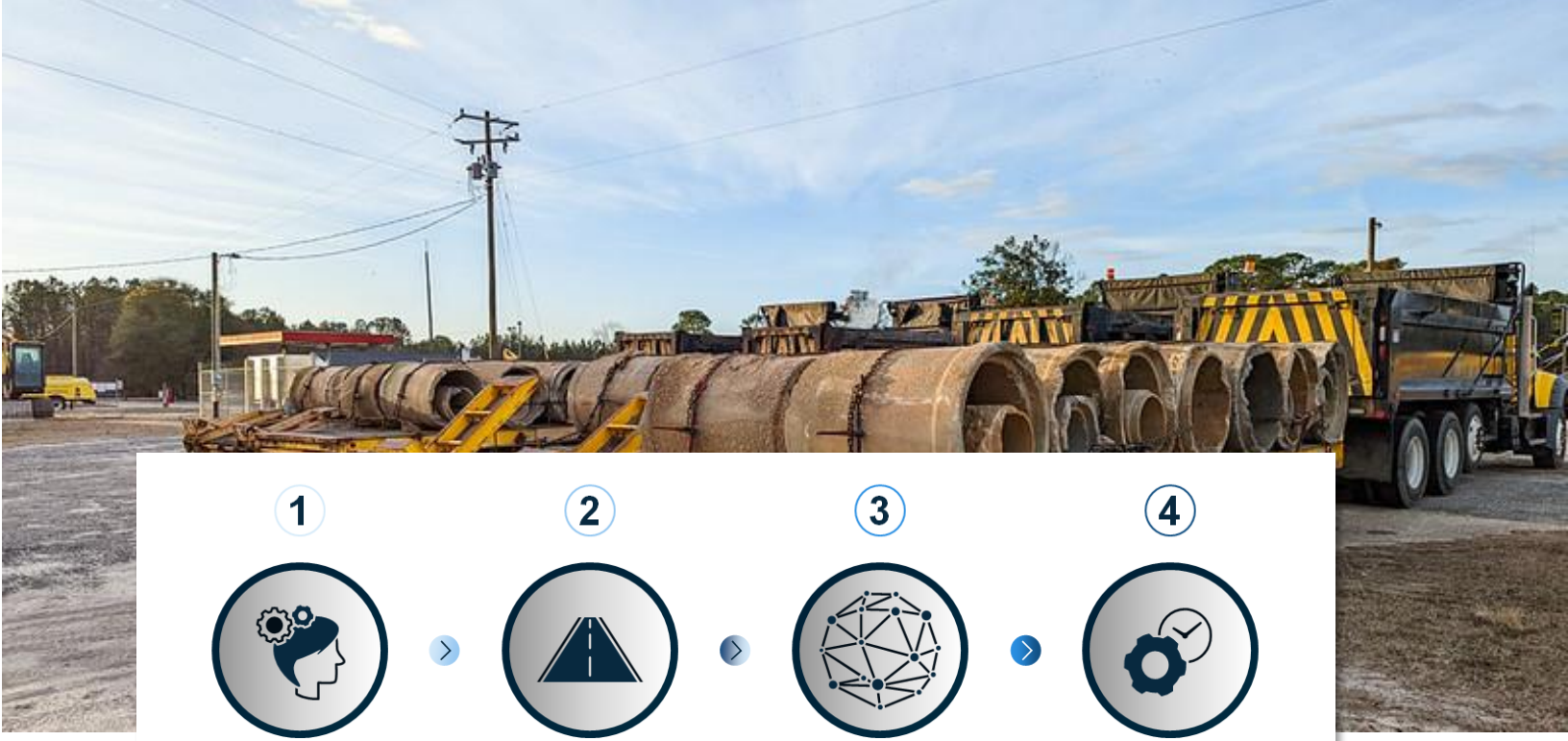


Figure 2 Growth in GDP and forecasted VMT in North Carolina

1.2.3 Asset Management Strategy & Framework

The Department strives to preserve the condition of the system at the right cost for the most benefit through carefully planned preservation strategies (i.e., preventive maintenance, corrective maintenance, and minor rehabilitation) and rehabilitation or replacement. The Department manages the system condition by performing the right treatment at the right time through a decentralized approach allowing Highway Division staff to use appropriate maintenance strategies and address needs specific to their areas. These strategies are then measured against production and expenditure targets that are critical to meeting our service goals and delivering safe, reliable, and efficient infrastructure.



The Department relies on information – stakeholder requirements, condition, performance – to project how most of our assets will perform, understand how they are likely to deteriorate, and understanding of assets and their criticality to the system helps to balance needs across the asset portfolio and ensure enhanced service to the public. The Department has been actively improving asset management methods, tools, and data which underpins analyses for performance projections and investment decision-making in this document.

In addition to planned maintenance activities, crews must be able to respond to unpredictable events such as weather events which can cause significant damage to the Department's infrastructure. Major events such as hurricanes and other tropical storms, localized heavy rain events, as well as significant winter storms, can have lasting impacts. These impacts can cause accelerated deterioration of assets, necessitating early replacement of drainage systems, emergency bridge repairs and replacement, and significant repairs to pavements. Responding to each of these scenarios, combined with an expanding asset base strains maintenance resources and limits the Department's ability to perform planned maintenance activities.

Transportation assets are interdependent, and their effective maintenance requires a holistic, corridor based, approach. For example, unaddressed drainage issues can lead to cascading impacts to the entire roadway. Inadequate drainage can erode roadway shoulders and ditches or cause standing water which saturates subgrades leading to pavement deterioration and potholes. Wet surfaces also increase the risk for traffic crashes.

2 INVESTMENT RECOMMENDATIONS & ACTIONS

The success of the Department's five-year Highway Maintenance Improvement Plan, and of the asset management program more broadly, depends on long-term, consistent, and sufficient funding targeting the assets which are in greatest need of intervention. At the time of writing this report, economic conditions are such as that uncertain price volatility continue to impact major spending categories such as fuel, materials and labor. These impacts are reflected in the recommended investment per year needed to sustain the reliability of our highway network. The Department together with industry partners are actively engaged to plan, assess risks and take action to continue providing services to the public.

Table 1 summarizes the investment recommendation as it relates to each major maintenance group.

Fund	FY 2022 Appropriation ($ Million)	Activity	Recommended Investment Per Year ($ Million)
Pavement Preservation	85	Preservation	192
Contract Resurfacing	571	Resurfacing	805
Bridge Program	301	Bridge Replacement	330
Bridge Preservation	70	Bridge Preservation	80
General Maintenance Reserve (GMR)	542	GMR Total	902
		• Bridge Maintenance	67
		• Routine Maintenance Activities	607
		• Snow and Ice/Non-Declared Emergencies	127
		• Statewide Programs	101
Roadside Environmental	117	Roadside Activities (Planned + Unplanned)	140

Table 1: Appropriations, Needs and Investment Recommendation

2.1 PAVEMENTS

Recommendations to provide consistent and sufficient investment for Contract Resurfacing and Pavement Preservation are as follows:

- Support long-term consistent investment for resurfacing and pavement preservation activities to meet and sustain industry recommended cycle times and goals
- Increase Contract Resurfacing investment to $805 million, an increase of $234 million
- Increase Pavement Preservation investment to $192 million, an increase of $107 million

2.2 BRIDGES

Recommendations to moderately increase the current investment for the Bridge Program:

- Fully fund Bridge Program needs of $330 million annually, an increase of $30 million over FY 2021 appropriations. This funding is used for replacement and major rehabilitation activities to meet or exceed targets by 2030.
- Increase funding to the Bridge Preservation Program to $80 million annually, an increase of $10 million, to provide additional investments focused on high value bridge preservation and lower maintenance costs of these assets.

2.3 ROADSIDE ASSETS

Recommendations to provide consistent and sufficient investment for Roadside Assets include:

- Increase Roadside Environment investment to $140 million, an increase of $23 million, renewing efforts to better maintain vegetation growth, remove litter and debris, improve rest area conditions, and increase roadside aesthetics.
- Increase GMR investment to $902 million, an increase of $360 million. This investment is determined by the routine maintenance needs and includes statewide programs.

3 Delivering The Asset Management Program

3.1 Highway Maintenance Improvement Program

The Highway Maintenance Improvement Program, or HMIP, is the Department's primary tool for planning asset level investments across the North Carolina highway system. With focus areas including pavements, bridges and other roadway assets, the current 5-year HMIP covers fiscal years 2023-2027. Each highway division has a schedule by county for each plan year within the 5-year plan. The first year is expected to be "firm," reflecting what will be delivered that year.

The HMIP is submitted annually with modifications to adjust years two through five (which will become years one through four) based on changing conditions such as needs and appropriation levels. For example, an unusually cold and wet winter may cause roads in western North Carolina to deteriorate faster than usual, requiring substantial investment in pavement repairs. Flooding in eastern North Carolina due to a hurricane can also cause deterioration to all assets, requiring unanticipated replacement and stabilization of drainage pipes. In some cases, the highway division may become aware of local economic development planned along one or more roadways that makes widening and strengthening those roadways a priority. A new year five will be developed as others roll forward.

The process is managed through the Asset Management System (AMS) which is composed of three subsystems: Pavement Management System (PMS); Bridge Management System (BMS); and the Maintenance Management System (MMS). AMS is used to identify potential areas which meet the treatment and funding requirements for inclusion in HMIP. Highway divisions use this data to develop and refine their work plans. Engineers use data from routine condition surveys on all assets to assist in developing their plans.

3.1.1 Pavements

Every year, the Department conducts pavement condition surveys of all its pavement assets on the interstate, primary and secondary systems. These surveys provide a point in time snapshot of the systems' pavement conditions. To develop the maintenance improvement plans, the Pavement Management System's (PMS) group uses the PMS's optimization capabilities to develop a five-year roadway section plan using the previous year's needs-based allocation. Divisions utilize the pavement condition information, and the recommendations from PMS, to develop contract resurfacing and pavement preservation investment plans to stay within budget over the 5-year period. The approved plans are used by the Divisions to track their work accomplished versus the plan. Additionally, interstate pavement maintenance project recommendations are also identified from the PMS and provided to the Divisions for development of resurfacing and preservation projects along interstate routes. These interstate maintenance projects are programmed within the 10-year STIP document and are updated as needed to be responsive to maintenance needs.

3.1.2 Bridges

The Department develops the 5-year bridge investment plan to make progress towards minimizing the proportion of bridges in poor condition. The Structures Management Unit (SMU) and the Divisions work cooperatively to identify and schedule bridge replacements within the 5-year improvement plan to ensure positive movement toward established goals.

Generally, SMU develops initial recommendations for interstate and primary system bridges and the Divisions develops recommendations for secondary road bridges. On an annual basis bridge condition results are gleaned from the BMS, provided to each Division, and reported to NCDOT senior management. Bridge performance is estimated based on current condition and budgetary amounts. Anticipated results are compared to NCDOT's long-term state asset targets. Based on the BMS analysis, a list of bridges which meet state funding requirements are prioritized using a Priority Replacement Index (PRI). Division and SMU program managers use this list as they develop the 5-year replacement schedule. Like pavements, interstate bridge maintenance project recommendations are also identified from the BMS and provided to the Divisions for development of bridge rehab and preservation projects for bridge structures along interstate routes. These projects may be stand alone or included within previously described interstate pavement maintenance project limits and are also programmed within the 10-year STIP document and are updated as needed to be responsive to maintenance needs.

3.1.3 Highway Assets

Highway Divisions also create 5-year routine maintenance investment plans at a detailed level for non-pavement and bridge assets for the first two fiscal years (2023-2025) based on the previous fiscal year's maintenance allocations. As further described in Section 4.3, this effort includes establishing monetary investment amounts for unplanned activities, as well as anticipated investments and resulting production levels for planned activities. The final three years of the five-year plan (2023-2025) are planned at a Division-wide level, based on historical expenditures and long-range maintenance needs.

3.2 Citizen Action Request System

The Citizen Action Request System (CARS) was created to provide a place for both citizens and state personnel to report and track reactive maintenance needs. The Department strives to address each submission in a timely manner; however, meeting CARS Responsiveness goals provides limited benefit to highway infrastructure longevity and is completely reactive, pulling staff away from any planned maintenance activities that impact infrastructure health. In FY 2022, the Department responded to 32,732 action requests in legislative categories, up over 25% from 26,039 requests in 2020.

Pursuant to the DOT Report Program (G.S. 136-18.05), the Department tracks its responsiveness for a selection of CARS maintenance categories including drainage, guardrail damage, pothole, shoulder repair, signal malfunction, and signing. Excluding

potholes which must be repaired within two days of notification, safety-related items must be properly addressed within 10 days of notification, and non-safety items must be addressed within 15 days of notification. Department performance in these categories for FY 2022 is shown in the **Table 2**.

Legislative Category	Deadline to Address	Legislative Action Requests	
		Total Reported	Total Addressed On-Time
Pothole	2 days	14,545	11,549
Non-Pothole Safety	10 days	10,314	8,503
Non-Pothole Maintenance	15 days	7,873	5,982

Table 2: FY 2020 Completed Citizen Action Requests, Legislative Categories Only

3.3 STAFFING

To examine staffing efficiency, **Table 3** shows the staffing distribution across the 14 Highway Divisions, and the road length, population, and geographic area served by each employee. The table includes the 2020 vacancy rate to demonstrate the increasing vacancy rate across most divisions. Overall staffing trends are consistent with urban/rural and geographical differences such as the Coastal, Sandhills, Piedmont or Mountain regions. For example, Division 1 manages fewer lane miles per employee (26 lane miles per employee) but has a higher area served per employee (13 square miles served per employee).

Division	2020 Vacancy Rate	2022 Filled Positions	2022 Vacancy Rate	Lane Mile / Employee	Population Served / Employee	Area Served / Employee (sq. mi.)
1	22%	398	22%	26	654	13
2	28%	321	30%	32	1,551	13
3	27%	339	28%	36	2,094	13
4	23%	399	24%	34	1,484	9
5	34%	367	32%	40	4,228	9
6	26%	370	22%	35	1,830	11
7	22%	356	25%	34	2,618	7
8	15%	390	24%	36	1,356	10
9	15%	352	19%	31	2,162	6
10	20%	369	27%	31	4,174	7
11	25%	371	29%	30	993	9
12	27%	302	32%	42	2,495	8
13	16%	417	19%	24	1,217	8
14	16%	437	21%	21	830	9
Average	**23%**	**395**	**25%**	**32**	**1,936**	**9**
Total	**-**	**5,188**	**-**	**-**	**-**	**-**

Table 3: Division Staffing, 2022

3.4 Adverse Weather Impacts on Maintenance

Hurricanes, winter storms, heavy rainfall, rockslides, earthquakes, and other weather-related events all affect the highway system and the Department's ability to perform planned maintenance activities. These events may receive emergency declarations and become eligible for federal reimbursement, but those reimbursements typically take three to five years to receive in full. Even then, full reimbursement is typically only 70% of the total cost of a declared event. The impact of these events is twofold: the cost of immediate response reduces funds available for routine planned maintenance, and weather-related events accelerate system degradation, creating additional maintenance needs for years to come.

While it can be expected that North Carolina will experience some degree of emergency impacts each year, the severity and scope is unpredictable. For example, as seen in **Figure 3** below, the Department incurred an average of $106 million per annum in declared

emergency expenses over the past five fiscal years (2018-2022). In that same time, expenses ranged from as low as $64 million to as high as $203 million. In general, only half of the total amount of emergency expenditures are eligible for federal reimbursement.

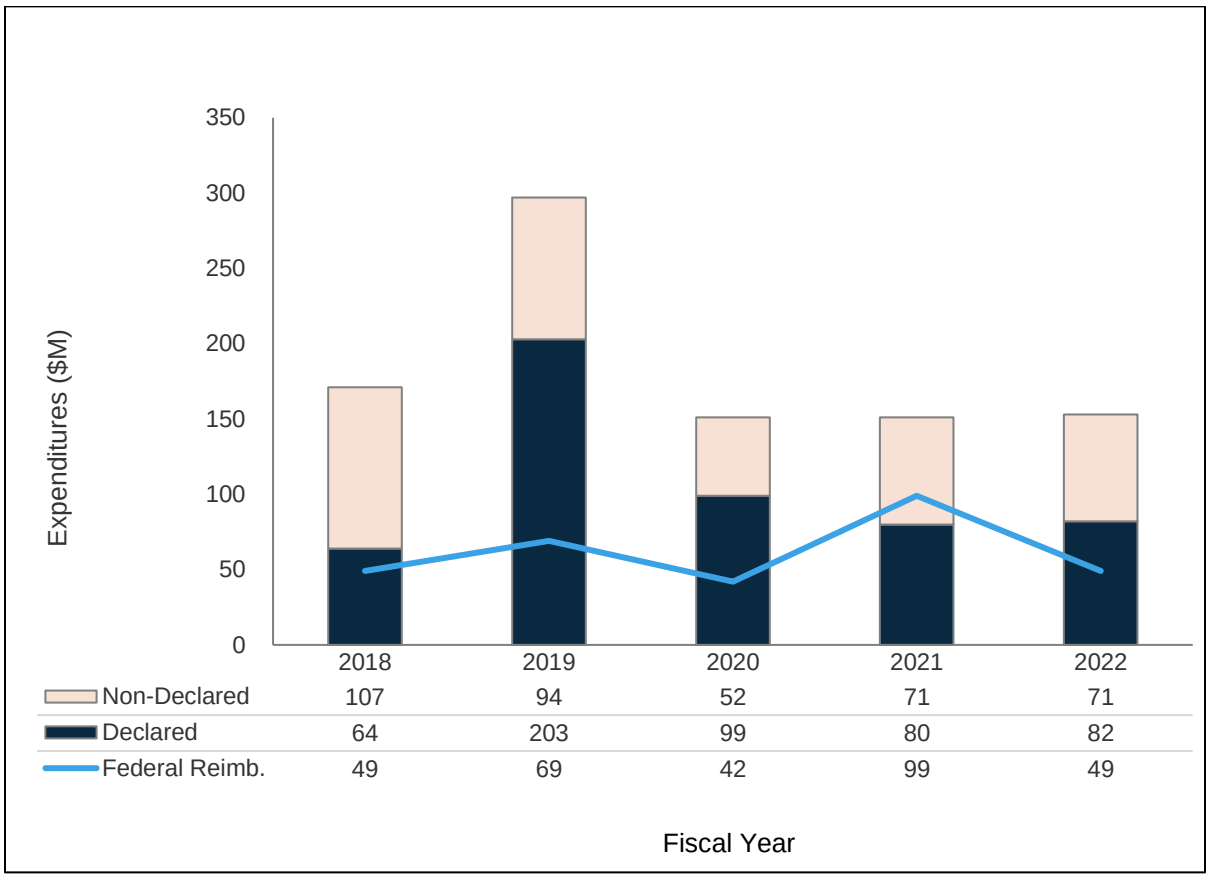


Figure 3 Emergency Expenditures and Federal Reimbursement

The Emergency Reserve, established in Session Law 2019-251, will aid the Department in managing annual fluctuations in declared disaster spending needs. However, since the reserve fund is legislatively mandated to be maintained at $125 million through annual transfers from the Highway Fund, the primary funding source for all highway maintenance activities, significant weather and other disaster events will still directly impact spending on core highway maintenance programs. **Figure 3** illustrates that while non-declared spending has increased from 2020, declared spending and federal reimbursement have shown a slight decrease. The chart also illustrates the lag time in federal reimbursements for declared events.

4 CURRENT CONDITION & TRENDS

Pursuant to NCGS 136-44.3, Section 2, goals for each of the major assets including pavements, bridges and highway asset are described below. The Highway Maintenance Improvement Plan (HMIP) governs these major assets and determines the production levels and investment required to meet stated goals.

4.1 PAVEMENTS

The pavement section of the Highway Maintenance Improvement Plan (HMIP) focuses on maintaining pavements of the state's primary and secondary roadway system. To develop and implement a successful work plan, the specific roadway characteristics, treatment type and timing of treatment must be carefully considered. The Department has a large roadway system, requiring a substantial financial investment to maintain. While the Department continues to provide significant financial investment into pavements, the improvements to pavement conditions will be gradual. Furthermore, while overall system conditions may change slowly from year-to-year, individual roadway conditions can vary seasonally, dependent upon rainfall, freeze-thaw cycles, and traffic loads. As such, the ability to easily respond to rapid condition changes by shifting resources and modifying previously identified treatments is critical.

With the funding level for resurfacing and pavement preservation programs over the past two years, the Department has been able to make some improvements in the number of miles treated and cycle time for which the Department treats pavements. Cycle time (the interval between each treatment activity) helps to identify the number of miles needed to reach targets. The industry recommends contract resurfacing to be completed every 12-15 years, while pavement preservation every 4-7 years. This section provides a summary of plans and accomplishments for each treatment type – contract resurfacing and pavement preservation.

While not included within the Department's HMIP planning process, it should be noted that maintenance of the pavement and bridge assets along the interstate system also require a significant annual monetary investment to ensure condition targets are maintained. Although the amount of road miles and bridges contained within the interstate system is far less than that of the primary and secondary systems, the highest volumes of traffic across the state use these routes every day. Interstate routes are critical to the movement of freight and other goods in and through the state and must be maintained at a higher level of service. Interstate maintenance (IM) projects are funded with federal aid funds, and as such are programmed within the 10-year State Transportation Improvement Program (STIP) and not within the 5-year HMIP. In the current 2023-2032 STIP, interstate maintenance investment

levels average about $150 million/year for the 10-year period. The projects are initialized with treatment types, limits, and cost estimates. Each Highway Division reviews projects in their area and submits recommendations based on local knowledge and engineering judgment. These recommendations can include changes to the treatment types, limits, and estimated cost. Senior management reviews the Division recommendations and selects projects from a statewide perspective within fiscal constraints.

4.1.1 Cycle Times

4.1.1.1 Contract Resurfacing

As shown in **Table 4**, cycle time for contract resurfacing on the primary system is 26 years – roughly double the industry recommendations, and cycle time for contract resurfacing on the secondary system is 41 years – nearly 3 times the industry recommendations. Reaching the recommended cycle times is essential to meeting an expected level of service for pavement conditions.

Contract Resurfacing	Planned	Completed + Under Contract
Primary (lane miles)	1,267	1,400
Cycle Time (years)	27	26
Secondary (lane miles)	3,015	3,133
Cycle Time (years)	42	41

Table 4: Contract Resurfacing Planned and Accomplished Work, HMIP Plan Year 2021

4.1.1.2 Pavement Preservation

The current accomplished cycle time for pavement preservation is 40 years, almost 6 times industry recommendations, **Table 5**.

Pavement Preservation	Planned	Completed + Under Contract
Secondary (lane miles)	4,555	3,066
Cycle Time (years)	28	40

Table 5: Pavement Preservation Planned and Accomplished Work, HMIP Plan Year 2021

4.1.2 Current Conditions & Trends

The Department conducts pavement condition surveys of its pavement assets on the interstate, primary and secondary systems. These surveys provide a point-in-time snapshot

of the condition. The results of these surveys are used to rate the pavement condition using a Pavement Condition Index (PCI). The PCI considers observed defects in the pavement such as cracking, patching, rutting, raveling, corner breaks, seal breaks and faulting. A segment of pavement with more of these types of defects will score lower on the PCI and trend towards a rating of “fair” or “poor.” A Good rating is defined as a PCI greater than 80 percent; a Fair rating is a PCI between 60 and 80 percent; a Poor rating is a PCI less than 60 percent. Pavement condition is influenced by activities funded through interstate maintenance (STIP), contract resurfacing, pavement preservation and routine maintenance programs.

Figure 4, **Figure 5** and **Figure 6** show pavement condition for interstate, primary and secondary routes since 2013. The proportion of interstate and primary route pavements in good condition has declined slightly in the last five years, while proportion of secondary routes in good condition has improved slightly.

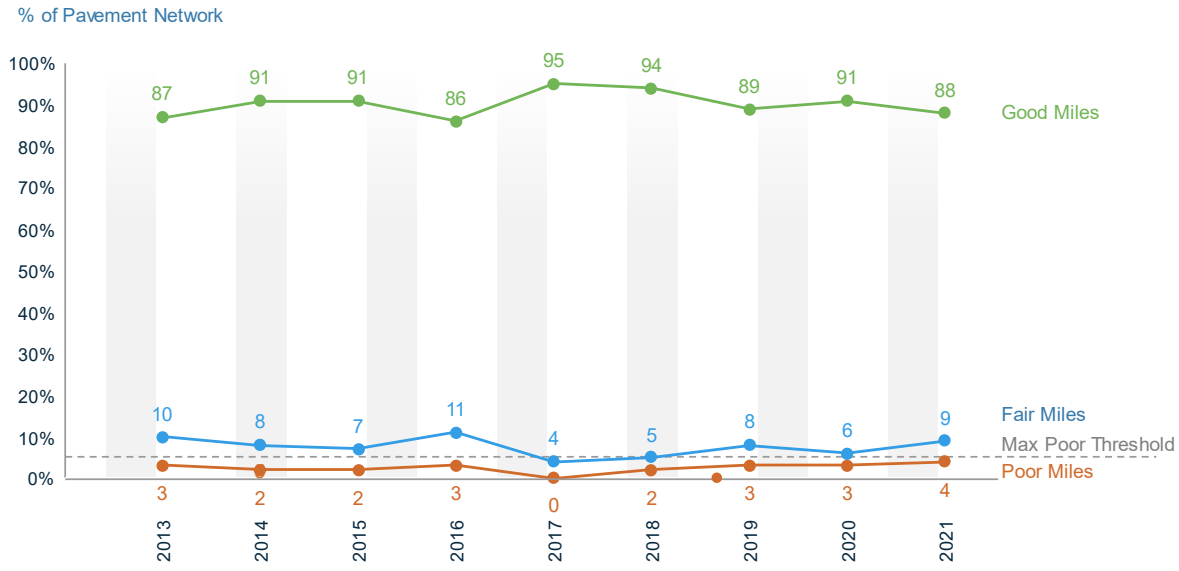


Figure 4 Interstate Pavement Condition, 2013-2021

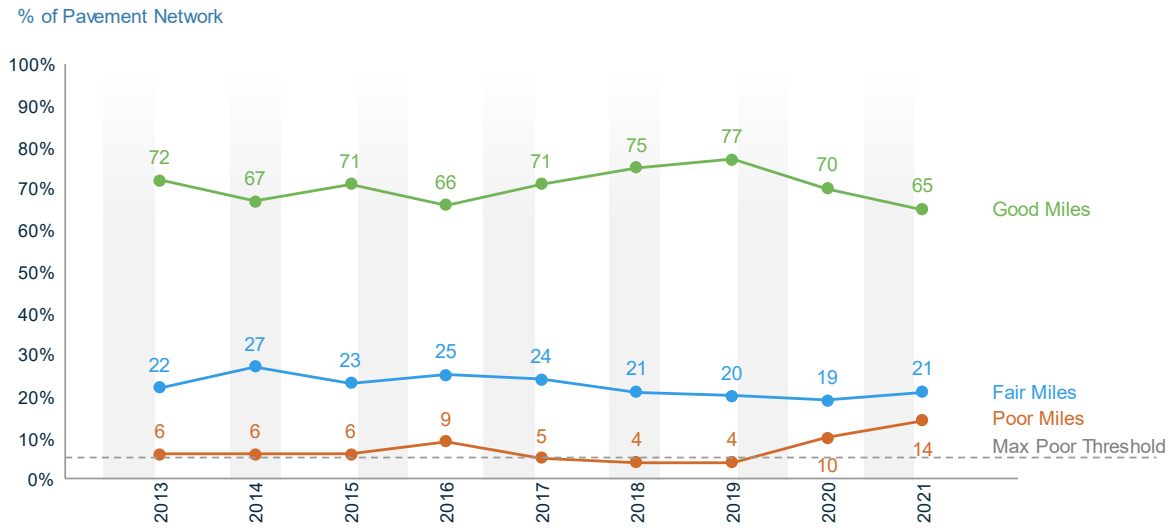


Figure 5 Primary Network Pavement Condition, 2013-2021

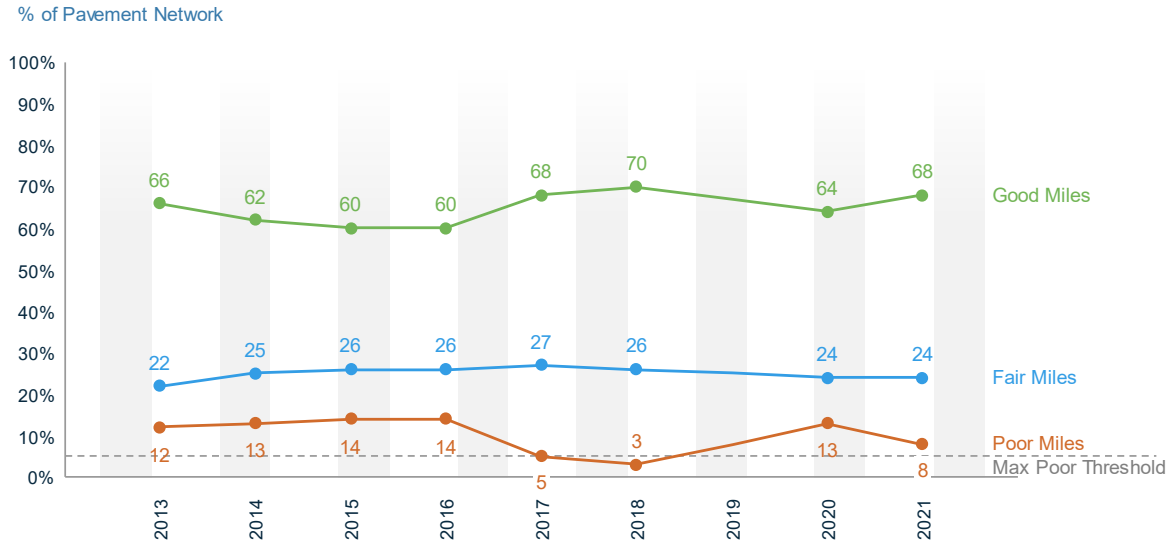


Figure 6 Secondary Network Pavement Condition, 2013-2021

4.1.3 National Highway System Pavements – Federal Performance Measures

There are 5,638 miles of road on the National Highway system in North Carolina– which comprises Interstate highways, interstate business, US, NC and selected secondary routes and ramps connecting to an NHS route. Conditions and progress towards targets are reported to the Federal Highway Administration (FHWA) in the Transportation Asset Management Plan (TAMP). Through MAP-21, national performance goals have been established for pavements and bridges to maintain the condition of these assets in a state of good repair. Performance ratings of good, fair, and poor condition for pavements have been established by FHWA based on a combination of several metrics collected by every state DOT in accordance with HPMS (Highway Performance Monitoring System). FHWA uses these metrics to quantify the condition of pavements in terms of roughness (International Roughness Index - IRI), percent cracking, rutting (asphalt) and faulting (concrete). As shown in **Figure 7** and **Figure 8**, the percentage of Poor NHS pavements has remained flat, and the percentage of good NHS pavements has increased slightly in the last decade.

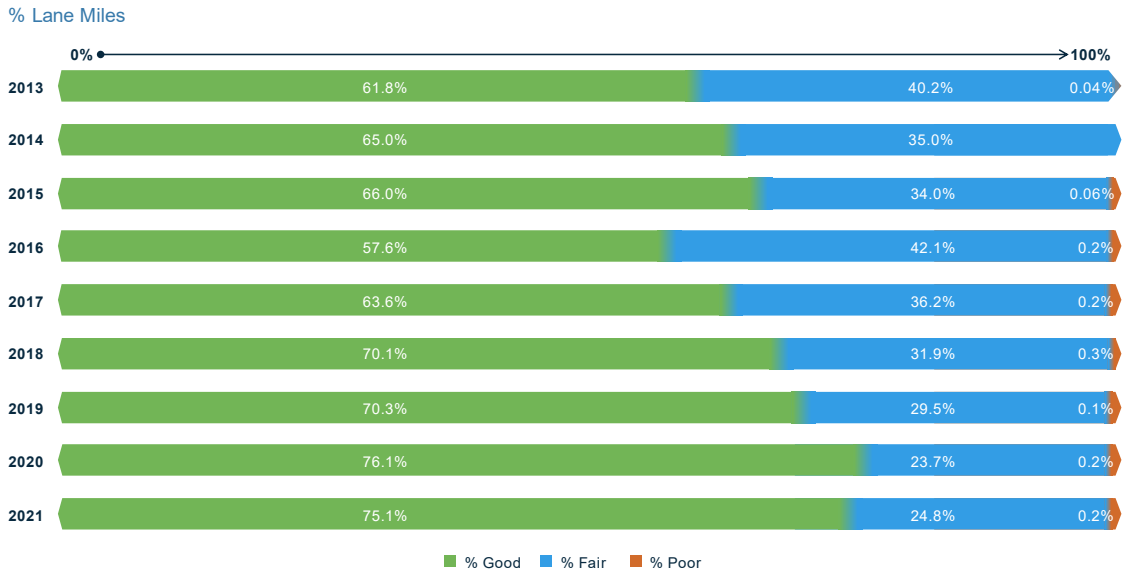


Figure 7 NHS Interstate System Pavement Conditions

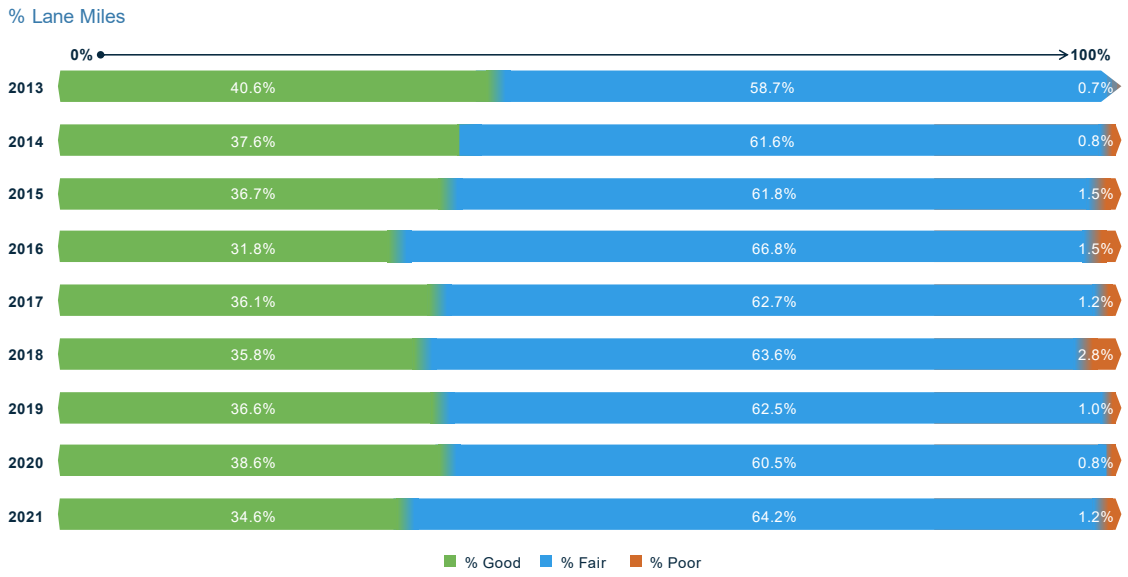


Figure 8 NHS Non-Interstate System Pavement Conditions

4.2 BRIDGES

All bridges go through a natural deterioration or aging process, although each bridge is unique in the way it ages. Regular inspections help the Department identify and schedule bridges for maintenance, repair, and replacement. The Department follows National Bridge Inspection Standards (NBIS). These structures are inspected on a 24-month cycle but may be inspected more frequently if warranted by poor condition ratings or other factors. Underwater inspections are performed on a 48-month cycle when underwater components cannot be assessed during an above-water inspection. NCDOT collects and stores bridge inspection data and reports for all state and locally owned bridges in North Carolina within the Bridge Management System. Bridge inspection data for all state and locally owned bridges on and off the NHS is collected in accordance with the requirements of NBIS. NCDOT collects data on all NHS routes regardless of owner.

Condition ratings for bridges were established based on a nine-point rating on each of three components: deck, superstructure, and substructure. Culverts are similarly rated on overall condition. The following table relates condition score to qualitative conditions, as shown in **Table 6**.

Element Rating	Condition Score
Good	7 to 9
Fair	5 to 6
Poor	0 to 4

Table 6: Bridge Rating System

The overall condition of a bridge is considered “good” only if all three components are “good”. It is considered “poor” if any one of the three components are “poor”. The bridge is otherwise considered “fair”. Culverts rated solely on their overall condition.

To fully address the issues on a bridge in poor condition, extensive rehabilitation or replacement is typically required. Since 2015, State funds have been the primary and necessary funding source for bridge replacements. As shown in **Table 7**, state funds for the replacement of bridges in poor condition has increased since fiscal year 2017. Beginning in fiscal year 2018, additional bridge preservation dollars were provided to fund cost effective solutions to maximize bridge life and lower lifetime costs.

Program	2017	2018	2019	2020	2021	2022	2023
Bridge Program	$242M	$280M	$272M	$201M	$273M	$274M	$275M
Bridge Preservation	-	$80M	$82M	$76M	$60M	$70M	$70M

Table 7: Bridge Program and Preservation Allocations

4.2.1 Inventory, Goals and Targets

North Carolina's bridge portfolio consists of approximately 13,600 bridges statewide, of which 8.4% are in poor condition. As shown below in **Table 8**, the percent of bridges in poor condition has significantly decreased since 2015. This decrease has continued as funds focused on bridge preservation and replacement have increased.

System / Year	FY2015	Current	Impact / Change	2030 Goal
Interstate	4%	3.1%	-0.9%	2%
Primary	9%	5.5%	-3.5%	6%
Secondary	21%	10.3%	-10.7%	15%
Statewide (weighted average)	**16%**	**8.4%**	**-7.6%**	**10%**

Table 8: Percentage of Bridges in Poor Condition, FY2015 vs. Current

While bridges being built today are designed for a 75-year life or longer, most of the bridges on the state system were designed for a useful life between 50-60 years. However, not all bridges that exceed this age are inherently in poor condition; there are several bridges older than this age that are safely handling traffic. By contrast, there are several bridges that have deteriorated into poor condition well in advance of the 50 - 60-year average age expectation. This can be due to a variety of factors including harsh environments, higher than anticipated traffic volumes and local/regional development. Approximately 5,000 of the Department's bridges are more than 50 years old, and many are likely nearing the end of their useful lives. As these bridges continue to deteriorate with age and continued exposure to traffic and environment, they will become poor in condition. **Figure 9** shows the number of bridges which have been newly classified as poor each year has been decreasing since 2019.

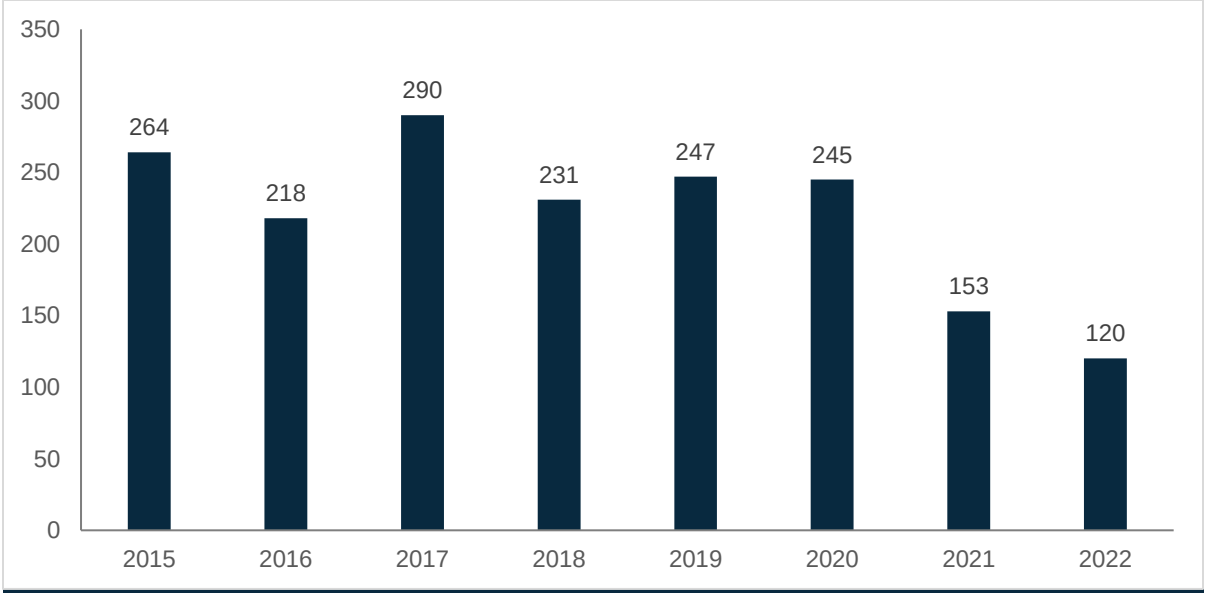


Figure 9 Number of bridges newly classified as "Poor" 2015 to 2022

At current funding levels, the Department is confident the Bridge Program will be able to overcome deterioration to continue recent condition improvements and achieve statewide goals by, or before, year 2030. **Figure 10** indicates the historical performance of the Department's bridge inventory across the interstate, primary and secondary road network—bridge preservation and replacement have driven consistent progress towards the department's goals.

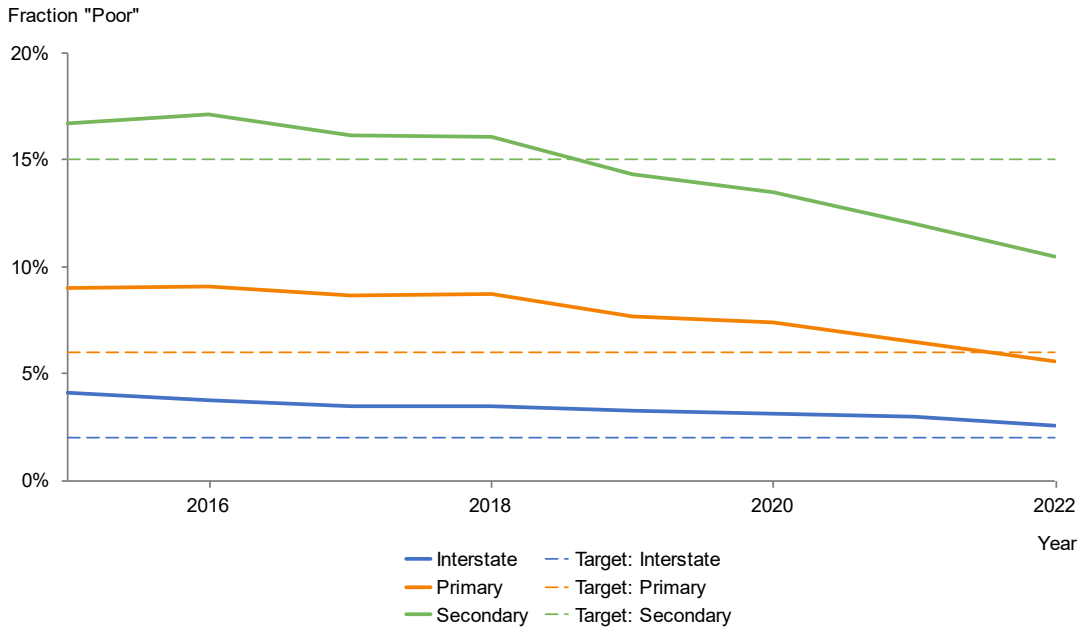


Figure 10 Historical Fraction of "Poor" Bridges

Several risks to achieving these goals have been identified. If the Department's "high value bridges", those which would cost more than $20 million to replace, are allowed to deteriorate, then progress toward goals may slow as a large portion of available funds would be required to replace a small number of costly structures. Additionally, while the annual average number of bridges dropping to poor condition is declining, there is risk of this number increasing given the large portion of the bridge system that is nearing the average end of life.

The Department is currently able to manage these risks, and is confident in projected performance, with the Bridge Preservation Program. These funds are used to employ cost effective solutions to maximize bridge life and lower lifetime costs. The program is targeting high value bridges with innovative preservation projects that will prevent continued deterioration and extend the useful life of the bridges. Once the risk associated with the high value bridge inventory is mitigated, bridge preservation funds will be employed on a larger number of bridges, thereby enabling a shift from replacement to preservation.

4.2.2 Bridge Program—Replacements

As shown in **Figure 10**, 16% of bridges on the secondary system were rated "poor" in 2017. That number has been reduced to 10% since then, due to consistent funding for bridge replacement and preservation. These funds were used in a concerted effort to improve the secondary system and the Department is now focused on ensuring these gains are maintained or further improved upon. Bridge Program projects are selected using NCDOT's ranking system – the Priority Replacement Index (PRI). The PRI produces a score for each structure that is intended to reflect the relative priority for replacement of bridges based on their condition and design, use, and functionality data. Municipal owned bridges are eligible for funding from the Federal Bridge Program with candidate municipal bridges prioritized by their PRI score.

Having achieved the goal for the secondary system, the Department has increased focus on the primary and interstate system to achieve all goals by 2030. Since primary and interstate system bridges are much more costly to replace, often between five and 10 times that of a secondary bridge, the rate of progress is expected to be slower than experienced with the secondary system. As shown in **Table 9**, the Department will use funding provided in the 2023 and 2024 Bridge Program to fund the replacement of 379 bridges, or 2.8% of the total bridge inventory. It is important to note that the impact as calculated in **Table 9**, does not account for additional bridges that will become poor during this period, and the actual net reduction may be marginally lower.

Road System	Total	"Poor"	% "Poor"	Replacements SFY23 & SFY24	Impact on % "Poor"
Interstate	1,180	37	**3.1%**	6	0.5%
Primary	3,804	211	**5.5%**	96	2.5%
Secondary	8,656	894	**10.3%**	277	3.2%
Statewide	**13,640**	**1,142**	**8.4%**	**379**	2.8%

Table 9: Impact of Bridge Program Replacements on bridges in "poor" condition through SFY 2022

4.2.3 Bridge Program—Preservation

While the Department is confident that funding for bridges is sufficient to reach performance goals, risks have been identified that delay goal achievement. One such risk is associated with bridges that have disproportionately high replacement costs. There are 205 "high value bridges" that would each cost between $20 million and $300 million to replace. While these only account for 1.5% of the inventory by bridge count, their combined replacement cost of $9.3 billion dollars accounts for 14% of the total bridge system value. If long term goals are to be met, it is imperative that these bridges are maintained in the best possible condition through systematic preservation.

In FY2018, the Bridge Preservation Program was established and initially funded at $80 million and is funded at $70 million in FY 2023. This program was sub-allocated into two programs. The first is a program that focuses on preserving the Department's high replacement cost bridges. As shown in **Table 10**, the upcoming two years of the preservation program focuses on preserving high value bridges and includes 54 bridges that would cost the Department over $2 billion to replace. The total funds required to deliver these preservation projects is $46 million. The remaining funds provided by the Bridge Preservation Program are allocated to Divisions to assist state bridge maintenance crews in prolonging the life of bridges by funding preservation projects, timely bridges repairs and maintaining bridge components critical to reducing long term maintenance costs.

Fiscal Year	# Bridges	Cost to Preserve	Cost to Replace
2023	25	$19 million	$1,137 million
2024	29	$27 million	$996 million

Sample of projects included in the 2023-2024 Bridge Preservation Program:

Bridge No.	County	Route Carried	Intersected Feature	Cost to Preserve ($M)	Cost to Replace ($M)
350120	GASTON	I85	US321 (N CHESTER ST)	$1.60	$29.60
000148	ALAMANCE	I40	Haw River	$2.20	$36.30
710014	PERQUIMANS	US17S	Perquimans River	$2.20	$64.70
590489	MECKLENBURG	SR3998	I277	$1.10	$25.50
180007	CHATHAM	US1S	Deep River	$1.30	$22.90
180477	CHATHAM	US1N	Deep River	$1.10	$27.40

Table 10: High Value Bride Preservation Projects

4.2.4 National Highway System Bridges – Federal Performance Measures

Bridges on the National Highway system comprise 2,932 or 22% of the total number of bridges on state-maintained routes. Conditions and progress towards targets are reported to the FHWA in the Transportation Asset Management Plan (TAMP). Per FHWA guidance, condition of NHS bridges is reported in percent of Deck Area in Good and Poor condition. As shown in **Table 11** and **Table 12**, 8.2% of NHS bridge deck area was rated “poor” in 2015. That number has been reduced to 3.1% in eight years. New two- and four-year targets have also been published in the 2025 TAMP as highlighted in **Table 12**.

System	Total Bridges	Total Deck Area (SF)	Poor Deck Area (SF)	% Poor Deck Area	Good Deck Area (SF)	% Good Deck Area
Interstate	1,132	20,732,462	424,802	2.0%	10,572,048	51.0%
Primary	1724	31,062,683	1,164,397	3.7%	12,943,795	41.7%
Secondary	76	1,066,381	29,819	2.8%	408,729	38.3%
Total	**2,932**	**52,861,526**	**1,619,017**	**3.1%**	**23,924,572**	**45.3%**

Table 11: Current Inventory and Condition of NHS Bridges

	SFY 2015	Current	Impact/ Change	2 Year Target	4 Year Target
% Poor Deck Area	8.2%	3.1%	-5.1%	< 5%	< 5%
% Good Deck Area	45.0%	45.3%	0.3%	> 38%	> 36%

Table 12: Condition Trends of NHS Bridges

4.3 HIGHWAY ASSETS – GENERAL MAINTENANCE RESERVE

The General Maintenance Reserve appropriations support a wide range of core maintenance activities essential to the upkeep of the highway system. In addition to the planned work functions in HMIP, Divisions also conduct unplanned routine maintenance work on a significant amount of additional work functions. **Table 13** shows historic expenditures across all activity categories, both planned and unplanned, funded by General Maintenance Reserve.

Activity Description	SFY 2020	SFY 2021	SFY 2022	3-Year Average
Snow and Ice	$30,676,762	$42,707,695	$64,182,259	**$45,855,572**
Shoulder/Ditch Maintenance	$30,390,679	$37,505,121	$44,847,239	**$37,581,013**
Pavement Maintenance	$17,970,982	$27,382,028	$35,234,045	**$26,862,352**
Bridge Maintenance	$5,317,127	$4,509,303	$6,390,545	**$5,405,658**
Removal of Hazards	$35,406,700	$31,277,452	$36,014,104	**$34,232,752**
Traffic Devices/Services	$39,363,376	$43,779,215	$51,476,742	**$44,873,111**
Barriers (Guardrail/ Cable rail)	$17,326,697	$21,003,048	$22,596,324	**$20,308,689**
Pipe Installation/ Replacement/Repairs	$20,785,792	$37,511,659	$59,165,453	**$39,154,301**
Vegetation Management	$9,734,351	$6,759,517	$15,862,026	**$10,785,298**
Office Engineering/ Inspection/Assess	$61,928,536	$65,715,150	$64,109,919	**$63,917,868**
Incident Management Assistant Program	$5,204,543	$5,886,095	$5,444,366	**$5,511,668**
Unpaved Roadway Maintenance	$4,864,628	$11,453,145	$12,405,748	**$9,574,507**
Construction/ Maintenance of Facilities	$477,188	$542,039	$749,032	**$589,420**
Specialty Services & Operations	$49,766,802	$47,085,442	$53,631,891	**$50,161,378**
Training and Development	$2,996,375	$1,604,378	$3,192,201	**$2,597,651**
TOTAL	**$332,210,539**	**$384,721,287**	**$475,301,894**	**$397,411,240**

Table 13: Historical expenditures in General Maintenance Reserve by Activity Type

Planned maintenance work activities/work functions are those that are performed on a recurring basis and can be planned to the route, system, or asset level in advance of the work taking place. However, as is typical with all work activities, there are unexpected events that will require forces to be reactive in their maintenance efforts. Therefore, not every expenditure associated with a planned maintenance work activity/work function can be anticipated in advance, resulting in both planned and reactive costs. Planned Routine Maintenance activities are based on condition and LOS targets. Examples include shoulders and ditch maintenance, crossline pipe replacements, pavement striping, bridge joint repairs, mowing, and painting steel girders, among others. In addition to the planned work

activities/work functions, Divisions conduct significant amounts of reactionary maintenance work on several additional work functions. These are activities that cannot be planned and typically require an immediate response. Examples of these activities include pothole repair, removal of hazards and guardrail repair.

4.4 Highway Assets – Roadside Environmental

The Roadside Environmental Apportionment supports a wide variety of vegetation management, litter removal, rest area maintenance, and aesthetic and beautification efforts along roadsides. Conditions of roadside assets frequently vary depending on seasonality, rainfall, and other factors, so establishing condition levels of service is not feasible. As such, performance criteria associated with delivery of programs at specific time intervals and cycles are established and measured/monitored by visual inspection. Roadside monitoring for 2022 revealed that Department was able to accomplish the prescribed cycle maintenance based on the budget allocation for the year. Deficiencies were identified with contractor equipment and labor issues that delayed some cycles from being performed in a timely manner. Additional cycles of mowing, litter and debris removal, as well as brush and tree work were identified to achieve the aesthetic appearance desired for 2023.

5 SAFETY AND MOBILITY

5.1 MEASURES OF CONGESTION

An efficient transportation network means faster and more reliable travel times for both people and goods. For example, with predictable travel times manufacturers can reduce distribution costs and, in turn, pass savings onto consumers. This section uses three measures to evaluate mobility. Each one provides insights into different aspects of congestion and should be viewed together to provide a more complete picture.

- Travel Time Index – the variability of travel time during rush hour
- Average Number of Congested Hours – the number of hours that speeds are slow
- Travel Time Reliability – the variability of travel time on a "bad day"

The first way the Department evaluates congestion is by comparing the variability of travel times. Specifically, travel at the speed limit is compared to travel during rush hour. This comparison is known as Travel Time Index (TTI). For example, if a trip takes 20 minutes when made at the speed limit and that same trip takes 30 minutes during rush hour, the TTI is 30/20 =1.50 and the Congestion Level is "Poor." The values and levels are provided in Table A. The higher the TTI, the more travel time varies between rush hour and non-rush hour trips. This means that commuters and businesses must allow extra time to make a trip during those hours.

Congestion Level	Additional Travel Time/Travel Speed	Travel Time Index	
Great	■ Congestion increases trip time by less than 15% ■ Travel speed within 15% of Posted Speed Limit (PSL)	<1.15	
Good	■ Congestion increases trip time by 15%-30% ■ Travel speeds 15%-30% below PSL	1.15 to 1.30	
Poor	■ Congestion increases trip time by more than 30% ■ Travel speeds 30% below PSL	>1.30	

Table 14: Congestion Level and Travel Time Index

In 2021, during the most congested hour of the day, 90% of heavily travelled interstates were rated as Great, 5% were rated as Good, and 5% were rated as Poor. Interstate congestion is concentrated in urban and suburban areas such as Raleigh, Charlotte, Asheville, Greensboro, and Winston-Salem, as shown in **Figure 11**.

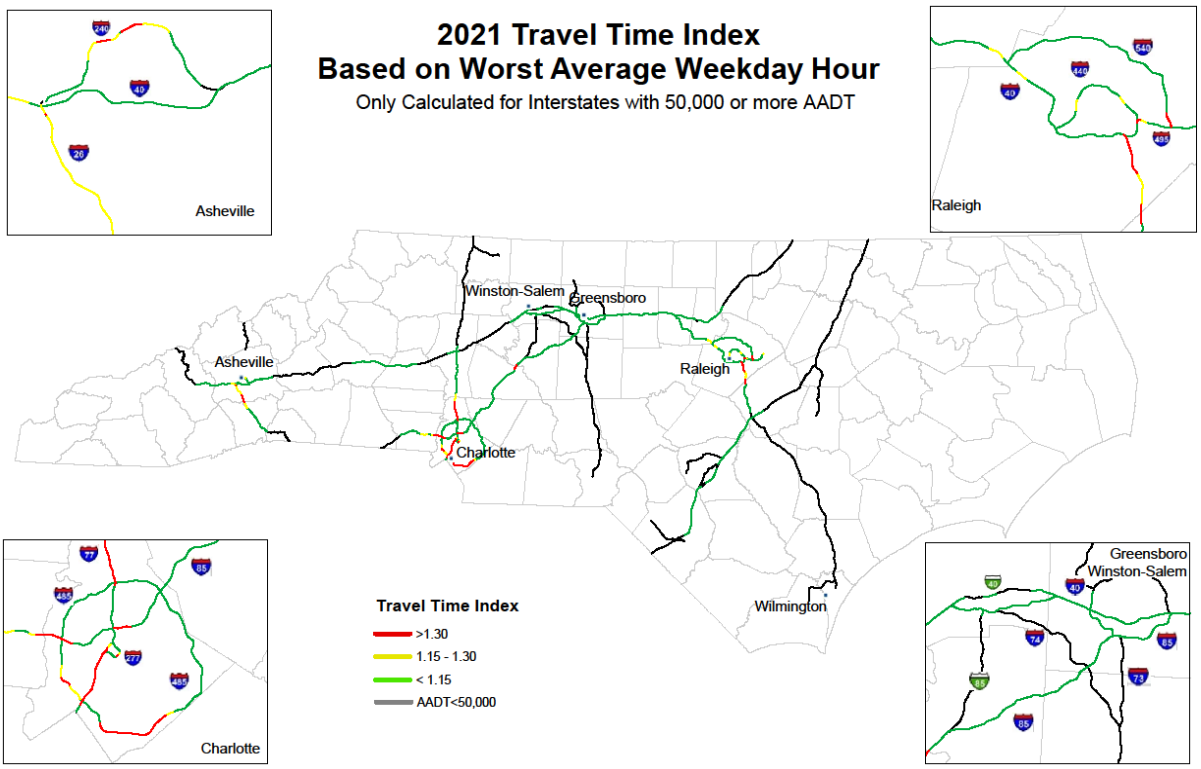


Figure 11 Levels of Traffic Congestion on Heavily Travelled Interstates

Congestion has improved from 2019 when 73% were rated as Great, 10% were rated as Good and 17% were rated Poor. Some improvements could be from lingering changes in travel patterns caused by COVID. Improvement was seen in these corridors:

- I-26 South of Asheville
- I-77 North of Charlotte
- I-485 East and West of Charlotte
- I-40 in Forsyth County
- I-540 North of Raleigh
- I-440 Around Raleigh
- I-40 in Wake and Durham Counties

5.2 Average Number of Congested Hours

A second dimension of congestion is “How long does it last?” On freeways, the Department considers congestion to begin when speeds drop below 45 miles per hour. **Table 15** shows the average number of hours that speeds drop below 45 miles per hour at the top 10 most congested locations.

RANK	COUNTY	ROAD	INTER-SECTION	EXIT	DIRECTION	AVG CONGESTED HOURS PER DAY
1	MECKLENBURG	I-77	ARROWOOD ROAD	EXIT 3	NORTH	7
2	MECKLENBURG	I-77	REMOUNT ROAD	EXIT 8	SOUTH	7
3	MECKLENBURG	I-77	NATIONS FORD RD	EXIT 4	NORTH	5
4	MECKLENBURG	I-77	I-277/US-74	EXIT 9	SOUTH	5
5	SURRY	I-77	NC-67	EXIT 82	SOUTH	5
6	MECKLENBURG	I-77	TYVOLA RD	EXIT 5	NORTH	5
7	MECKLENBURG	I-277	NC-16/FOURTH ST	EXIT 2	NORTH	4
8	GASTON	I-85	NC-273	EXIT 27	SOUTH	4
9	MECKLENBURG	I-85	SAM WILSON RD	EXIT 29	SOUTH	4
10	YADKIN	I-77	NC-67	EXIT 82	NORTH	4

Table 15: Locations with highest average number of congested hours per day on heavily travelled interstates

5.3 Travel Time Reliability

In addition to assessing the variability in travel times during different periods of the day, the Department also evaluates day to day travel time reliability. The Level of Travel Time Reliability (LOTTR) index represents how poorly a road performs on a “bad day” – i.e., that day with a crash, weather event or active work zone, compared to an average day. For example, if it takes a motorist 40 minutes to make a given trip on a bad day compared with 20 minutes to make the same trip on an average day, then the LOTTR would be 40/20 = 2.0. The Federal Highway Administration defines an LOTTR higher than 1.5 to mean that the road was considered “unreliable.” This means there is a wide variability in travel times from day to day. In addition to the trip taking longer than normal, this variability makes trip planning challenging for motorists.

Figure 12 and **Figure 13** show travel time reliability on North Carolina Interstates and the NC Non-Interstate System in 2021. **Table 16** and **Table 17** show the locations with the worst LOTTR across the state for Interstate and non-Interstate Routes.

ROAD	DIRECTION	COUNTY	INTERSECTION	MILES	LOTTR
I-485	EASTBOUND	MECKLENBURG	US-521/EXIT 61	0.58	3.28
I-485	EASTBOUND	MECKLENBURG	REA RD/EXIT 59	1.21	2.96
I-77	NORTHBOUND	YADKIN	NC-67/EXIT 82	2.74	2.86
I-40	WESTBOUND	WAKE	US-70	0.77	2.84
I-40	EASTBOUND	WAKE	I-440/US-64/EXIT 301	0.78	2.79
I-77	SOUTHBOUND	SURRY	NC-67/EXIT 82	1.46	2.75
I-77	NORTHBOUND	MECKLENBURG	I-485/EXIT 2	1.02	2.61
I-77	SOUTHBOUND	MECKLENBURG	NC-73/EXIT 25	0.69	2.41
I-40	EASTBOUND	WAKE	JONES SAUSAGE RD/EXIT 303	1.33	2.39
I-77	SOUTHBOUND	MECKLENBURG	I-277/US-74/EXIT 9	0.82	2.37
I-77	NORTHBOUND	MECKLENBURG	GILEAD RD/EXIT 23	0.59	2.34
I-40	EASTBOUND	WAKE	JONES SAUSAGE RD/EXIT 303	0.78	2.21
I-85	SOUTHBOUND	MECKLENBURG	I-485/EXIT 30	1.00	2.19
I-40	WESTBOUND	JOHNSTON	JOHNSTON—WAKE BORDER	1.18	2.17
I-485	EASTBOUND	MECKLENBURG	REA RD/EXIT 59	0.50	2.13
I-77	SOUTHBOUND	MECKLENBURG	GILEAD RD/EXIT 23	0.60	2.10
I-485	WESTBOUND	MECKLENBURG	NC-160/STEELE CREEK RD/EXIT 4	0.86	2.08
I-85	NORTHBOUND	MECKLENBURG	STATESVILLE AVE/EXIT 39	0.65	2.07
I-40	WESTBOUND	DURHAM	US-15/US-501/EXIT 270	0.51	1.95
I-77	SOUTHBOUND	MECKLENBURG	GILEAD RD/EXIT 23	1.78	1.95
I-485	WESTBOUND	MECKLENBURG	NC-160/STEELE CREEK RD/EXIT 4	0.74	1.91
I-77	SOUTHBOUND	MECKLENBURG	NC-73/EXIT 25	2.38	1.89
I-77	SOUTHBOUND	MECKLENBURG	REMOUNT RD/EXIT 8	0.59	1.74
I-26	WESTBOUND	BUNCOMBE	NC-146/EXIT 37	2.64	1.73
I-77	NORTHBOUND	YADKIN	US-21/EXIT 79	4.79	1.72
I-77	SOUTHBOUND	YADKIN	US-21/EXIT 79	2.74	1.69

ROAD	DIRECTION	COUNTY	INTERSECTION	MILES	LOTTR
I-77	SOUTHBOUND	SURRY	US-21/EXIT 83	0.76	1.67
I-40	EASTBOUND	WAKE	US-70/EXIT 306	1.18	1.63
I-77	NORTHBOUND	MECKLENBURG	TYVOLA RD/EXIT 5	0.57	1.62
I-85	NORTHBOUND	MECKLENBURG	GRAHAM ST/EXIT 40	1.36	1.62
I-85	NORTHBOUND	GASTON	MAIN ST/EXIT 22	1.46	1.61
I-77	NORTHBOUND	MECKLENBURG	TYVOLA RD/EXIT 5	0.65	1.60
I-77	SOUTHBOUND	MECKLENBURG	NC-49/TRYON ST/EXIT 6	0.78	1.59
I-77	SOUTHBOUND	MECKLENBURG	TYVOLA RD/EXIT 5	0.50	1.56
I-77	NORTHBOUND	SURRY	US-21/EXIT 83	1.70	1.55
I-85	NORTHBOUND	GASTON	NC-7/EXIT 23	0.59	1.54
I-26	EASTBOUND	BUNCOMBE	AIRPORT RD/EXIT 40	2.69	1.54
I-77	SOUTHBOUND	IREDELL	IREDELL-MECKLENBURG BORDER	1.01	1.52
I-40	EASTBOUND	WAKE	US-70/EXIT 306	0.68	1.51
I-85	SOUTHBOUND	GASTON	NC-273/EXIT 27	0.53	1.50
I-77	SOUTHBOUND	MECKLENBURG	CLANTON RD/EXIT 7	0.67	1.50

Table 16: Interstate Locations with Travel Time Reliability (LOTTR) Greater than 1.5

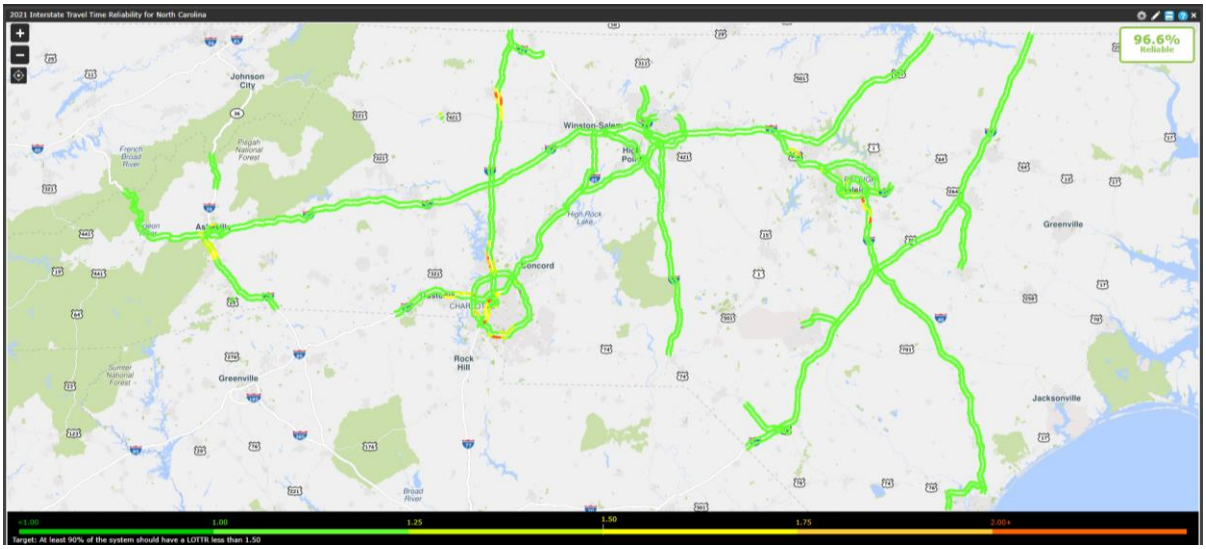


Figure 12 Interstate Travel Time Reliability

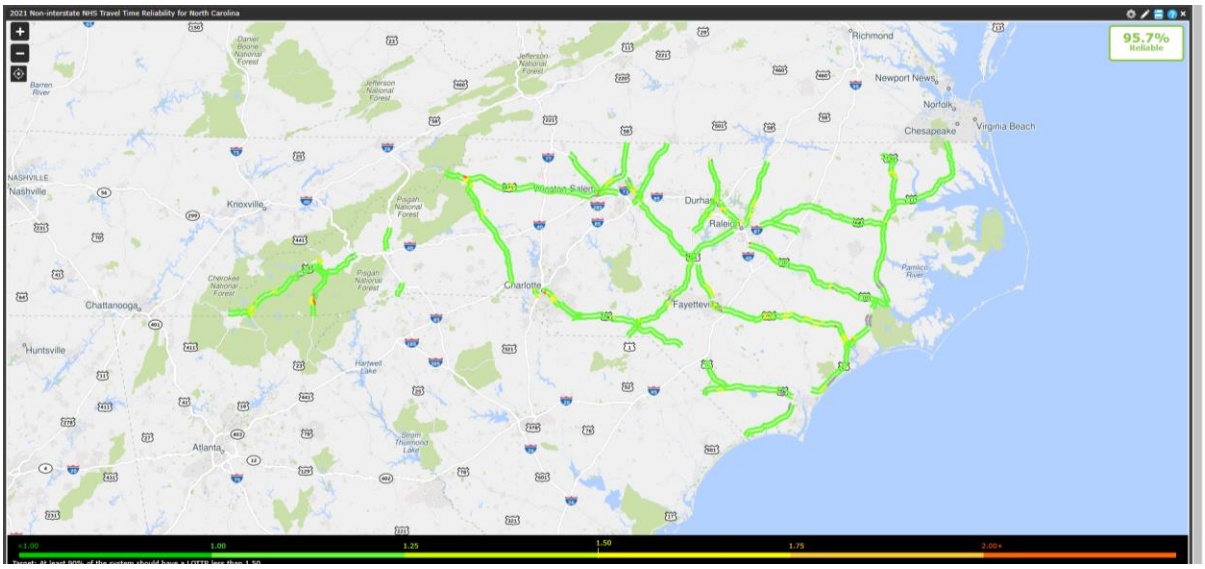


Figure 13 Non-Interstate Travel Time Reliability

ROAD	DIRECTION	COUNTY	INTERSECTION	MILES	LOTTR
US-29	SOUTHBOUND	GUILFORD	I-85 BUS/I-40/US-421	0.51	3.35
US-74	EASTBOUND	MECKLENBURG	HAWTHORNE LN	0.39	2.70
US-74	WESTBOUND	MECKLENBURG	SAM WILSON RD	0.66	2.69
US-301-BR	SOUTHBOUND	NASH	KINGSTON AVE	1.44	2.64
NC-172	EASTBOUND	ONSLOW	NC-24/FREEDOM WAY	9.55	2.54
US-421	NORTHBOUND	HARNETT	S WILMINGTON AVE	0.39	2.53
US-64-BR	EASTBOUND	NASH	SUNSET AVE	0.49	2.52
NC-27	WESTBOUND	MECKLENBURG	HARRISBURG RD	0.96	2.51
NC-55	WESTBOUND	CRAVEN	ALFRED A CUNNINGHAM BRG	0.43	2.41
NC-96	NORTHBOUND	JOHNSTON	I-95/US-301/NC-1009	0.38	2.38
US-158	EASTBOUND	HALIFAX	HALIFAX-NORTHAMPTON BORDER	0.39	2.38
US-64	WESTBOUND	MARTIN	US-13/US-17	0.31	2.36
US-521	SOUTHBOUND	MECKLENBURG	I-485/US-521	0.36	2.32
US-70	EASTBOUND	DURHAM	S MINERAL SPRINGS RD/S MIAMI BLVD	0.56	2.25
NC-115	NORTHBOUND	IREDELL	NC-150	1.46	2.25
US-70	WESTBOUND	BUNCOMBE	BROADWAY ST	0.61	2.22

ROAD	DIRECTION	COUNTY	INTERSECTION	MILES	LOTTR
NC-73	EASTBOUND	CABARRUS	ODELL SCHOOL RD	2.06	2.22
NC-115	SOUTHBOUND	IREDELL	GRIFFITH ST	3.47	2.18
NC-115	SOUTHBOUND	MECKLENBURG	I-485	0.27	2.17
NC-41	EASTBOUND	ROBESON	N PINE ST/E ELIZABETHTOWN RD	0.46	2.17
NC-27	WESTBOUND	MECKLENBURG	MOUNT HOLLY HUNTERSVILLE RD	1.21	2.15
US-23	NORTHBOUND	MACON	US-64/US-441/MURPHY HWY	5.21	2.14
US-64-BR	EASTBOUND	NASH	US-301 BYP/N WESLEYAN BLVD	0.28	2.13
US-64-BR	WESTBOUND	NASH	US-64 (WEST)	0.41	2.13
US-29	SOUTHBOUND	MECKLENBURG	STATESVILLE AVE/N GRAHAM ST	0.49	2.13
US-17	SOUTHBOUND	ONSLOW	US-17 BUS (SOUTH)	0.82	2.08
NC-101	EASTBOUND	CRAVEN	CUNNINGHAM BLVD	0.50	2.07
US-321	NORTHBOUND	WATAUGA	NC-1107	2.82	2.07
NC-16	NORTHBOUND	MECKLENBURG	I-277/US-74/NC-16/JOHN BELK FWY	0.32	2.04
NC-24	WESTBOUND	SAMPSON	US-701/US-421/SUNSET AVE	0.29	2.00
GREEN ST	NORTHBOUND	CUMBERLAND	NC-210/NC-24/GROVE ST	0.28	1.97
US-17-BR	SOUTHBOUND	ONSLOW	US-17/CORETTA SCOTT KING AND MLK JR HWY	0.49	1.95
NC-160	SOUTHBOUND	MECKLENBURG	WESTINGHOUSE BLVD	1.32	1.95
US-301-BR	SOUTHBOUND	NASH	US-301 BYP/S WESLEYAN BLVD	2.21	1.95
SUGAR CREEK RD	NORTHBOUND	MECKLENBURG	I-85	1.37	1.94
NC-115	NORTHBOUND	IREDELL	I-77	0.29	1.93
US-221	SOUTHBOUND	RUTHERFORD	US-74 BUS/US-221/NC-108	0.98	1.93
US-117	NORTHBOUND	NEW HANOVER	HOLLY SHELTER RD	0.391	1.92
PARK ST	NORTHBOUND	RANDOLPH	NC-42/W SALISBURY ST	1.43	1.92
PARK ST	SOUTHBOUND	RANDOLPH	US-64/NC-49/W DIXIE DR	1.43	1.91

Table 17: Top 40 Non-Interstate Locations with Travel Time Reliability (LOTTR) Greater than 1.5

5.4 Responding to Roadway Incidents

Crashes and disabled vehicles can cause a significant amount of non-recurring congestion. Clearing crashes quickly minimizes delay and improves travel time reliability and safety. The Department works with local first responders to promote the quick clearance of incidents that disrupt the flow of traffic. Currently, NCDOT's average clearance time for reported major crashes is 75 minutes. NCDOT continues to work with law enforcement, emergency medical services, fire, towing, utilities to clear crashes more quickly to restore traffic flow.

One of NCDOT's most visible and effective congestion management resources is the Incident Management Assistance Patrol (IMAP). Their primary function is to help manage and expedite the safe clearance of crashes and other incidents along major corridors in the state. Amongst other benefits, quickly clearing the scene of an incident reduces congestion and improves safety by minimizing the likelihood of secondary crashes. IMAP also assists disabled motorists by changing flat tires, jump starting vehicles, providing small quantities of fuel, and many other tasks which keep motorist safe and moving. In 2021, 42 IMAP drivers patrolled over 850 miles of roadway across the state. IMAP responded to nearly 53,000 calls for service and assisted nearly 36,000 motorists across the state. While the Department is maximizing the current allocation of IMAP resources, more drivers would be necessary to effectively provide the ideal level of service. The lack of IMAP resources is most evident during peak travel times, in significant work zones, and during adverse weather events like hurricanes and severe winter weather.

5.5 Recommendations for Congestion Reduction

Reducing congestion requires a multi-faceted approach which includes both capital and operational improvements. Operationally, NCDOT has 4 Transportation Management Centers across the state: one in Charlotte, one in Raleigh, one in Greensboro and one in Asheville. Statewide, over 300 dynamic message signs and 900 traffic cameras are valuable tools to manage congestion caused by crashes, work zones and weather. NCDOT retimes traffic signal systems to maximize throughput on busy corridors. NCDOT manages DriveNC.gov and 511 for traveler information by web and phone. NCDOT coordinates with Google, Apple, Waze, HERE and others to help our citizens who use these services.

More robust deployment of these operational strategies would improve mobility across North Carolina:

- Implementing Advanced Traffic Management Software to optimize traffic management processes
- Additional traffic cameras and dynamic message signs at needed locations
- Fully staffing IMAP and increasing the number of NCDOT Transportation Management Centers
- Upgrading traffic camera images on DriveNC.gov website to full motion video