2016 Maintenance Operations and Performance Analysis Report (MOPAR)

December 2016


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Legislative Requirements for this Report

The North Carolina General Assembly requires the Department to report on the condition of the State highway system and maintenance funding needs. In 2014, NCGS 136-44.3 was modified to require the following:

The Department shall establish performance standards for the maintenance and operation of the State highway system. In each even-numbered year, the Department of Transportation shall survey the condition of the State highway system and shall prepare a report on the findings of the survey. The report shall provide both quantitative and qualitative descriptions of the condition of the system and shall provide estimates of the following:

(1) **The annual cost to meet and sustain the established performance standards for the State highway system**, delineated by costs to the primary and secondary system, to include the following categories of work: (i) contract resurfacing, (ii) pavement preservation, (iii) routine highway maintenance, (iv) disasters and emergencies, (v) structurally sound bridge maintenance, and (vi) structurally unsound bridge rehabilitation, repair or replacement.

(2) **Projected system condition and the corresponding optimal funding requirements for a seven-year plan to sustain established performance standards**. The report shall also identify target levels of service for each maintenance activity and assess historical program performance across divisions, including project delivery rates, staffing, and direct and indirect costs. The Department shall clearly denote prioritized maintenance needs and recommend resource allocations and distribution methods to achieve each target.

(3) **Any significant variations in system conditions among highway divisions**. The report shall include an examination of how well the highway divisions streamline project delivery, maximize efficiency and prioritize spending based on needs, as well as recommendations on ways to improve these processes. The report shall analyze the cost of delivering maintenance activities by division and make recommendations on how to reduce these costs regionally and state-wide.

(4) **An assessment of the level of congestion throughout the primary highway system based on traffic data,** and a ranking of the most congested areas based on travel time reliability and the average number of congested hours, together with the Department's recommendations for congestion reduction and mobility improvement.

(5) **An analysis of existing highway division staffing levels** and recommendations to ensure staffing levels are distributed appropriately based on need.

(6) **A cross-divisional comparison summary document**, not to exceed one page in length, which includes the divisional performance data described in subdivision (2) of this section as well as the most deficient roads and bridges in each division.

The report on the condition of the State highway system and maintenance funding needs shall be presented to the Joint Legislative Transportation Oversight Committee by December 31 of each even-numbered year, and copies shall be made available to any member of the General Assembly upon request.

This report satisfies the requirements made in NCGS 136-44.3.

Contents

1 Forward

Dear North Carolina General Assembly members,

The North Carolina Department of Transportation (the Department) is proud of the role it plays in enhancing the economy and vitality of North Carolina. Through its responsibility for a highway network with a value of $575 billion, the Department connects people, products and places safely and efficiently with customer focus and accountability. Given the Department's expansive road network and their critical importance to our state's mobility, economy and quality of life, it is imperative that we operate and maintain a high quality system as effectively and efficiently as possible.

This 2016 Maintenance Operations and Performance Analysis Report (MOPAR) builds on NCGS 136-44.3's strategic shift in direction for the Department's highway maintenance activities. Leveraging the General Assembly's lead, the Department engaged in a concerted effort over the last two years to craft a strategic asset management vision and capability beyond which previously existed in North Carolina. In this regard, the Department completed a robust outreach effort with Division and County staff comprising of dozens of meetings and hundreds of individual contacts to critically analyze our organizational capabilities and formulate improvement plans geared towards achieving desired levels of service. These plans will provide the Department with the tools necessary to track progress, establish and refine system goals and drive outcomes with meaningful cost-benefit considerations in mind.

The Divisions' improvement plans will undoubtedly evolve over time they will enable the Department to continue to migrate from a statewide maintenance plan developed off the back of historical spending levels to a plan derived from thoughtful goal setting and performance targets. Successful implementation of these plans are rooted in the flexible funding for our maintenance programs. Session Law 2016-94 charged the Department to consolidate the primary and secondary maintenance accounts into one account for general maintenance activities. Division managers and field forces have provided positive feedback on the benefits of this recent flexibility for the planning and delivery of maintenance operations.

Over the past two years, our approach to highway maintenance has evolved, matured and gained momentum, but our organizational, cultural and tactical march towards improvement must continue. This evolution will help the Department be more transparent in its operations and enable the Department to more accurately track and describe how the network is performing and estimate the cost of maintaining and improving the network on an ongoing basis. As our

systems, our plans and our culture matures to fully leverage performance-based approaches to asset management, the Division of Highways will be positioned to extend its capabilities to support other Departmental asset classes.

After careful review of NCGS 136-44.3 and numerous strategic planning sessions with Division and County staff, we have established a new vision that provides a framework within which we can mature into a performance-oriented asset management organization.

On behalf of the Department's fourteen Division Engineers and the approximately 7,200 employees supporting North Carolina's Division of Highways, I would like to thank the General Assembly for its support relating to highway maintenance and, more broadly, asset management. The same foresight that enabled the shift to data-driven capital decisions through the state's Strategic Transportation Investments (STI) law can now be seen in the vision and direction the Department is taking with regards to maintaining its network.

Our vision is that the Division of Highways will restore its legacy as the "Goods Roads State" by providing customers with a safe, reliable, and high quality travel experience.

Respectfully yours,

Michael L. Holder, PE
Chief Engineer

2 Executive summary

The North Carolina Department of Transportation (NCDOT or the Department) is responsible for one of the country's largest state-maintained road networks with a value of approximately $575 billion. This network is comprised of a broad range of assets which the Department maintains in order to ensure efficiency and safety for the travelling public, as well as retaining value and minimizing costs for future generations.

2.1 The annual cost to meet and sustain the established performance standards for the State highway system

The network is growing and aging. This, along with North Carolina's growing population and economy, challenges the Department to balance maintenance needs with the funds that are provided. Funding has an impact on all aspects of the maintenance program, impacting the ability to plan, produce and deliver. Pursuant to NCGS 136-44.3 Section 1, the table below identifies the annual funding needs to reach target levels of service and recommended levels of funding. The recommended funding recognizes highway funds are limited and is based on a reasonable timeline to reach target levels of service. In keeping with the strategic direction set by the General Assembly in 2014, the Department's recommended funding departs from past precedence of relying on historical expenditures to establish current year plans. The following recommended funding is based on Division Improvement Plans and statewide production goals.

Major Programs	Funding Need ($ million)	Recommended Funding ($ million)
Contract Resurfacing	$523	$523
Pavement Preservation	$162	$120
Bridge Program	$250	$250
General Maintenance Reserve		
Highway Maintenance	$685	$483
Routine Bridge Maintenance	$143	$90
Statewide Programs	$131	$131
High Value Bridge Preservation	$30	$30
Subtotal, General Maintenance Reserve	$988	$734
Total	**$1,924**	**$1,627**

Note: Statewide programs include asset maintenance and operations, snow and ice, non-declared emergencies, research and development, state and federal obligations.

2.2 Projected system condition, variations and the corresponding funding requirements

Pursuant to NCGS 136-44.3 Sections 2, 3 and 6, a summary of the condition analysis and funding needs are provided in the table below. In addition, detailed information for each division is provided in the Appendices. The following key findings and recommendations across each of the asset types consider roles that the Department and the legislature both play in maintaining the state's highway portfolio.

Observations and Findings	Influencing Factors	Recommendation/ NCDOT Action
The condition of the primary highway system has shown improvement with steady contract resurfacing funds. However, pavements in good and fair condition remain slightly below target Levels of Service (LOS).	■ Consistent long term contract resurfacing funds	■ Fully fund contract resurfacing needs of $523 million to maintain and reach target LOS (an increase of $25 million compared with FY17). ■ With increased funds the Department will expand its focus to cover lower Average Annual Daily Traffic (AADT)-primary roads; impacting the largest portion of the primary system
The condition of the secondary highway system has been declining for several years. However, the decline is stabilizing given accomplishments over the past several years.	■ Inadequate pavement preservation funds for several years	■ Increase funding for pavement preservation activities to $120 million (an increase of $35 million compared with FY17). ■ It is important to note this recommended funding for pavement preservation is only a portion of what is needed to achieve target LOS. It is anticipated that production and expenditures will ramp up together over time. ■ With additional funds the Department will expand its pavement preservation focus to include low AADT roads (0-5,000 AADT); impacting the largest portion of the secondary system.

Observations and Findings	Influencing Factors	Recommendation/ NCDOT Action
Both contract resurfacing and pavement preservation cycle times are significantly longer than nationally recognized treatment cycles	■ Inadequate funding to meet asset cycle needs	■ Sufficient funding will enable the Department to treat pavements more often and better align with best practices.
The percent of structurally deficient bridges has decreased steadily since 2013	■ Bridge Program objectives (reducing SD bridges) and funding are aligned	■ Continue to fully fund Bridge Program needs of $250 million annually for 15 years. ■ Expand focus to primary system needs to ensure performance goals are achieved by 2030.
Deterioration of high value bridges will likely lead to higher overall costs, and prevent the Department from reaching structurally deficient percentage goals.	■ Bridge Program funding is focused on improving structurally deficient bridges. ■ There are 185 high value bridges each with an estimated replacement cost between $20 and $300 million. ■ Adequate funding is not available to maintain bridges currently in good to fair condition.	■ Extend service life of high value bridges by funding preservation program needs of $30 million annually (included in recommended GMR below).
With the establishment of the Routine Maintenance Improvement Plan (RMIP), the department is better able to focus resources where they are needed, and ensure consistent service across the state.	■ Given the increased flexibility provided to the GMR, the department established the RMIP to drive emphasis on planned maintenance, and hold divisions accountable to production levels. ■ In addition, the RMIP is a tool that helps divisions better balance planned and reactionary demands	■ Increase funding for GMR to $734 million (an increase of $266 million compared with FY17). ■ Additional funds will be used to support key activities discussed in Chapter 3 that extends the life of the system or greatly improves safety.

Observations and Findings	Influencing Factors	Recommendation/ NCDOT Action
Underlying assumptions that define maintenance needs for drainage, roadside, traffic, and other structures will be based on a combination of condition assessments and asset cycle approach.	■ N/A	■ With the increased attention towards planned maintenance, the Department is refining condition targets, and methodologies to more precisely determine needs.

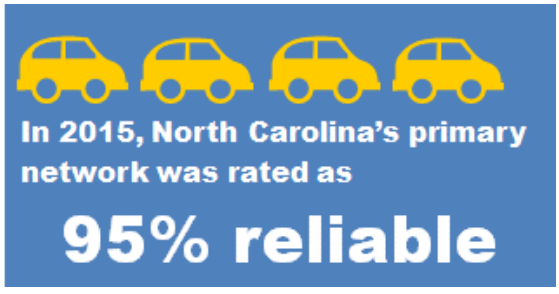
2.3 Delivering Maintenance and Operations Effectively and Efficiently

Pursuant to NCGS 136-44.3 Sections 2 and 5, the analyses of direct and indirect costs, and staffing are summarized below. These two measures, along with many others, are closely monitored by the Department because they directly impact the development of realistic work plans that can be successfully delivered.

- **Staffing Summary –** Overall trends for lane-miles, population, and area served per employee are consistent with regional characteristics such as the Coast/Sandhills, Piedmont or Mountains. While the cross-division comparison helps to understand overall trends in order to ensure staffing is appropriately distributed, this analysis is being incorporated with the Routine Maintenance Improvement Plan (RMIP). **Division Engineers will be asked to review staffing needs in conjunction with submission of the RMIP (June 1, 2017) to ensure that plans drive division staffing levels. The Chief Engineer will review staffing needs by August 1, 2017.**
- **Direct/ Indirect Summary –** Estimates for indirect costs for maintenance related activities, developed by the Financial Management Unit, represent a snapshot in time and are more appropriately viewed as a range rather than a single, fixed value. When fully accounted, the Department's SAP system indicates that indirect costs represent approximately 11-13% of spending on delivering highway maintenance and operations activities. **The Department is currently working with a financial services contractor to refine and simplify indirect cost accounting methods. These systems are expected to be in place by May 1, 2017.**

2.4 Safety and Mobility

Safety across the entire state-wide network is the top priority. With an increased number of miles travelled over the last decade, there has been an increased number of road crashes and fatalities. These increases are in line with national trends as statistical evidence indicates that distracted driving, impaired driving, and speed are all major factors contributing to this troubling trend. Additionally, a high-quality network is an important part of a healthy economy. Adequate investments in safety and mobility will continue to support transportation routes and ensure competitive economic growth.



Pursuant to NCGS136-44.3 Section 4, this report provides a detailed analysis of congestion throughout the primary highway system and discusses recommendations for improving mobility.

Based on three key industry metrics including travel time index, average number of congested hours per day, and level of travel time reliability, much of the state's congestion is concentrated in the most populous areas of the state. The Department's efforts to focus on spot projects for safety have been very effective for targeting localized concerns. On average spot safety projects have a benefit:cost ratio of 14:1. As such, programs like these, explained in more detail in the following chapters, are recommended to continue to improve safety.

2.5 Summary of NCDOT Actions

The table below provides a summary of NCDOT actions and their schedule timing:

Summary of NCDOT Actions	Plan/ Schedule
Refine and simplify indirect cost accounting methods.	May 1, 2017
Convene a work group with Division staff to reach a consensus on the methodology and tools to support the RMIP, this includes developing an asset inventory and asset cycle time policies. In addition, reevaluate the Maintenance Condition Assessment Program (MCAP) to align with objectives of the RMIP, and inventory and asset cycle time approach.	Ongoing through June 1, 2017
Conduct follow up regional meetings with Division and County offices to refine implementation of the RMIP and tailor individual plans to division and regional priorities and needs.	Ongoing through June 1, 2017
Division Engineers will be asked to review staffing needs in conjunction with the submission of the RMIP (June 1, 2017) to ensure the plans drive division staffing levels.	August 1, 2017

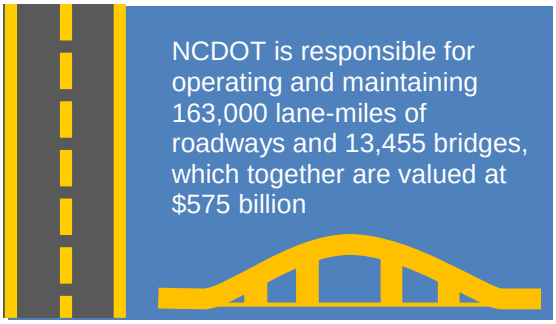
The Department recognizes the responsibility it has to the state of North Carolina to illustrate results of any additional funds and will demonstrate to the legislature the expected outcomes of any additional investment that is made in the maintenance program. The Department remains committed to working with the legislature in maintaining a highway network that re-establishes North Carolina's reputation as the "Good Roads State."

3 NCDOT Asset Management Program

3.1 Establishing the Asset Management Vision

Dating as far back as the 1920s, the Department has been widely regarded as an industry leader in transportation. In 1912, before the state was responsible for building out the road network, there were 48,000 miles of road, only 2,100 miles of which were made of a substance other than dirt. After the passage of the "Good Roads Bill" in 1921, the state took over the challenge of building new roads and improving existing roads, as well as developing a complete system of state highways. In only a decade, the state built 3,425 miles of concrete and asphalt roads and was in charge of more than 4,000 miles of less-improved roads.

By 1930 the state had an excellent road system, connecting all but one or two county seats and state institutions with 18-foot-wide concrete highways. As a result of these improvements, North Carolina developed a nationally recognized reputation as the "Good Roads State."



Now, over 80 years later, the state highway network is still an integral part of the lives of all North Carolinians – these critical assets keep our state moving safely and effectively every day. As the network ages, effective whole-life management of these assets is a growing priority. Departments of Transportation (DOTs) nationwide are being challenged to balance current and future asset requirements while staying within their means. The challenge is especially evident for the Department given the high lane mileage and wide variety of operating environments and asset groups. Regions in the western, central, and eastern parts of the state have fundamentally different maintenance challenges, asset demands, geology/topography and climates, making the Department's job of maintaining the system even more challenging.
To address these challenges, the Division of Highways (DOH) launched an initiative to coordinate activities across the 14 Divisions, focusing maintenance activities statewide on achieving a broader asset management strategy. Specifically, DOH has established the following Asset Management Vision which has its roots in the state's rich legacy as the Good Roads State:

The Division of Highways will restore its legacy as the "Good Roads State" by providing customers with a safe, reliable, and high quality travel experience.

3.2 Engaging Divisions and Self-Assessment

To support the development of this vision, DOH launched an asset management self-assessment process to understand the maturity of current practices. In the spring of 2016, field operations across all 14 Divisions were engaged in meetings, surveys and interviews, comprising of:

- 275 surveys administered across 14 Divisions including division staff and county maintenance engineers. The surveys included 42 questions targeting the asset management organizational and operational strategy.
- Both group and one-on-one interviews were conducted with some 18 people including Division Engineers, District Engineers, County Maintenance Engineers, and key Central Office staff.

The findings of this Self-Assessment formed the vision and plots a path to drive "line of sight" – consistent understanding of the goal, objectives and tactical approach – to ensure accountability throughout the organization, and enhance production and condition.

3.3 Program and Implementation Strategy

The Asset Management Program continues to evolve as the vision is translated into goals that drive Improvement Plans. These plans are supported by a number of service delivery standards and performance measures which enable the measurement of overall achievement of the goals. The Program is decentralized, allowing Division staff the flexibility to choose the appropriate maintenance strategies for inclusion in their Improvement Plans, which will then be measured against clear and consistent production targets that tie back to the Department's wider asset management vision.

> *"Success with planned maintenance will require funding stability from year to year as a foundation upon which to plan. In addition, moving more towards an inventory based funding mechanism is preferred."* Division Engineer

DOH is developing a complete Transportation Asset Management Plan (TAMP) that incorporates a risk management approach and tools to make better informed decisions. TAMP development involves undertaking an activity cycle analysis that defines the likely costs of an asset from construction to the end of its useful life. Such analysis enables the Divisions to develop maintenance strategies and quantify the needs of each treatment option. One of the advantages of this approach is a clear understanding of the costs associated with choosing a treatment option, and more importantly, the costs of foregoing other options. This helps to simplify decisions such as whether to focus on primary or secondary routes.

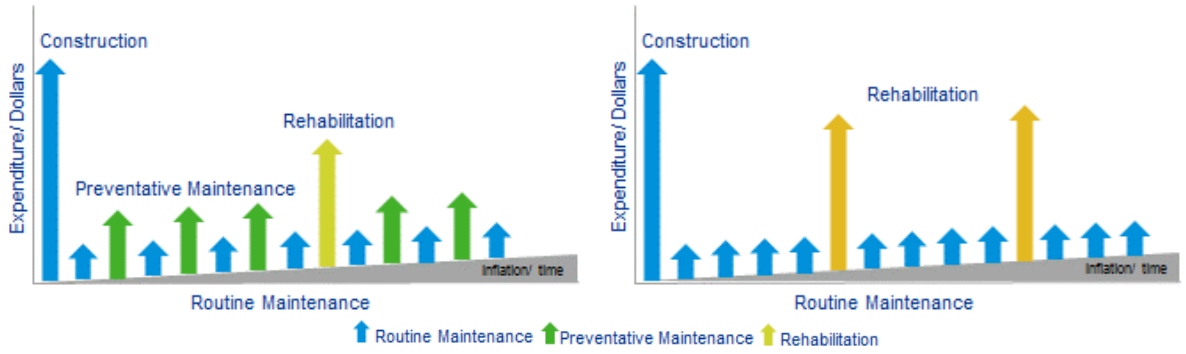
As part of recent DOH strategic asset management efforts, this risk based, asset cycle approach is being examined for statewide implementation. For example, this departure from current methods of determining needs for routine maintenance, which is currently based on a snapshot-in-time of asset condition, is expected to change the nature of planned activities, LOS targets, and methodologies for condition surveys.

3.3.1 Emphasis on Planned Maintenance

Planned maintenance is essential in order to perform the most cost-effective maintenance over the activity cycle. Figure 1 shows the relative expenditures of an activity by the size of its arrow. For example, preventative maintenance, a relatively inexpensive treatment, may only bring a slight improvement in the condition, but still makes a significant positive impact and may postpone or avoid the need for a much more expensive treatment later in the asset life.

Planning allows for the DOH to take advantage of such cost saving treatments. In addition, when this approach is taken across a wider asset portfolio the cost saving potential multiplies.

Figure 1: Relative Maintenance Expenditures



Planning for maintenance is inherently difficult due to the magnitude of different tasks and the difficulty in coordinating them. The focus of the DOH has become concentrated on developing a coordinated Improvement Plan consisting of the Highway Maintenance Improvement Plan (HMIP), Bridge Maintenance Improvement Plan (BMIP), and RMIP. This plan is designed to coordinate a wide-range of maintenance activities as efficiently and effectively as possible. Figure 2 provides an overview of the planning priorities and goals that are reflected in division's plan.

Figure 2: Five Priority Areas and Example Goals

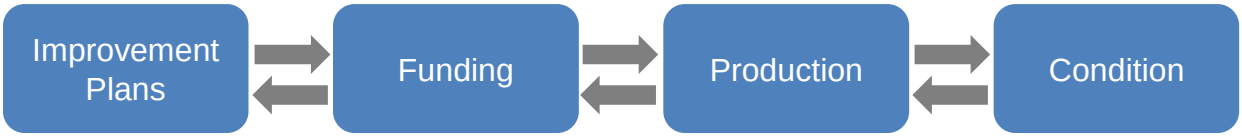
Infrastructure	Example Goals
Pavement	■ Extending pavement life/durability/longevity ■ Increasing ride quality ■ Reducing potholes
Bridges	■ Reducing the rate of structurally deficient bridges ■ Extending the life of bridges that have high replacement costs ■ Establishing a robust bridge maintenance funding program ■ Minimizing load posted bridges ■ Ensuring safe accommodations for all modes of traffic
Drainage	■ Ensuring proper functioning drainage (shoulders, pipes, and ditches) ■ Minimizing high and low shoulders
Roadside	■ Maintaining timely vegetation control ■ Reducing litter ■ Maintaining guardrail/ barriers
Traffic	■ Lowering crash rates ■ Increasing mobility and providing predictable travel times ■ Replacing signs ■ Increasing visibility of traffic markings ■ Ensuring consistent roadway lighting ■ Maintaining and synchronizing traffic signals

3.3.2 Format of the Report

This report discusses statewide trends with detailed analysis for each Division provided in the Appendices. The analysis in the following chapters is streamlined to provide a clear understanding of inputs (such as plans and funding), and outputs (the impact on production and condition) both statewide and at the Division level. In addition, the report evaluates trends and compares performance with the 2014 report (note the MOPAR is presented to the JLTOC each even-numbered year).

At the time of writing this report, DOH is transitioning towards the new vision and direction. (It is important to note that implementation of Improvement Plans is progressing and matured data may not be fully available.) In keeping with the strategic direction set by the General Assembly in 2014, the Department's maintenance strategy departs from past precedence of relying on historical expenditures to establish current year plans. This new approach focuses on planned activities to drive funding, production and condition goals.

Figure 3: Overview Format of the Report



4 Needs, Recommended Funding, and Priorities

4.1 Introduction – Maintaining High Quality Assets and Operations

NCDOT is responsible for the second largest state-maintained road network in the United States and continues to grow its asset portfolio. North Carolina's highway assets have a value of roughly $575 billion and the Department is responsible for ensuring this value is retained for future generations. Figure 4 below summarizes the quantity of major assets being managed and their value:

Figure 4: Highway Asset Portfolio

Highway Asset Type	Approximate Quantity	Estimated Asset Value
Bridges (number)	13,500	$60 billion
Pavement (lane miles)	163,000	$62 billion
Other Roadway Assets (centerline miles)	80,000	$446 billion
Large Pipes and Culverts (each)	27,000	$7 billion
Total	NA	$575 billion

Much of the system is growing and the committed portion, or the first 5 years of the 2016-2025 State Transportation Improvement Plan (STIP) will add roughly 1,200 lane miles of new capacity and 170 new bridges to the system, which in turn entail growing maintenance and operations responsibilities. This growth is further increased by the vast and growing subdivision routes that DOH also maintains. This growing portfolio underlines the importance of a robust and effective maintenance and operations program.

4.2 Needs, Recommended Funding and Allocation

Flexibility and consistency in funding are important in order to sustain maintenance of the asset portfolio and to ensure plans are realistic and achievable. Pursuant to Session Law 2016-94 Section 35.24.(c), DOH is able to more effectively allocate funding to critical needs of the system. A summary of current funding programs and example activities are summarized in Figure 5 below:

Figure 5: Summary of Current Funding Program and Activities

Major Program	Governing Improvement Plan	Example Activities
Contract Resurfacing	Highway Improvement Plan (3-year plan, condition assessed annually)	■ Placement of plant mixed asphalt ■ Milling existing asphalt ■ Shoulder reconstruction ■ Pavement markings
Pavement Preservation	Highway Improvement Plan (3-year plan, condition assessed annually)	■ Chip seals ■ Crack seals ■ Joint sealing ■ Micro surfacing ■ Diamond Grinding ■ Full-depth Reclamation
Bridge Program	Bridge Maintenance Improvement Plan (5-year plan, condition assessed every 2 years)	■ Bridge replacement ■ Bridge rehabilitation ■ Large drainage structure replacement
Maintenance (General Maintenance Reserve)	Routine Maintenance Improvement Plan (2-year plan, condition assessed annually)	■ Drainage maintenance ■ Shoulder maintenance/reconstruction ■ Litter pickup ■ Roadside vegetation management ■ Grass mowing ■ Pavement patching ■ Installing or replacing: – Pavement markings – Signals and signs – Markers and symbols ■ Repairing concrete bridge decks ■ Bridge girder painting ■ Emergency bridge repair ■ Statewide programs

Figure 6 below identifies the funding need – pursuant to legislation NCGS136-44.3 Section 1, this amount is the “annual cost to maintain and sustain the established performance standards for the State highway system,” – and the recommended funding. However, recommendations for pavement preservation and the GMR are less than the need, and do not directly tie with target levels of service. Rather, this recommended funding considers annual production and anticipates a gradual ramp-up over time. The Department is confident this stepwise approach for pavement preservation and GMR will be effective to reach long term performance goals.

Figure 6: Annual Needs and Recommended Funding (FY18 & FY19)

Major Programs	Funding Need ($ million)	Recommended Funding ($ million)	Percent of Funding Need
Contract Resurfacing	$523	$523	100%
Pavement Preservation	$162	$120	74%
Bridge Program	$250	$250	100%
General Maintenance Reserve			
Highway Maintenance	$685	$483	71%
Routine Bridge Maintenance	$143	$90	63%
Statewide Programs	$131	$131	100%
High Value Bridge Preservation	$30	$30	100%
Subtotal, General Maintenance Reserve	$989	$734	74%
Total	**$1,924**	**$1,627**	**85%**

Figure 7 below, compares the current appropriation in FY17 with the future recommended funding, and provides estimates for allocations between statewide programs and Divisions.

Figure 7: Recommended Funding and Allocation

Major Programs	FY17 State Appropriation	FY18 & FY19 Additional Funds	FY18 & FY19 Total Funds	Allocated to Statewide Programs	Allocated to Divisions
Contract Resurfacing	$498	$25	$523	$3	$520
Pavement Preservation	$85	$35	$120	$0	$120
Bridge Program	$242	$8	$250	$0	$250
General Maintenance Reserve	$468	$266	$734	$131	$603
Total	**$1,293**	**$334**	**$1,627**	**$134**	**$1,493**

The General Maintenance Reserve also supports statewide programs including (details provided in Figure 8):

- **Asset maintenance and operations** – Funds are used to support statewide needs including condition assessments, incident management, rest area renovations, and non-declared emergencies
- **Snow and ice activities** – Funds used for snow and ice removal account for roughly 70% of the statewide program. Needs for snow and ice removal activities in a given year are based on a 5 year average expenditure of approximately $50 million, and can range from $15 million to $77 million. (Refer to Appendix A for details.) Because of the wide range of potential expenditures and challenges with forecasting needs, budget allocation in a given year also includes overages from the previous year. Funds are also used to cover unanticipated expenditures for non-declared emergency operations.

- **Research and development** – Funds are used for research, developing and piloting technologies, practices and procedures such as Institute for Transportation Research Education (ITRE) programs and customer service surveys.
- **State and Federal obligations** – Funds are required to support state or local federal laws, regulations or rules including railroad signal maintenance, overweight/ oversize bridge repairs, and weigh station maintenance.

Figure 8: Statewide Program Detailed Breakdown

Statewide Programs	FY17 Allocation	% of Total
Asset Maintenance and Operation	$18 million	14%
Snow and Ice and Non-Declared Emergencies	$90 million	68%
Research and Development	$1 million	1%
State and Federal Obligation	$22 million	17%
Total	**$131 million**	**100%**

Note: Snow and ice expenditures are based on a 5 year average plus any overages from the previous year.

Subsequent chapters explain how funding impacts each Improvement Plan (i.e. production), and as result, the condition of our system. In addition, a forecast for future production and condition expectations are also discussed.

4.3 Prioritizing Funds

In November 2016, Division Engineers (DEs) were gathered to provide input and field perspective on funding allocation and priorities. All 14 DEs provided input and ranked funding priorities for planned maintenance, results have been consolidated in Figure 9 and Figure 10. The planned maintenance priorities do not include disasters and emergencies. Although they form a core part of the Department's accomplishments, they are not considered activities that can be planned. After any disasters and/or emergencies, the Department is fully committed to restoring the pre-emergency conditions.

Figure 9 assumes a funding increase, where routine maintenance would be supplemented first, followed by bridges and pavements. Under this scenario, within bridges and pavements, additional focus is placed on preservation activities since replacement and major rehabilitation activities will have been adequately funded.

Figure 9: Funding Priority Assuming Increases

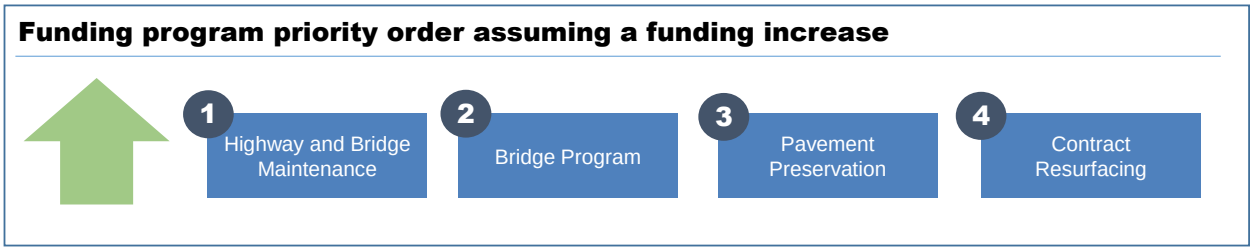
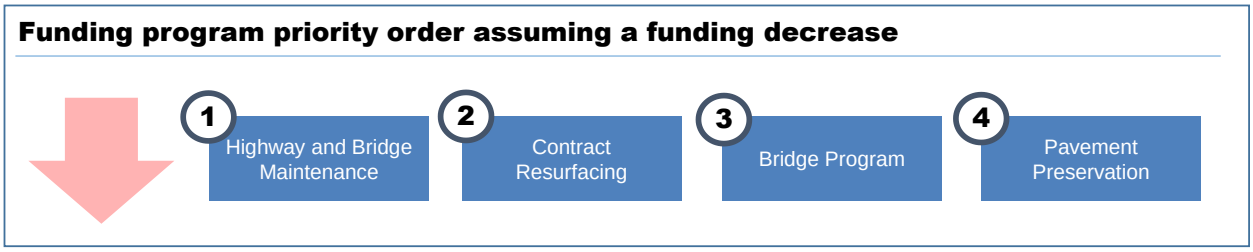


Figure 10 shows a scenario that assumes funding decreases. In this scenario routine maintenance remains a top priority followed by contract resurfacing and bridge replacement. It is important to first address the most critical needs through resurfacing and replacement when funding decreases. Under this scenario, while preservation needs are secondary, inadequate funding for these activities over several years can have costly impacts to the system condition as experienced with secondary pavement conditions today.

Figure 10: Funding Priority Assuming Decreases



4.3.1 Recommendations for Funding

Recommendations for funding are highlighted in the box below. Associated NCDOT actions and next steps are described in the following chapters.

1. Recommendation to support long term consistency and maximum flexibility in funding appropriations:

- In order to reach and sustain condition goals, provide long-term consistent funding
- Maintain consistent funding for contract resurfacing (approximately $523 million per year) and Bridge Program (approximately $250 million per year)
- Increase funds for pavement preservation to $120 million (an increase of $35 million compared with FY17)
  - This recommended amount for pavement preservation is not sufficient to reach to target LOS. It is anticipated that funding needs will gradually ramp up with production over time.
- Increase funds for GMR activities to $734 million (an increase of $266 million per year compared with FY17).
  - The recommended amount for GMR maintains the current condition, but is not sufficient to reach to target LOS. It is anticipated that funding needs will gradually ramp up with production over time.

5 Asset Condition, Production, and Trends

5.1 Introduction

This chapter discusses condition trends, performance, and investment needs for replacing and/or maintaining the key focus areas including pavements, bridges and roadway assets (i.e. drainage, traffic and roadside). The chapter is organized as follows:

- **Overview 2015-2016 asset condition** – Overview of target LOS and recent condition scores for the key focus areas
- **Detailed discussion by asset type:**
  - **Overview of Improvement Plans –** Discussion of key features for governing plans of each asset (HMIP, BMIP and recently established RMIP)
  - **Detailed asset condition –** Historical and long-term trends, recent changes, and future projected conditions by system
  - **Funding levels and condition implications** – Compares plans and accomplishments, based on funding. Discusses the impact of funding and policies on accomplishments and condition
  - **Trade-off analysis and risk management –** Discuses the key drivers to achieve LOS goals, priorities and the risks associated with various activities
  - **Recommendations** – As required in NCGS 136-44.3, this section provides recommendations for resource allocation and distribution methods to achieve each target

Additionally, this chapter will discuss the impacts of the recently established DOT REPORT program on delivering Divisions' planned maintenance activities.

5.2 CY2015-2016 Overview Maintenance Asset Condition Targets and Results

Independent field surveys are used to develop condition analysis and scores. Surveys are a snapshot of the condition at a particular point in time. These condition scores, combined with local knowledge of specific routes, provide a complete view of the asset condition. Figure 11 below provides an overview of the most recent condition targets and scores and are discussed in more detail in subsequent sections. Due to the vast number of pavement lane miles that need to be surveyed, CY2015 pavement surveys are the most complete set of condition analysis. CY2016 surveys are in progress and are expected to be completed and evaluated by the end of the first quarter of 2017. In 2015, LOS targets were refined to better align with the nature of the asset. This resulted in a slight decrease in LOS targets for drainage and roadside features. Improvement Plans and funding allocations are based on LOS targets and mid-year changes may not be fully reflected in Division Improvement Plans. It is important to keep in mind these target changes when comparing condition scores and targets across multiple years.

Figure 11: Statewide Asset Condition

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			86	80	75
PAVEMENT	Minimum Pavement % Good	Pavement Condition Rating >= 80	90	71	61
			5	7.5	10
	Maximum Pavement % Poor	Pavement Condition Rating < 60	2	5	13

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			2	6	15
BRIDGES AND OTHER STRUCTURES	Percent of SD Bridges	Percent of structurally deficient bridges by system and statewide target of 10% by 2030	4	9	17
			85	80	75
	NBIS Culverts	Condition Rating >= 6	99	98	97
			80	75	70
	Non-NBIS Culverts	Condition Rating = Good	96	94	85
			90	90	
	Overhead Sign Structures	Condition Rating = Good	98	97	N/A

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
DRAINAGE	Unpaved Shoulders	No drop-offs greater than 3 inches and no shoulders higher than 2 inches	95	93	94
	Ditches (Lateral Ditches)	No blocked, eroded, or nonfunctioning ditches	98	95	93
	Crossline Pipe (Blocked)	Greater than 50% diameter open	89	78	79
	Crossline Pipe (Damaged)	No damage or structural deficiency effecting functionality	93	93	90
	Curb & Gutter (Blocked)	No obstruction greater than 2 inches for 2 feet	95	93	95
	Boxes (Blocked or Damaged)	Grates and outlet pipes of boxes blocked <50%. Inlets and outlets of boxes are not damaged, and grates are present and not broken.	80	87	87

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
TRAFFIC	Long Line Pavement Markings	Present, visible	93	96	88
	Words and Symbols	Present, visible	71	91	91
			90	85	85
	Ground Mounted Signs	Visible and legible	97	97	95
	Pavement Markers	Present and reflective	78	61	N/A
	Overhead Signs	Visible and legible	96	95	N/A

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
ROADSIDE	Vegetation (Brush & Tree)	Freeways: 45' from travelway, 5' behind guardrail, not blocking signs; Non-Freeways: Vertical clearance of 15' over roadway and 10' back of ditch centerline or shoulder point	76	83	84
	Vegetation (Turf Condition)	Areas free of erosion	93	95	96
	Stormwater Devices (NPDES)	Functioning as designed	94	83	80
			85	80	
	Landscape Plant Beds	Achieving a score of 2 or higher on the inspection form	92	92	N/A
			90	90	
	Rest Areas & Welcome Centers	Condition Rating of 90	94	93	N/A

5.3 Pavements

5.3.1 Overview and Summary

Section Summary - Pavements

This section describes the HMIP – the planning process, work performed by Divisions, and funding implications. A summary of key observations are provided below:

- Recommended funding:
  - $523 million for Contract Resurfacing – An increase of $25 million compared with current funding.
  - $120 million for Pavement Preservation – An increase of $35 million compared with current funding. This recommended amount for pavement preservation is not sufficient to reach to LOS goals. It is anticipated that funding needs will gradually ramp up with production over time.
- The interstate and primary system is at or near target
  - Consistent long term funding is proven to be one of the most important factors of pavement condition on interstates and primaries today.
  - Average Annual Daily Traffic (AADT) is a metric that describes how “busy” a road is. With increased funding, the Department can expand its focus to roads with an AADT of 0-15,000 AADT, and effectively impact the largest portion of the primary system. (Roads of this AADT account for 93% of the primary system.)
  - The cycle time for contract resurfacing is approximately 19-39 years for primary and secondary roads. While this is an improvement, it is above best practice average of 12-15 years.
- Pavements in good condition on the secondary system have been declining, with pavements in fair and poor condition increasing.
  - The pavement preservation budget increase from $65 million to $100 million in FY 16 and $85 million, recurring in FY 17 demonstrated an effective use of funding. With these additional funds, the Department was able to decrease cycle time by 50% from approximately 30 to 15 years. However, the cycle time remains well above best practice average of 4-7 years.
  - The overall secondary-condition drop is largely observed on the low AADT roads that make up 94% of the secondary system. In contrast, higher AADT-road conditions experienced a small decline in good condition, but represent only 3% of the secondary system.
  - With additional preservation funds, NCDOT will expand focus to low AADT roads (0-5,000 AADT) to impact the largest portion of the secondary system. This is important for improving the overall system condition and keeping majority of the secondary roads from further deteriorating.

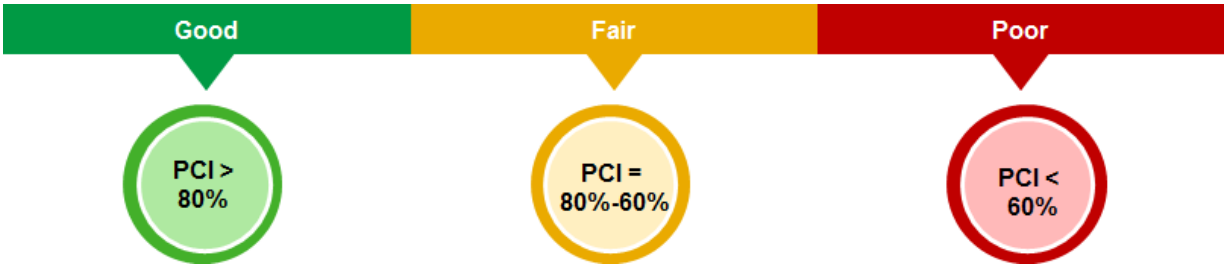
5.3.2 Highway Maintenance Improvement Plans (HMIP) and Condition Surveys

Pursuant to N.C.G.S. 136-44.3A (g) the Department implemented the Highway Maintenance Improvement Plans (HMIP), a three-year work plan based on Division allocated funds that identifies routes and optimal treatments to reach LOS goals in 2015. These Division plans, pursuant to legislation, are adopted by the Board and updated annually to reflect actual budget allocations for years two and three. For example FY17, FY18 and FY19 plans are based on

FY16 appropriations, this assumes that future year appropriations remain consistent. Without consistent funding, it is challenging to forecast condition and achieve long term progress towards goals. To successfully meet targets, the types of treatments undertaken are just as important as the dollar spent. The Division's flexibility to fully implement plans enables accurate tracking of planned and actual activities.

At the beginning of every year, DOH commences pavement condition surveys of all Department pavement assets – 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), included in Figure 12 below. The PCI considers observed defects in the pavement such as cracking, patching, rutting, traveling, 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 "fair" or "poor." Pavement condition is influenced by activities funded through the contract resurfacing, pavement preservation, and routine highway maintenance programs.

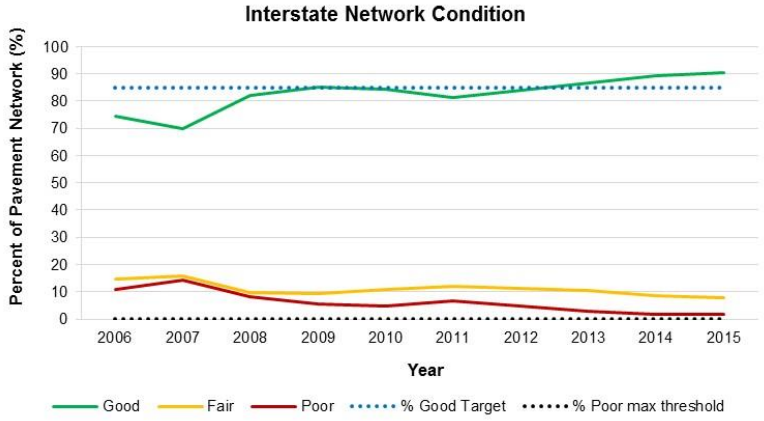
Figure 12: Pavement Condition Index



5.3.3 Pavement – Current Condition and Trends

The figures below show historical pavement condition trends for the interstate, primary and secondary networks from 2006 to 2015 (Refer to Appendix B for Division details). Interstate pavements have consistently been close to their target and – for the last several years – have met or exceeded their target of 85% of pavement miles being in good condition.

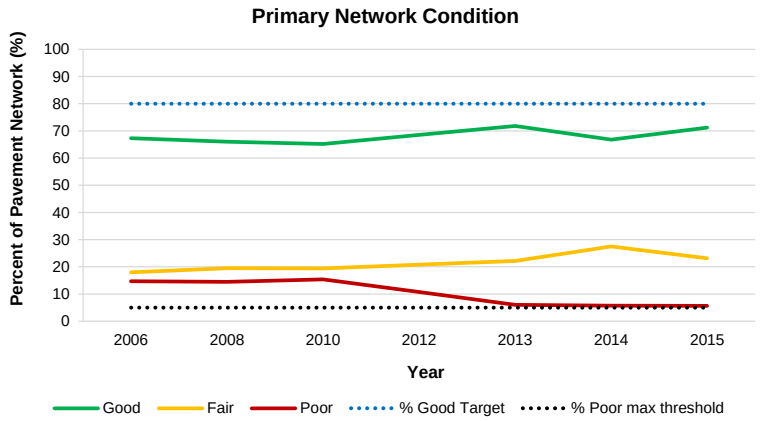
Figure 13: Interstate Pavement Condition Since 2006



Interstate pavement conditions have met or exceeded their target of 86% over the past 8 years.

The primary network condition, depicted in Figure 14, has shown improvement with steady contract resurfacing funds. While at 71% "good" this past year, a 5% improvement from 2014, the primary network is still below the target of 80% in good condition.

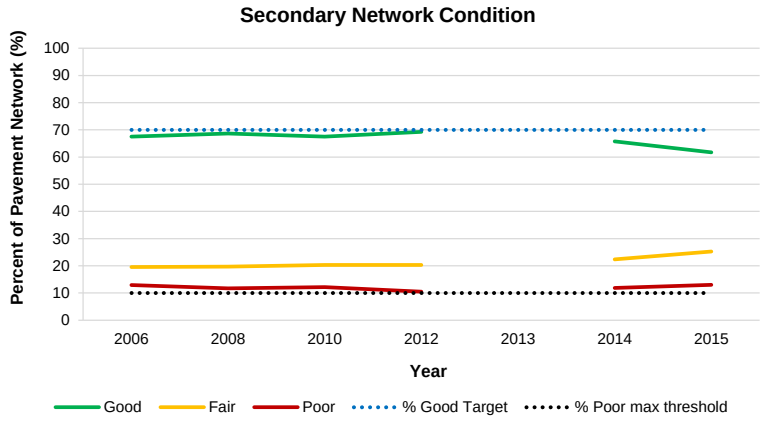
Figure 14: Primary Pavement Condition Since 2006



Emphasis on contract resurfacing in recent years is a key driver of our Primary system pavement conditions

Figure 15 shows the condition of the secondary highway system has been declining for several years. However, the decline is stabilizing given accomplishments over the past several years. Inadequate pavement preservation funds for several years is key driver of this decline. Note condition surveys on the secondary roads were previously conducted every two years however, in 2014 the surveys have been conducted annually.

Figure 15: Secondary Pavement Condition Since 2006

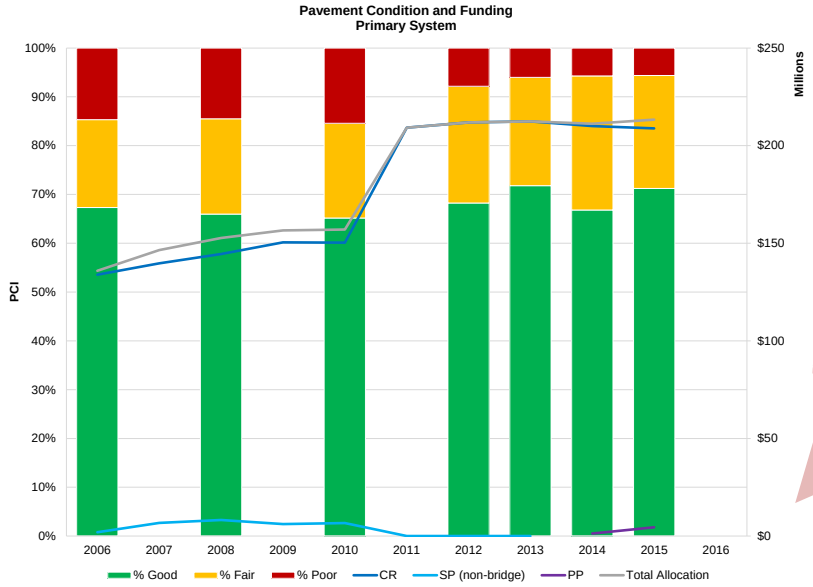


Secondary system deterioration has accelerated after several years on or near target

5.3.4 Funding levels and condition implications

The figures below show the condition of the primary and secondary network plotted against funding since 2006. The relatively stable percentage of good primary pavements can be directly attributed to consistent funding for contract resurfacing since FY11, depicted in Figure 16 below. While there are minor fluctuations between good and fair pavements, the percentage of poor pavements have remained consistent and has been confined to less than 10%.

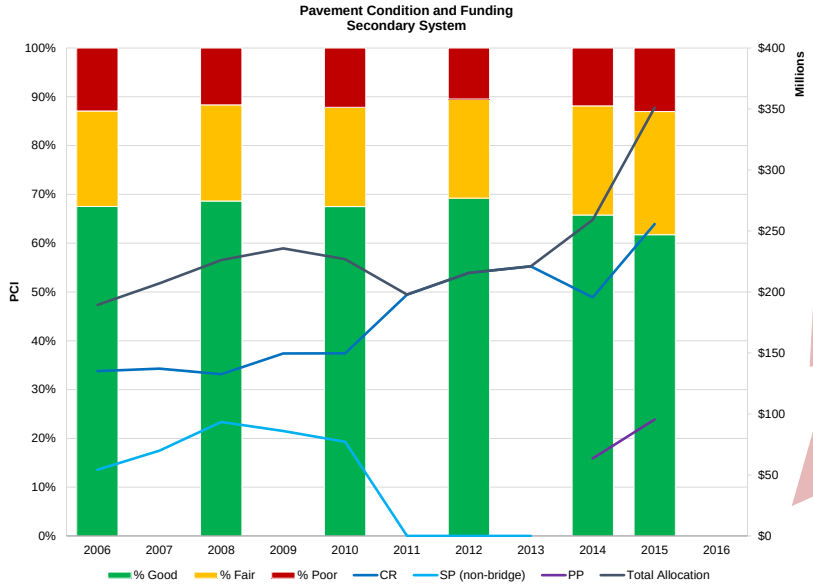
Figure 16: Funding and Primary System Condition



Primary System

The focus on contract resurfacing and consistent funding has led to significant improvements in good and fair pavement condition. While there are minor fluctuations in good and fair condition, pavements in poor condition has been confined to less than 10%.

Figure 17: Funding and Secondary System Condition



Secondary System

Over the past 3-4 years, good and fair pavement conditions have fluctuated with funding. The lack of preservation activities in 2011-2014 have led to an increase in fair and poor condition. While preservation funding has been restored, widespread improvements are not expected until 2018.

The overall secondary system condition has fluctuated over the last 3-4 years and is declining, as shown in Figure 17. While pavement preservation funding was restored in FY15, there were several years where attention to this treatment was missing, as evidenced by the declining condition. Preliminary condition data for 2016 indicates that the overall deterioration is declining at a slower pace, suggesting that the condition is stabilizing. It is expected that even with dedicated and consistent funding, conditions will likely not experience widespread improvements until at least 2018. This slow progression further highlights the importance of consistent funding.

Preliminary 2016 Condition Survey Results

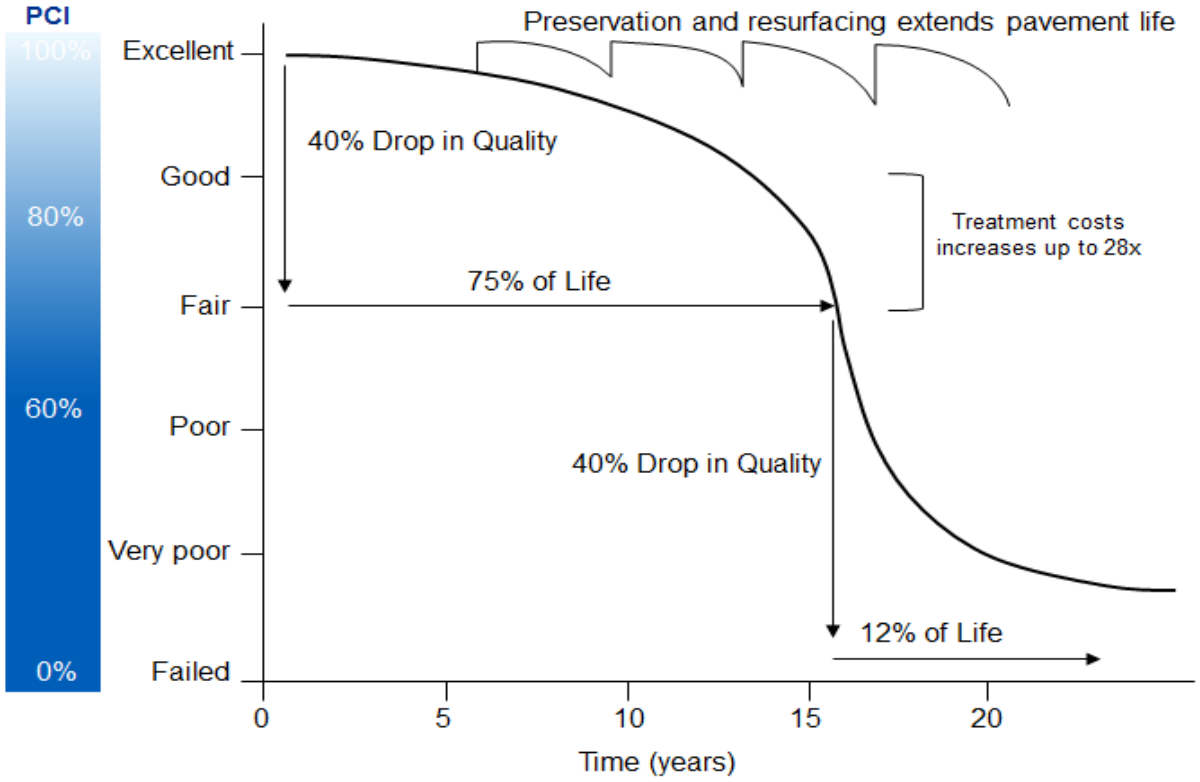
Pavement condition surveys are collected on an annual basis. Due to the vast number of pavement lane miles that need to be surveyed, an addendum to this report, with complete survey results for 2016 will be issued by the end of Q1 2017. At the time of writing results for the primary system are available for 7 Divisions, and results for the secondary system are available for 12 divisions. Preliminary statewide observations include:

- The primary system has slightly improved in 2016. This slight improvement demonstrates the effectiveness of a continued focus and commitment to consistent funding for the contract resurfacing program. In addition, condition surveys are showing the interstate condition has fluctuated in the past year with a slight decline of 3%.
- On the secondary system, the percent of pavements in good condition has further declined. While the condition of good pavements reduced in 2016, this is occurring at a slower pace than previous years, indicating early signs of stabilizing. This can be attributed to pavement preservation funds being restored. However, a widespread increase in good condition is not expected until at least 2018. This slow progression further highlights the importance of consistent funding.

5.3.5 Trade-off Analysis and Risk Management

The range of pavement maintenance and treatments that are undertaken is an important consideration in this analysis. While the efficient use of funds is a key driver of maintaining condition, it is equally important that the mix of treatments, their timing, and the type of road are carefully selected. Figure 18 provides an overview of benefits and treatment activities during the pavement life. The curve displays how pavement deteriorates over time and the associated Pavement Condition Index (PCI). It is important to note the tipping point at 15 years, this is generally when the quality of the asset is expected to fall by approximately 40%, if the “right” treatment is not performed. A predictable and consistent treatment during specific years of a pavement’s life are important to achieving LOS goals and extending the life of the asset.

Figure 18: Pavement Condition Cycle Time with Treatment and Cost



Evaluating cycle times (the intervals between each treatment activity), helps to identify the production required to reach LOS goals. Figure 19 and Figure 20 below, compares plans (HMIP) and accomplished work for contract resurfacing and pavement preservation activities. Even considering the additional funding and the increased accomplishments, current cycle times are significantly longer than the expected average cycle times based on industry surveys. (Refer to Appendix B for Division details.)

As shown in Figure 19, based on the estimated budget for FY16, contract resurfacing cycle time was approximately 21 to 48 years on the primary and secondary system. With an additional appropriation in FY16, DOH received a significant funding increase. This increase is reflected in the cycle time under accomplishments (including work that has been completed and under contract). (See Appendix B for Division details.) **With the contract resurfacing budget increase of $58 million (FY16), cycle time decreased on primary roads by 2 years and on secondary roads by 9 years.**

Figure 19: Planned and Accomplished Cycle-time for Contract Resurfacing

Contract Resurfacing	Planned	Accomplished
Primary	1,688 lanes miles	1,817 lane miles
Percent of system treated	5%	5%
Cycle Time	21 years	19 years
Secondary	2,566 lane miles	3,102 lane miles
Percent of system treated	3%	2%
Cycle Time	48 years	39 years

Note: Accomplished[1] includes work that is completed or under contract

Figure 20 below highlights the cycle time for pavement preservation (a secondary system focused activity). With an additional appropriation of $35 million (FY16) the number of lane miles treated almost doubled and the cycle time was cut in half, going from 30 years to 15 years. While cycle times are still well above what is required to maintain the system to target LOS, the benefit cost of pavement preservation on the secondary system is evident.

Figure 20: Planned and Accomplished Cycle-time for Pavement Preservation

Pavement Preservation	Planned	Accomplished
Secondary system treated	4,142 lane miles	7,962 lane miles
Percent of system treated	3%	7%
Cycle Time	30 years	15 years

Note: Accomplished[1] includes work that is completed or under contract

[1]It is important to draw a distinction between the December 1, 2016 Report on Pavement Preservation Accomplishments and this report. That report showed a very different number for pavement preservation accomplishments because the purpose of that report was to calculate all pavement preservation activities that occurred during the past fiscal year, regardless of the year in which those activities were programmed, let, or funded. By contrast, this MOPAR report is focused on tracking accomplishments against the HMIP, for projects that were funded with money from each of the HMIP plan years to track accomplishments against the stated plan. These two reports are providing essentially, different answers because the questions asked are two different questions.

To identify the focus areas within each system, traffic levels for the primary and secondary system are evaluated. As shown in Figure 21, the largest improvement in condition since 2014 has come on highly travelled roads (ADDT 20,001 to 25,000+). While these are the most travelled primary roads, this makes up a very small portion of the statewide primary network (approximately 3%). In addition, modest material gains have been made throughout the primary network, across AADT ranges, since 2014. **Based on the AADT for primaries, increase funding and an expanded focus on 0-15,000 AADT roads (93% of the primary system) will have the greatest impact on the overall condition.**

Figure 21: Change in Primary Network Condition by Traffic Volume, CY2014 to CY2015

AADT Range	% of Network by LM	% Good	% Fair	% Poor
0-5,000	54%	+4.5%	-3.5%	+1.0%
5,001-10,000	28%	+2.5%	-4.2%	-1.7%
10,001-15,000	11%	+4.4%	-4.7%	-0.3%
15,001-20,000	4%	+9.5%	-9.6%	+0.1%
20,001-25,000	2%	+7.3%	-6.4%	+0.9%
25,000+	1%	+20.5%	-16.1%	+4.4%
Average		**+8.1%**	**-7.4%**	**+0.7%**

On the secondary network shown in Figure 22 below, most of the system consists of low volume roads (approximately 94%). While a decline in condition occurred across the network, the largest impact is due to the low volume roads (AADT 0-5000), with a decrease of 4%. **With additional preservation funds, NCDOT will expand focus on low secondary AADT roads (0-5,000 AADT) which impact the largest portion of the secondary system. This is important for improving the overall system condition and keeping a majority of the secondary roads from further deteriorating.**

Figure 22: Change in Secondary Network Condition by Traffic Volume, CY2014 to CY2015

AADT Range	% of Network by LM	% Good	% Fair	% Poor
0-5,000	94%	-4.0%	+2.9%	+1.1%
5,001-10,000	3%	-3.4%	+3.0%	+0.4%
10,001-15,000	1.3%	-3.6%	+4.4%	-0.8%
15,001-20,000	0.7%	-4.0%	+1.1%	+2.9%
20,001-25,000	0.3%	-4.4%	-1.1%	+5.4%
25,000+	0.7%	-5.0%	-1.7%	+6.7%
Average		**-4.1%**	**+1.5%**	**+2.6%**

5.3.6 Recommendations and NCDOT Actions

2a) Recommendation to provide consistent and sufficient funding for contract resurfacing and pavement preservation

- Support long term consistent funding for resurfacing and pavement preservation activities to meet and sustain LOS goals.
- Fully fund Contract Resurfacing at $523 million, an increase of $25 million compared with current funding.
- Increase pavement preservation funds to $120 million (an increase of $35 million compared with current funding). This recommended pavement preservation funding level is not sufficient to reach to LOS targets. It is anticipated that funding needs will gradually ramp up with production over time.

2b) NCDOT Actions

- At current funding levels, NCDOT will continue activities to maintain conditions on the interstate and primary system.
- With additional funding, NCDOT will expand focus on lower primary AADT routes (0-15,000) to improve overall system condition.
- With additional preservation funds, NCDOT will expand focus on low secondary AADT roads (0-5,000 AADT) which impact the largest portion of the secondary system. This is important for improving the overall system condition and keeping majority of the secondary roads from further deteriorating (or reaching poor condition).

5.4 Bridges

Section Summary – Bridges

This section describes the BMIP – the planning process, work performed by Divisions, and funding implications. A summary of key observations are provided below:

- State funding of $250 million annually meets the need for structurally deficient bridge improvement.
- However, to mitigate risks, managing deterioration of “high value” bridges is important
  - There are 185 high value bridges each with an estimated replacement cost between $20 million and $300 million.
  - If allowed, continued deterioration will require replacement of these bridges.
  - The number of substantially deficient bridges will increase and Bridge Program funding would be consumed at a faster pace, resulting in an inability to meet established SD targets by 2030.
  - High value bridge preservation of $30 million annually can significantly extend the service life – preventing them from becoming structurally deficient and in need of replacement.

5.4.1 Bridge Program and Bridge Maintenance Improvement Plans

In December of 2014, the Department proposed targets related to SD bridges along with funding options to achieve targets within 7, 10, or 15 years. In response, Session law 2014-100 Section 29.6 renamed System Preservation to Bridge Program, dividing the funds in this new program for improvements to culverts, SD and Functionally Obsolete[2] (FO) bridges. In addition, funds were provided in the FY2015 budget that closely corresponds with the Department's recommended 15 year plan of $250 million annually through 2030. As a result, NCDOT is committed to achieving the following SD targets by 2030 as shown in Figure 23:

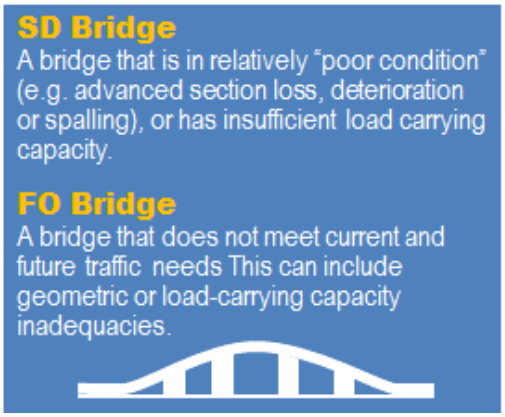


Figure 23: Bridge Program 15 Year Target for SD Bridges

System	2030 Percentage SD Target
Interstate	2%
Primary	6%
Secondary	15%
Statewide (weighted average)	**10%**

This shift in the Bridge Program underscores the importance of making use of available bridge funds to focus on SD bridges because:

- Maintenance costs are significantly higher.
- System reliability is reduced due to more lane closures for increased maintenance activities and more posted weight limits on state bridges.
- Federal law imposes penalties if the percentage of bridges that are structurally deficient on the national highway system is greater than 10%.

This new focus implemented the BMIP – a five year improvement plan for bridges that includes replacement and rehabilitation. The plan has three main parts – a baseline plan, an updated baseline, and dynamic plan to continuously track progress.

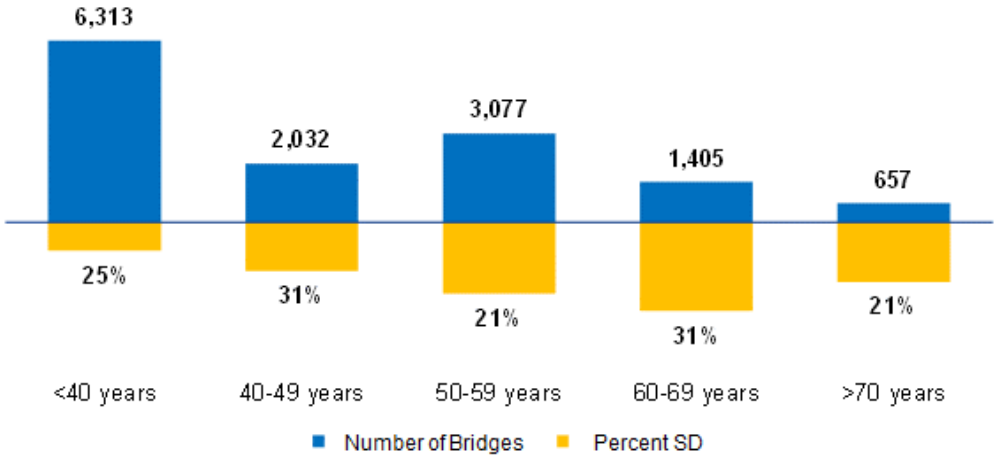
5.4.2 Bridges – Current Conditions and Trends

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 SD, or even necessarily FO. There are a number of bridges in excess of this age that are safely handling traffic and are not SD or FO. By contrast, there are a number of bridges that have become SD 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. A large portion of North Carolina's bridges are 50-70 years old and nearing or at the end of their useful-

[2] Structurally Deficient and Functionally Obsolete Bridges definitions are based on National Bridges Inspection Standards

design lives. Figure 24 below provides the number of bridges and percentage of structurally deficient bridges by age.

Figure 24: Structurally Deficient Bridges by Age



Currently, North Carolina's bridge portfolio consists of approximately 13,500 bridges statewide of which 13% are considered SD. As shown below in Figure 25, the percent of SD bridges statewide and by network have decreased since 2013. This decrease is further accelerated in 2015 and 2016 following a focus on reducing the number of SD bridges.

Figure 25: Percent SD Bridges Comparison, 2013 vs. Current (2016)

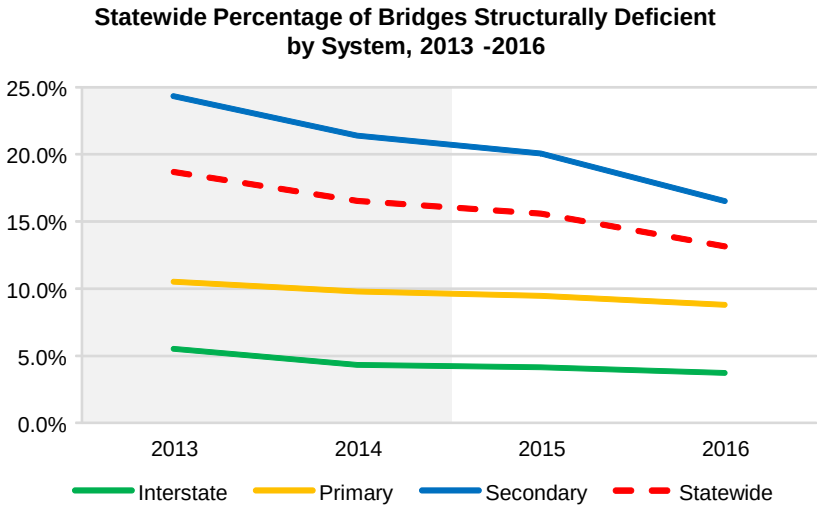
System / Year	2013	Current (2016)	Impact / Change
Interstate	6%	4%	-2%
Primary	11%	9%	-2%
Secondary	24%	17%	-7%
Statewide (weighted average)	**19%**	**13%**	**-6%**

5.4.3 Funding Levels and Condition Implications

The Department has made significant progress toward meeting the goals on the secondary system. As shown in Figure 26 below, 21% of bridges on the secondary system were rated SD in 2014. That number has been reduced to 16.5% in less than two years, in large part due to the Bridge Program funds provided in the 2015 budget, as shown in Figure 26 below. These funds were used in a concerted effort to improve the secondary system and the Department is now on track to meet the goals well within the 15 year target.

The majority of secondary bridges are low volume (by AADT) bridges that, compared to primary bridges, cost less to replace. As a result, the Department was able to make a major impact on the secondary system in the first year of the new Bridge Program. The Department will now begin to increase focus on the primary system in order to ensure statewide connectivity and achieve performance goals by 2030.

Figure 26: Impact of Bridge Program Since 2014



Since the implementation of the Bridge Program in December 2014, the percentage of SD bridges has been decreasing. Further, this decrease is accelerated in 2015 and 2016.

As shown in Figure 27, the Department will use approximately $447 million provided in the 2016 and 2017 Bridge Program to fund the replacement of approximately 500 bridges or 4% of the total bridge inventory. The number of bridges scheduled for replacement was made possible through the total increase of $139 million in the Bridge Program allocation, over this biennium. It is important to note that the condition impact does not account for additional bridges that will become structurally deficient during this period. This means the net impact of funding will be less than a 4% reduction.

Figure 27: Bridge Program Replacement Impact, 2015-2017

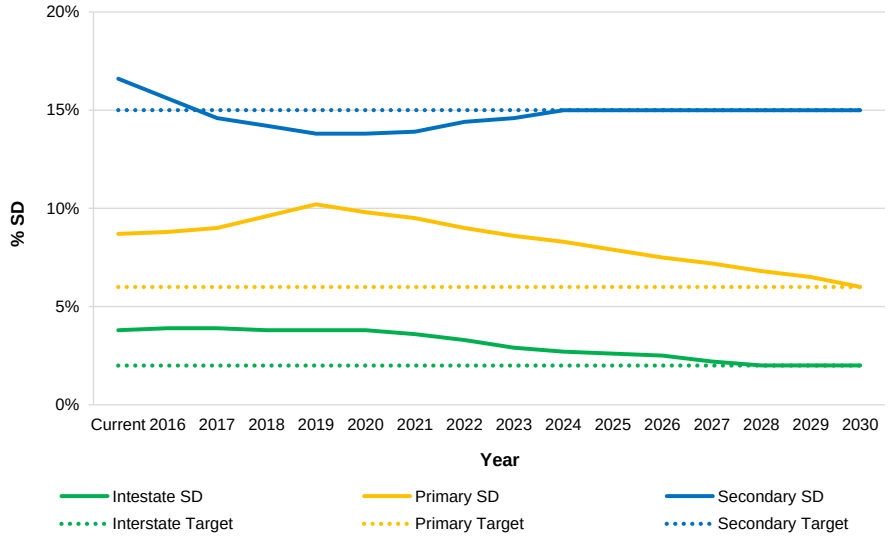
SD Bridges by Division - Plan, Production and Condition Impact (% SD)						
Division	**Total Bridges**	**SD Bridges**	**Current % SD**	**# Bridges Replaced**	**Projected % SD**	**Replacement Impact**
1	286	25	9%	6	7%	-2%
2	888	90	10%	25	7%	-3%
3	652	88	13%	30	9%	-4%
4	961	65	7%	22	4%	-3%
5	1,031	76	7%	28	5%	-2%
6	722	75	10%	28	7%	-3%
7	934	142	15%	36	11%	-4%
8	915	72	8%	26	5%	-3%
9	768	139	18%	33	14%	-4%
10	942	108	11%	16	10%	-1%
11	1,304	312	24%	81	18%	-6%
12	942	131	14%	31	11%	-3%
13	1,581	252	16%	95	10%	-6%
14	1,561	198	13%	51	9%	-4%
Statewide	**13,487**	**1,773**	**13%**	**508**	**9%**	**-4%**

Figure 28 below provides a long-term projection for SD bridges by network. The Bridge Program reflects the 15 year plan to reach target in 2030 at levels funded by the legislature. These

projections were developed based on forecasted projects. Therefore, the number of projects in a given year might fluctuate depending on repair needs and ongoing bridge deterioration. The Department is confident in the overall trends portrayed in Figure 28 below, as well as the ability to reach the end goal of target SD percentages in 2030 however, the exact percentage each year is subject to variance.

As discussed below and shown in Figure 28, the initial focus on secondary bridges will lead to a rapid decrease in secondary bridge SD percentages, with percentages reaching the 2030 target by 2018 and remaining below the SD target through the mid-2020s. Deterioration will cause an increase in primary SD bridges through 2020 prior to results being realized from the increased focus on the primary system (does not account for additional bridges becoming SD). The percentage of SD interstate bridges will fluctuate slightly between 3.5% and 4% through 2020, with a stepwise decrease to our target of 2% by 2030.

Figure 28: Bridge Program 15-Year Projection with SD Targets



The Department is confident in the overall trends and the ability to reach the end goal of target SD percentages in 2030.

However, this projection, based on recommended funding levels, does not account for additional bridges that will become SD during this period.

5.4.4 Managing Risks

While the Department is confident that funding for SD bridges is sufficient to reach performance goals, risks have been identified that could prevent these goals from being achieved. One such risk is associated with bridges that have disproportionately high replacement costs. There are 185 “high value” bridges that would each cost between $20 million and $300 million to replace. While these only account for 1.4% of the inventory by bridge count, their combined replacement cost of $9 billion dollars accounts for 15% of the total statewide asset 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. **The Department recommends additional funding of $30 million annually to minimize the number of high value bridges becoming structurally deficient and needing replacement.**

5.4.5 Recommendations and NCDOT Actions

3a) Recommendation to maintain the current funding for the Bridge Program (SD bridges) and to support bridge preservation needs

- Continue to fully fund Bridge Program needs of $250 million annually for 15 years. This funding is used for replacement and major rehabilitation activities to reach SD targets by 2030.
- Support a focus on high value bridges preservation of $30 million annually. Example of bridge preservation activities include painting steel beams, overlaying bridge decks, and repairing damaged concrete supports.

3b) NCDOT Actions

- Convene a work group with Division staff to reach a consensus on the methodology and tools to support the development and implementation of custom work plans for each bridge.
  - Identify appropriate preservation, rehabilitation or replacement activities
  - Identify routine maintenance items over the next 2 years
  - Program all SD bridges

5.5 Maintenance

Routine maintenance includes activities that are performed on a recurring basis and are associated with the maintenance and upkeep of the system. These maintenance activities generally can be viewed in two categories:

- **Planned routine maintenance activities** – These activities are planned 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.
- **Reactionary routine maintenance activities** – These are activities that cannot be planned and typically require an immediate response. Examples of these activities include pothole repair, removal of hazards, guardrail repair, among others.

5.5.1 Routine Maintenance Improvement Plan

The RMIP was established in 2016 as a planning and communication tool for Divisions to identify production goals and allocate funding based on targets and objectives. For example, a Division that identifies drainage issues would have a higher production and allocate a higher portion of funds for activities such as shoulder ditch maintenance or crossline repair. In summary, the RMIP provides details of Division allocation funds to maintain their assets and meet objectives. Key objectives of the RMIP are outlined below:

- **The RMIP holds divisions accountable to their budget allocation.** Each Division allocates 75% of their GMR funds to specific planned and reactionary activities in their plan. In addition, Divisions also commit to meeting their production goals expending their allocation by the end of the fiscal year. This unplanned allocation provides divisions with flexibility to support reactionary needs that cannot be anticipated during development of plans at the beginning of each year.

A review of 2016 plans indicate that planned and reactionary activities each account for 50% of the division maintenance funds. These planned and reactionary distributions varies across divisions as the needs and conditions are different. Recommended GMR funds will enable Divisions to increase the amount of planned routine maintenance activities and in the long term, contain and reduce the amount of reactionary activities. For example, if County Maintenance Engineers can increase spending to eliminate high and low shoulders, this will increase safety for the traveling public, extend the pavement life, and in turn, this will likely decrease the number of Citizens Action Requests (details described in 5.5.7).

- **The RMIP verifies that divisions are allocating funds to planned activities.** Plans drive performance and communicate where Divisions will spend their funds. The RMIP will also identify the type of activity (i.e. planned or reactive), and focus on defining and reducing unit cost. These plans will be developed by the Divisions and County Engineers relying on local/ historical knowledge to ensure work is being performed on routes and assets that will better the system condition.

5.5.2 RMIP Refinement and Practices

An established inventory of assets and their expected asset cycle time enables Divisions to determine where maintenance funds have the highest returns on investment. Moving towards an inventory approach to managing assets is one of the key drivers of success for asset management, and has been demonstrated with the Department's pavements and Bridge Program. However, the challenge is determining the amount of detail an inventory requires in order to be effective for planning needs. Unlike bridges and pavements, roadway assets are vast in number and some assets are difficult to assess because they are not in plain view.

As such, the Department is currently evaluating the amount of detail an inventory assessment should include to effectively support the RMIP objectives. In addition, the Department is also re-evaluating the maintenance condition assessment metrics and processes. These two efforts are intended to better support the link between the nature of the asset, maintenance needs and performance targets. **Workshops including Division staff will be held to reach a consensus on the inventory-methodology and tools that will be used to develop the RMIP. In addition, a report summarizing key findings and establishing the methodology and tools will be completed by June 1, 2017.**

The Department is committed to developing an inventory and activity cycle based approach to more accurately determine annual plan maintenance needs. In the absence of the complete methodology and set of tools, recommended funding and production goals for maintenance activities are currently based on a preliminary analysis of inventory and activity cycles combined with condition survey results.

5.5.3 Current Conditions

Roadway asset performance and condition has been relatively consistent between 2014 and 2016. Figure 29 below, provides a snapshot-in-time of the current condition of drainage, traffic roadside assets, and other structures (culverts), against their targets.

Figure 29: Target and Current Condition

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
DRAINAGE	Unpaved Shoulders	No drop-offs greater than 3 inches and no shoulders higher than 2 inches	95	93	94
	Ditches (Lateral Ditches)	No blocked, eroded, or nonfunctioning ditches	98	95	93
	Crossline Pipe (Blocked)	Greater than 50% diameter open	89	78	79
	Crossline Pipe (Damaged)	No damage or structural deficiency effecting functionality	93	93	90
	Curb & Gutter (Blocked)	No obstruction greater than 2 inches for 2 feet	95	93	95
	Boxes (Blocked or Damaged)	Grates and outlet pipes of boxes blocked <50%. Inlets and outlets of boxes are not damaged, and grates are present and not broken.	80	87	87

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
TRAFFIC	Long Line Pavement Markings	Present, visible	93	96	88
	Words and Symbols	Present, visible	71	91	91
			90	85	85
	Ground Mounted Signs	Visible and legible	97	97	95
	Pavement Markers	Present and reflective	78	61	N/A
	Overhead Signs	Visible and legible	96	95	N/A

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			90	85	80
ROADSIDE	Vegetation (Brush & Tree)	Freeways: 45' from travelway, 5' behind guardrail, not blocking signs; Non-Freeways: Vertical clearance of 15' over roadway and 10' back of ditch centerline or shoulder point	76	83	84
	Vegetation (Turf Condition)	Areas free of erosion	93	95	96
	Stormwater Devices (NPDES)	Functioning as designed	94	83	80
			85	80	
	Landscape Plant Beds	Achieving a score of 2 or higher on the inspection form	92	92	N/A
			90	90	
	Rest Areas & Welcome Centers	Condition Rating of 90	94	93	N/A

Target	Condition Element	Performance Measure	Interstate	Primary	Secondary
			85	80	75
OTHER STRUCTURES	NBIS Culverts	Condition Rating >= 6	99	98	97
			80	75	70
	Non-NBIS Culverts	Condition Rating = Good	96	94	85
			90	90	
	Overhead Sign Structures	Condition Rating = Good	98	97	N/A

The next sections will discuss key drivers of the RMIP and accomplishments for drainage, traffic and roadside activities, and separately the Structures Management Unit's efforts to prioritize bridge maintenance and funding implications.

5.5.4 RMIP and Preliminary Activity Cycle for Drainage, Traffic, and Roadside Activities

Based on best practices and field experience, preliminary findings of activity cycle time analysis are summarized in Figure 30. The selected activities in Figure 30 form a large part of highway maintenance activities for drainage, traffic and roadside. Unit costs for these activities are closely monitored as part of the efficiency and baseline unit cost efforts. Ultimately this list of activities and associated cycle times will be expanded to represent the complete roadway and bridge system (bridge maintenance is discussed in the following section 5.5.6).

Figure 30: Preliminary Activity Cycles

Select Activities	Activity Cycle Time
Replacing Drainage Pipe <= 48''	50 years
Replacing Drainage Pipe > 48''	50 years
Ditch Maintenance	8 years
Shoulder Maintenance	8 years
Installing Pavement Markings (Paint)	4 years
Installing Long Life Pavement Markings (Thermo, Poly)	10 years
Replacing Ground Mounted Signs	10 years
Mowing – Interstate	2.5 months
Mowing – Primary	2.5 months
Mowing – Secondary	2.5 months

5.5.5 Annual Need and Accomplishments for Drainage, Traffic and Roadside Activities

Annual needs for maintenance activities comprise of planned and reactionary maintenance components. Figure 31 below provides an estimate of the annual needs for planned activities including drainage, traffic and roadside. These estimates are based on preliminary analysis of the asset inventory and activity cycle along with the average unit cost from the Efficiency – Establishing Baseline Unit Pricing and Streamlining Project Delivery report.

Figure 31: Annual Maintenance Needs (status quo condition) and 2016 Accomplishments

Select Routine Maintenance Activities	Annual Need ($M)	Accomplishment ($M)	Accomplishment (%)	Needs vs. Accomplishment ($M)
Long Line Pavement markings (Long Life)	$20	$2	12%	$17
Pipe > 48"	$80	$10	12%	$70
Ditch Maintenance	$13	$3	20%	$10
Shoulder Maintenance	$29	$10	35%	$19
Pipes <= 48"	$41	$21	52%	$20
Ground Mounted Signs	$14	$8	53%	$7
Long Line Pavement markings (paint)	$17	$11	61%	$7
Signals	$21	$20	98%	$1
Mowing	$39	$47	120%	-
Total	**$274**	**$132**	**N/A**	**$151**

This annual highway maintenance needs comprise of $274 million for planned activities and $210 million to support reactionary expenditures. These reactionary expenditures are based on RMIPs developed by all 14 Divisions and the anticipated level of reactionary activities.

5.5.6 RMIP and Inspections for Routine Bridge Maintenance Activities

The Department performs a safety inspection on each of its bridges and NBIS culverts every 24 months. Through this process, maintenance needs are identified and prioritized by the Structures Management Unit. In addition, division bridge maintenance offices perform annual reviews of each bridge to identify maintenance needs. These bridge maintenance needs are categorized into the following priorities:

- **Critical Finds –** Needs that require immediate response to ensure safety, or restore necessary weight limits.
- **Priority Maintenance –** Needs that may result in a safety concern or reduce the posted weight limit in the near term.
- **Planned and Routine Maintenance –** Needs, that if addressed, will slow deterioration and reduce future lifecycle costs and unplanned service disruptions.

Division bridge maintenance crews are responsible for addressing these needs with their GMR allocation. In addition, repairs to large non-inventory pipes and culverts are also funded through the GMR allocation. Recent allocations have been sufficient to address Critical Finds, Priority Maintenance, and emergency pipe replacements, but most planned and routine maintenance needs have lacked attention because of their relative low priority. The recommended additional GMR funding will enable the Division bridge maintenance crews to address these planned routine maintenance needs. An increase in planned activities will lead to the following benefits:

- Slowed deterioration and reduced future funding needs for structurally deficient bridges
- Reduced needs for critical and priority repairs
- Decrease interruptions to planned maintenance activities
- Increase overall efficiency of maintenance efforts

5.5.7 Trade-off Analysis and Managing Risks

The Department understands the importance of customer service and citizen's requests and legislative compliance are a priority. However, costs related to these responses also influence overall maintenance expenditures and planned accomplishments. Pursuant to NCGS 136-18.05 and the implementation of Responsiveness, Efficiency, Performance, Oversight, Restructure, and Transparency (REPORT) DOT program, the Department is closely tracking and quantifying activities and associated expenditures.

The Citizen Action Request System (CARS) records citizen's requests into a centralized work order system and in timely manner, sends information to appropriate field crews. CARS Action Requests (ARs) are routed to the relevant unit within the Department. Each county or division unit develops an internal system for distributing ARs, following up with field forces and the requesting party/ motorist, and then after repairs are completed, there is a process to document and close the AR. The Department received and in a timely manner completed approximately 28,000 ARs from January through November 2016.

5.5.8 Recommendations and NCDOT Actions for Maintenance

4a) Recommendation to increase routine maintenance funding to support planned and reactive activities

- Recommended funding to support highway maintenance of $734 million, an increase of $266 million compared with current funding. This comprises of:
  - Highway Maintenance: $483 million
  - Routine Bridge Maintenance: $90 million
  - Statewide Programs: $131 million
  - High Value Bridge Preservation: $30 million
- This estimated funding represents a portion of the need and is based on preliminary analysis of roadway inventory and cycle time. The recommended funding do not raise conditions to LOS goals. With increased funds, the Department is better equipped to focus on planned maintenance activities that help to slow the asset deterioration and avoid much costlier attention at a later

4b) NCDOT Actions

- Convene a work group with Division staff to reach a consensus on the methodology and tools to support the RMIP, this includes developing an asset inventory and asset cycle time policies.
- Conduct follow up regional meetings with Division and County staff to refine implementation of the RMIP and tailor individual plans to division and regional priorities and needs.
- Reevaluate the maintenance condition assessment to align with objectives of the RMIP, and inventory and asset cycle time approach.

6 Delivering Maintenance Activities

Pursuant to NCGS 136-44.3 Sections 3 and 4, the following sections examine how well the Department maximizes efficiency and distributes staffing. In addition, this section discusses overall baseline unit pricing efforts as they relate to broader initiatives to maximize efficiency. However, for details regarding establishing the baseline unit pricing and monitoring efforts refer to analysis in the quarterly reports presented to the JLTOC.

6.1 Staffing Levels and Distribution

The staffing distribution across 14 Divisions is provided in Figure 32. To examine staffing efficiency, the number of lane-miles, population served, and areas served per employee (i.e. 2016 filled position) are also provided.

Figure 32: Division Staffing

Division	2014 Filled Positions	2016 Filled Positions	2014-2016 Reduction	Lane Mile (L-M)	L-M/ Employee	Population	Population Served/ Employee	Area (square -mile)	Area Served/ Employee
1	515	456	59	10,910	24	260,476	571	5,273	12
2	443	383	60	10,816	28	497,857	1,300	4,168	11
3	446	373	73	12,063	32	709,928	1,903	4,432	12
4	531	433	98	13,733	32	592,031	1,367	3,482	8
5	565	476	89	14,950	31	1,551,516	3,259	3,219	7
6	477	400	77	13,325	33	677,187	1,693	4,008	10
7	452	400	52	12,129	30	931,929	2,330	2,458	6
8	494	442	52	14,588	33	528,904	1,197	4,093	9
9	428	408	20	10,970	27	760,887	1,865	2,185	5
10	469	438	31	11,424	26	1,540,047	3,516	2,444	6
11	516	462	54	12,475	27	368,569	798	3,314	7
12	437	389	48	13,102	34	753,603	1,937	2,351	6
13	507	454	53	10,862	24	507,371	1,118	3,152	7
14	560	482	78	10,502	22	362,497	752	4,040	8
Average	489	428	60	N/A	29	N/A	1,686	N/A	8
Total	6,840	5,996	844	171,849	N/A	10,042,802	N/A	48,619	N/A

Key highlights include:

- There has been an overall decrease of 844 filled positions since 2014, representing a reduction of approximately 12%
- Overall trends for lane-miles, population served, and areas served per employee are consistent with regional characteristics such as the coast/Sandhills, Piedmont or Mountain. A few examples of the trends based on these regions are highlighted below:
  - Divisions that manage fewer lane miles per employee such as Division 1, have a higher area (square miles) covered by each employee
  - Divisions 13 and 14 also manage fewer lane miles per employee. These Divisions experience high levels of snow which requires significant resources to manage, and further, these Divisions are predominantly rural with travel times greater than would be anticipated for similar distances in other parts of the state due to the winding nature and steeper grades of the highway.
  - Division 10 is predominantly urban and has a lower lane-mile per employee however, the population served per employee (3,516 people served per employee) is the highest across divisions.

While this comparison of Divisions helps to understand overall trends, in order to ensure appropriate distribution levels, Divisions will incorporate staffing levels with the RMIP. The objective of this study is to align target LOS and production with the number of employees and contract forces needed. **Division Engineers will be asked to review staffing needs in conjunction with the submission of the RMIP (June 1, 2017) to ensure the plans drive division staffing levels. The Chief Engineer will review staffing needs by August 1, 2017.**

6.2 Direct and Indirect Cost Analysis for Maintenance Activities

The Financial Management unit views maintenance expenses in two categories– direct and Indirect. Direct cost is the actual expense of delivering each Project. Indirect costs include administrative expense, statewide technical support and division/ region support. Indirect costs are funded by both administrative and encumbrance budgets and can be further broken down into three types:

- **Enterprise and oversight costs –** Approximately $15 million can be associated to the Maintenance program for Department wide administrative expense. This includes Financial, IT, General Services, Inspector General, DOH Administration, Operation Administration and State Asset Management.
- **Central shared support costs** – Central units provide project support to Divisions for all types of maintenance projects. The Maintenance portion of shared support costs are is approximately $40 million.
- **Division/ region support costs** – This component represents indirect costs for field activities, and is approximately $87 million. This also includes the cost of division administrative support and management of the Maintenance program as well as costs for regional units that provide support to the Divisions e.g. geotechnical, location and surveys

Of the approximate total indirect cost of $142 million, roughly 11% is related to statewide administrative cost and 89% is project related.

Estimates for indirect costs, developed by the Financial Management Unit, represent a snapshot in time and are more appropriately viewed as a range rather than a single, fixed value. When fully accounted, the Department's SAP system indicates that indirect costs represent approximately 11-13% of spending on delivering highway maintenance and operations activities. **The Department is currently working with a financial services contractor to refine and simplify indirect cost accounting methods. These systems are expected to be in place by May 1, 2017.**

6.3 Baseline Unit Cost

In accordance with Session Law 2015-241, Section 29.14.(b), Baseline unit costs for principal work activities and transportation goods were established in the December 1, 2015, report titled Efficiency – Establishing Baseline Unit Pricing & Streamlining Project Delivery. These include the following:

- Contract resurfacing
- Pavement preservation
- Bridge replacement
- 10 planned maintenance work functions
- FOB goods most commonly used by maintenance forces

At the end of each quarter, the Department submits a report to the JLTOC and Fiscal Research Division to identify quarterly unit cost results for each Division and include explanations as to why certain Divisions exceeded the established baseline unit prices and what actions they are taking to address any noncompliance. In reviewing the data, the Department is confident that positive progress continues to be made in regards to Highway Divisions conducting their operations within 10% of established statewide baseline costs.

Since tracking and reporting on these costs began in the fall of 2015, the quality of data captured and reporting efforts has improved, and Divisions have placed emphasis on meeting production rates and achieving the required outcomes. Data continues to be analyzed and used to refine cost targets and expectations for the coming year as the Department continues to push for efficiency in its operations. As such, SAS is reevaluating the established baseline unit costs based on data collected in the first year.

6a) NCDOT Actions

- Staffing needs will be analyzed and adjusted in conjunction with the submission of the RMIP by Divisions (June 1, 2017). The Chief Engineer will review staffing needs by August 1, 2017.
- The Department is currently working with a financial services contractor to refine and simplify indirect cost accounting methods. These systems are expected to be in place by May 1, 2017.

7 Safety and Mobility Program Update

A high-quality highway network is an important part of a healthy economy. Investments by previous generations of North Carolinians have been instrumental in putting in place national freight transportation routes for goods and services that ensured sustained economic growth and competitiveness on both a national and international scale. Therefore, inadequate investment in our maintenance program will have a negative impact on the economic growth of the state. This chapter evaluates statewide safety and mobility conditions and concludes with recommendations to expand these programs.

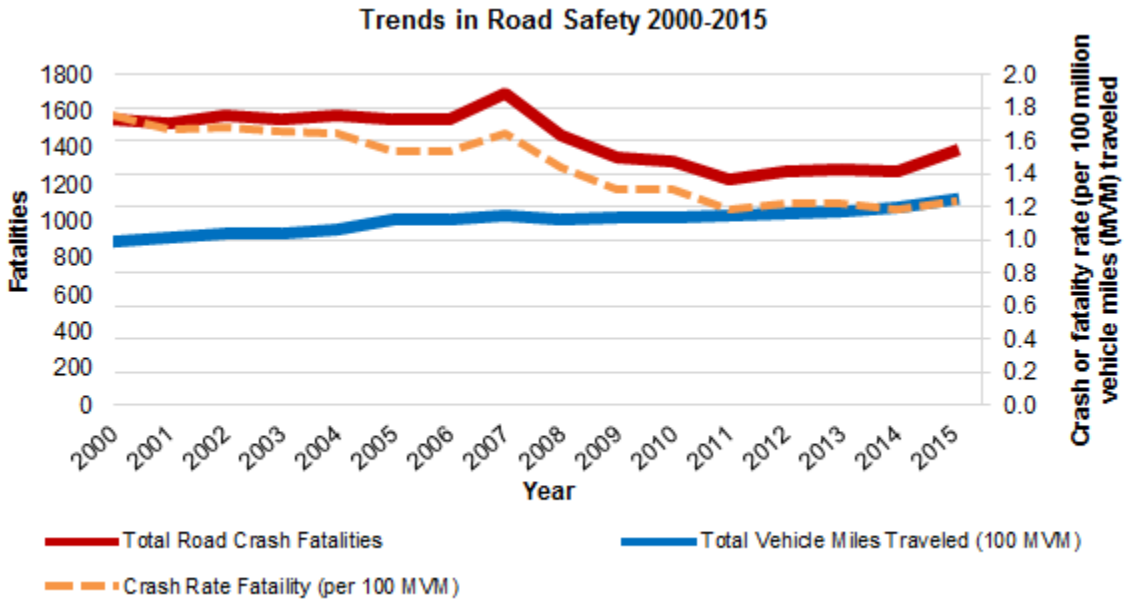
7.1.1 Improving Safety for Motorists

Safety is the number one priority and is central to NCDOT's role across the state. NCDOT is an integral part of the State Executive Committee for Highway Safety, the Strategic Highway Safety Plan and the implementation of the legislative Secondary Road Safety Report. **The Department's safety program is funded through a combination of federal aid and state funds totalling approximately $72 million per year.** Data indicates that the strategy of targeting localized engineering solutions in conjunction with statewide awareness campaigns has been effective in improving safety for the traveling public and working-crews.

As shown in Figure 33, over the past decade, overall safety has improved even with an increased number of miles travelled. However, as forecasted and consistent with national trends, North Carolina observed an increasing fatality rate and more severe crashes in 2015[3]. National experts indicate that distracted driving, impaired driving, and speed are all major factors contributing to this trend.

[3] At the time of writing this report, complete data for 2016 was not readily available.

Figure 33: Long-term Trends in Road Safety



The safety program supports a wide range of activities from tracking and monitoring of hazardous locations, to designing and implementing engineering solutions that minimize hazards through elimination, protection and/or warnings. Safety concerns and types of projects are shown in Figure 34 below (See Appendix C for Division statistics). However, in addition to engineering solutions, strategic public awareness campaigns and law enforcement efforts are essential to improving safety. As such, DOH actively works with other units within NCDOT and other state agencies to coordinate such efforts including the Governor's Highway Safety program and Vision Zero.

Figure 34: Safety Concerns and Example Types of Safety Projects

Safety Concerns	Example Types of Projects
Intersection Improvements	■ Traffic Signals (new & upgrades) ■ Roundabouts ■ All Way Stops ■ Turn Lanes ■ Channelization ■ Pedestrian Refuge Islands
Corridor Improvements	■ Median Modifications / Left-Overs / Synchronized Street Configuration ■ Shoulder and Lane widening ■ Guardrail and roadside hardware ■ Rumble strips ■ Curve improvements
Systemic Features	■ Median Barrier ■ Curve Warnings

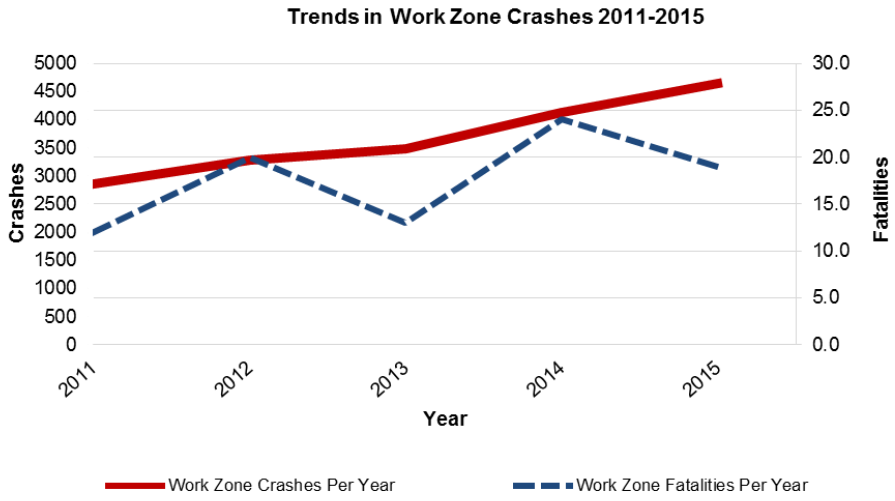
Spot safety projects target specific location issues and are not typically funded through the State Transportation Investment (STI) program. Over the past five years, 611 spot safety projects have been implemented. These projects have a one-time cost of $50 million and have resulted in a significant decrease in the number of crashes, leading to a benefit to cost ratio of approximately 14 to 1. This means crash costs are reduced $14 for every dollar invested in location-specific safety engineered solutions. This program investment demonstrates the effective use of our spot safety funds. Given the priority and benefits of this program, the Department is recommending continued funding to maintain this program.

B/C 14:1 | **Our safety program yields a 14 to 1 benefit to cost ratio**

7.1.2 Improving Safety for Road-Crews

NCDOT recognizes the importance of prioritizing the safety of road crews. Figure 35 below compares work zone crashes and fatalities over the past five years. Work zone crashes have been increasing since 2011. However, the number of fatalities in work zones decreased in in 2015, and can be attributed to the increasing number of work zones for maintenance and/ or construction activities.

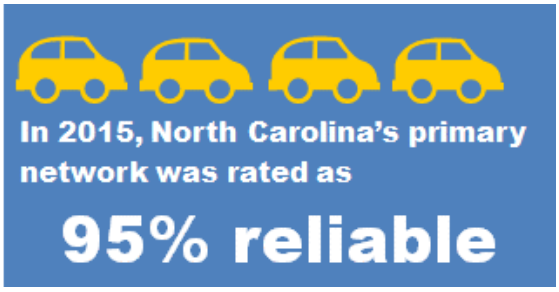
Figure 35: Work Zone Crash Trends



In response to this trend, NCDOT has implemented multiple initiatives in work zones:

- Launching the Work Zone Safety Program aimed at educating motorists about the importance of work zone safety and protecting travelers and working-crews.
  - The Work Zone Safety Program designated April 2016 as Work Zone Safety Awareness Month and promotes “Drive Smart. Do Your Part,” among other campaigns.
- Expanding night time lighting
- Increasing high visibility markings and masking
- Using digital signage to adjust speed limits to active work zone needs

7.2 Improving Mobility for Motorists

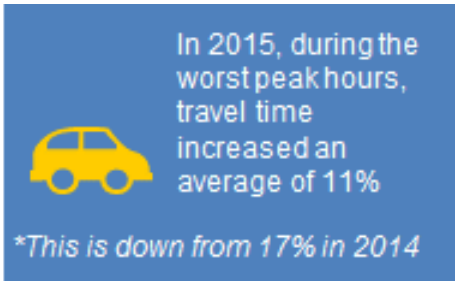


North Carolinian's living in urban areas lose an average of 36 hours and $815 per year to traffic congestion costs.[4] An efficient transportation network means faster, more reliable travel times for both people and goods. For example, with predictable travel times manufactures are able to reduce distribution costs, and in turn, this may lead to cost savings for consumers.

This section assesses mobility conditions using three key metrics to evaluate the most congested routes. Each metric provides insights into different aspects of congestion and should be viewed together to provide a more complete picture. The three industry metrics are outlined below:

- **Travel Time Index** – A measure of congestion that compares the additional time needed on the worst day to a typical day.
- **Average Number of Congested Hours per Day –** A measure of the number of hours that speeds drop below a threshold of 45 miles per hour on interstate routes. Often times this method may overlook seasonal changes in congestion, differences in travel between the morning and afternoon periods, and congestion patterns for weekday and weekend travel.
- **Level of Travel Time Reliability (LOTTR) –** A measure travel time variability or reliability. A high LOTTR means that travel time is variable, and likely not reliable during different times of the day. While a low LOTTR typically means travel time is reliable, it can also mean that roads are always congested regardless of the time of day and travel time does not vary.

7.2.1 Congestion Levels and Travel Time Index



North Carolina's most heavily travelled highways carry 67% of the total interstate traffic. Measuring congestion on these routes is key to better understanding how the network is performing across the state. To this end, the Department uses an index for evaluating level of congestion by comparing peak period travel time with free flow travel time, as described in Figure 36. For example, if a 20-minute trip takes 30 minutes, the travel time index is 1.50 and is considered "Poor."

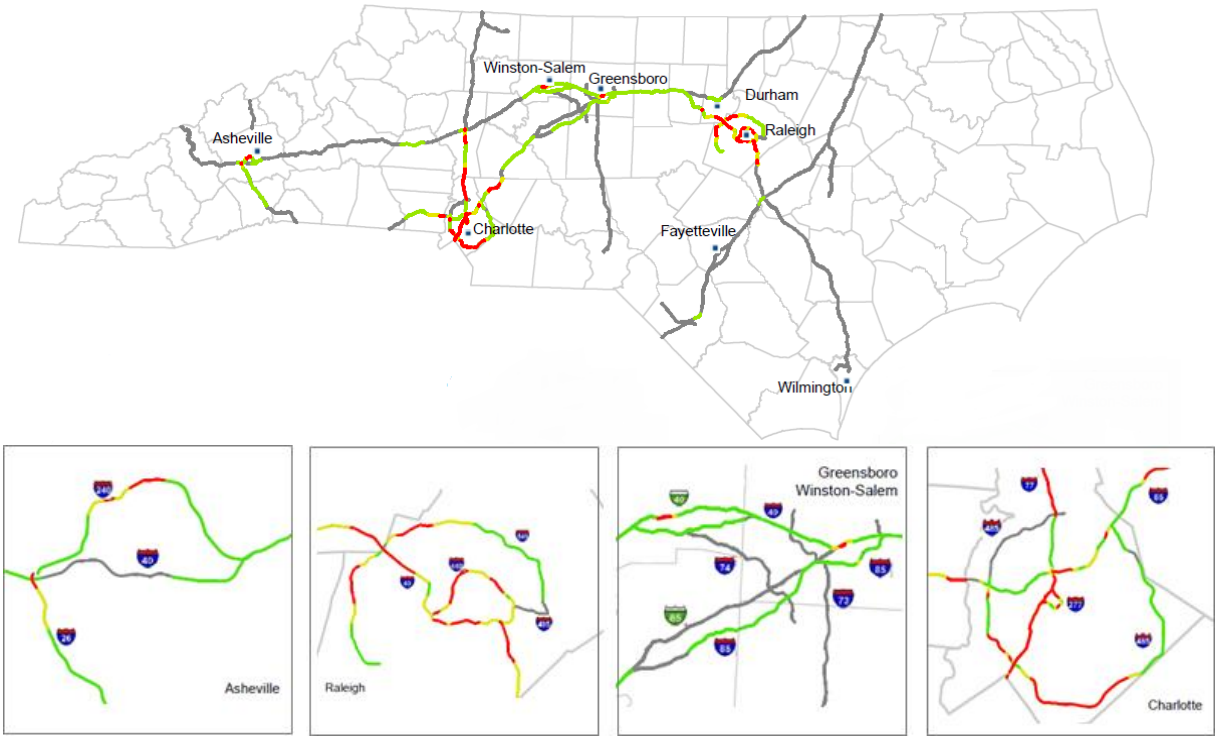
[4] Texas Transportation Institute, 2014 Urban Mobility Report

Figure 36: Congestion Level and Travel Time Index

Congestion Level	Additional Travel Time/Travel Speed	Travel Time Index	
None: **No Congestion**	■ No additional time ■ Posted Speed Limit (PSL)	1.0	
Great: **Little to moderate congestion**	■ Congestion increases trip time by less than 15% ■ Travel speed within 15% of PSL	<1.15	
Good: **Moderate to Severe**	■ Congestion increases trip time by 15%-30% ■ Travel speeds 15%-30% below PSL	1.15 to 1.30	
Poor: **Severe Congestion**	■ Congestion increases trip time by over 30% ■ Travel speeds 30% below PSL	>1.30	

During the most congested hour, 76% of interstate roads experienced little to moderate levels of congestion, 11% experienced moderate to severe congestion, and 13% experienced severe congestion. Much of the congestion is concentrated in urban and suburban areas including Raleigh, Charlotte, Asheville, Greensboro and Winston-Salem. An overview of the statewide congestion levels on the most heavily travelled interstate routes is highlighted in Figure 37 below.

Figure 37: Levels of Traffic Congestion on Heavily Travelled Interstates, 2015



7.2.2 Average Number of Congested Hours

Some places experience congestion only during the morning and evening “rush” hour. Other areas experience congestion for a significant part of the day. Figure 38 shows the most congested interstate locations when speeds drop below the 45 miles per hour threshold. As

confirmed by the travel time index and the number of congested hours, motorists travelling on I-77 in uptown Charlotte and Iredell County experience some of the most severe congestion in the state, with an average of up to 4.5 hours of congestion per day.

Figure 38: Top 10 Locations with the Highest Average Number of Congested Hours in 2015

Rank	Road	Direction	Location	County	Miles	Avg. # of Congested Hours per Day
1	I-77	NORTH	US 70 - I-40 / EXIT 49-51	IREDELL	2.82	15.0
2	I-77	NORTH	I-485 - WOODLAWN RD / EXIT 2-6	MECKLENBURG	4.55	4.5
3	I-77	SOUTH	REMOUNT RD - I-277/US 74 / EXIT 8-9	MECKLENBURG	1.64	4.5
4	I-77	SOUTH	GILEAD RD - NC 73 / EXIT 23-25	MECKLENBURG	9.54	4.1
5	I-77	NORTH	GILEAD RD / EXIT 23	MECKLENBURG	4.34	4.1
6	I-77	SOUTH	GRIFFITH ST / EXIT 30	MECKLENBURG	6.93	3.0
7	I-77	SOUTH	NATIONS FORD RD - CLANTON RD/ EXIT 5-7	MECKLENBURG	4.33	2.6
8	I-485	EAST	RAE RD - US 521 / EXIT 59-61	MECKLENBURG	2.37	2.4
9	I-77	NORTH	I-277/NC-16/W 11TH ST/BROOKSHIRE FWY - LASALLE ST / EXIT 11-12	MECKLENBURG	1.22	2.0
10	I-77	NORTH	NC-73 / EXIT 25	MECKLENBURG	1.76	2.0

Note: US-70 /I-40 interchange is under construction with reduced speeds throughout the work zone

7.2.3 Level of Travel Time Reliability

Travel time reliability is typically one the highest priorities for motorists. The Level of Travel Time Reliability (LOTTR) index represents how poorly a road performs on a “bad day”. For example, if it takes a motorist twice the time to travel on a bad day compared with a good day, then the LOTTR will be 2.0. FHWA considers a LOTTR higher than 1.5 unreliable.

Figure 39: Top 10 Least Reliable Interstate Locations in 2015

Rank	Road	Direction	Location	County	Miles	LOTTR
1	I-77	North	I-485/G MARTIN-ARROWOOD /EXIT 2 - 3	Mecklenburg	2.12	3.4
2	I-77	South	LANGTREE RD/EXIT 31	Iredell	1.66	3.3
3	I-77	South	I-277/US-74/EXIT 9	Mecklenburg	0.86	3.1
4	I-540	East	US-70/GLENWOOD AVE/EXIT 4	Wake	1.45	3.1
5	I-40	East	AIRPORT BLVD/EXIT 284	Wake	1.25	3.0
6	I-40	West	US-70/EXIT 309	Wake	0.82	2.9
7	I-85	North	STATESVILLE AVE/EXIT 39	Mecklenburg	0.74	2.8
8	I-77	South	NC-73/EXIT 25	Mecklenburg	3.02	2.8
9	I-85	North	NC-73/EXIT 55	Cabarrus	1.39	2.7
10	I-485	Inner	US-521/EXIT 61	Mecklenburg	2.52	2.6

The least reliable interstate locations in Figure 39 reconfirms not only that I-77 is a severely congested route but on a “bad” day, motorists can experience travel three times longer than compared with a “good” day. This variability in travel time is also exhibited in fast growing areas of uptown Charlotte and Iredell County. In addition, areas around Raleigh are also experiencing variable travel time.

7.2.4 Notable congestion improvements over the past 2-3 years

- **I-485/ Charlotte** – Completion of construction on portions of I-485 has led to less congestion in Mecklenburg County.
- **Fortify**[5] – NCDOT's significant deliberate efforts to mitigate the effect of construction related delays in the "Fortify" work zone has contained work zone related congestion to manageable levels. In fact, since 2013 severe congestion has decreased in Wake County and specifically on I-40.

7.2.5 Responding to Emergency Events and Incidents

NCDOT has demonstrated time and again that it has the skills and readiness to respond to emergency events with minimal impact on the ability to deliver its core mission. This operational resiliency was demonstrated most recently through the response to Hurricane Matthew in October 2016, which was a historic event in terms of rainfall and number of flooded river basins. At the height of the storm there were over 600 road closures, with 90% of the eastern division staff engaged in the response efforts (approximately 2,800 employees). Emergency crews worked around the clock to reopen the I-95 corridor by the start of the following week – just a few days later. Contributions from FHWA and FEMA are instrumental in NCDOT providing such a response which allows the State to rebound rapidly from emergency events.

In addition to these large-scale emergency events, the Department also responds to incidents on the roadway. Clearing accidents 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. In 2015, the State's average incident clearance time was 71 minutes (Refer to Appendix C for division statistics). This clearance time represented an increase from previous years. When compared to the U.S. target of "90% of incidents cleared within 90 minutes", NCDOT is currently clearing 81% of incidents within 90 minutes. NCDOT is conducting SHRP-2 Incident Responder training to increase the number of first responders who have been educated on the methods and benefits of quick clearance. In addition, NCDOT is also working towards establishing multi-agency shared incident clearance goals for quicker clearance of traffic crashes through coordinated efforts.

7a) NCDOT Actions

- Continue to expand traffic signalization and timing – Adjust signal timing to improve traffic flow, travel time reliability, and reduce congestion costs.
- Deploy use of Intelligent Transportation Systems – Expand tools and operations that provide travelers with real time information.
- Establish multi-agency quick clearance goals – Create multi-agency shared incident clearance goals to expedite clearance of crashes.
- Enhance traffic management plans – Develop plans with stakeholders for all urban work zones.

[5] (Fortify begins at Exit 301(I-440) on I-40 and continues until Exit 293 (I-440/US-1/64). On I-440 Fortify begins at Exit 14 (I-495/US-64/264) and continues to Exit 16 (I-40).)

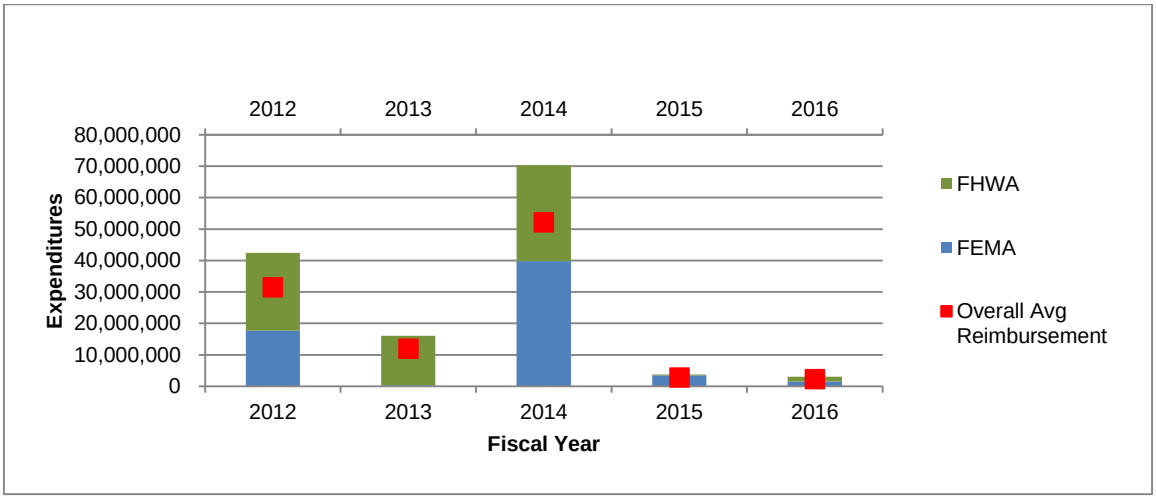
8 Appendices Contents: Division Details

9 Appendix A: Needs and Recommended Funding

9.1.1 Declared events

Over the last 5 years the Department has expended an average of roughly $26 million per year on declared events ($12 million for FEMA declared events, and $14 million related to FHWA declared events) as shown below.

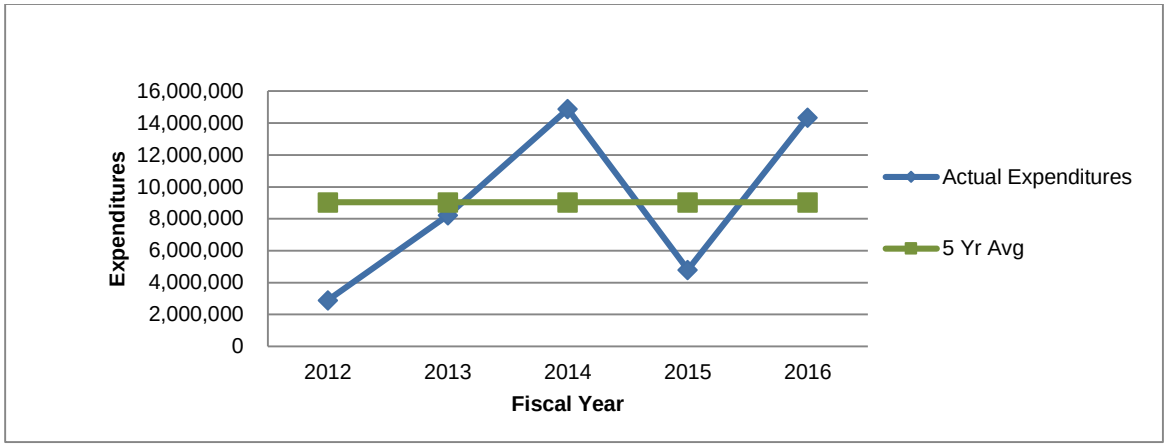
Figure 40: Declared event expenditures



9.1.2 Non-declared events

Non-declared events are smaller events and do not qualify for federal reimbursement. Over the previous 5 years, the average annual cost related to non-declared events has been roughly $10 million (and ranges between $3 million to $15 million). The unpredictable nature of emergency events highlights the challenge with budgeting maintenance funds.

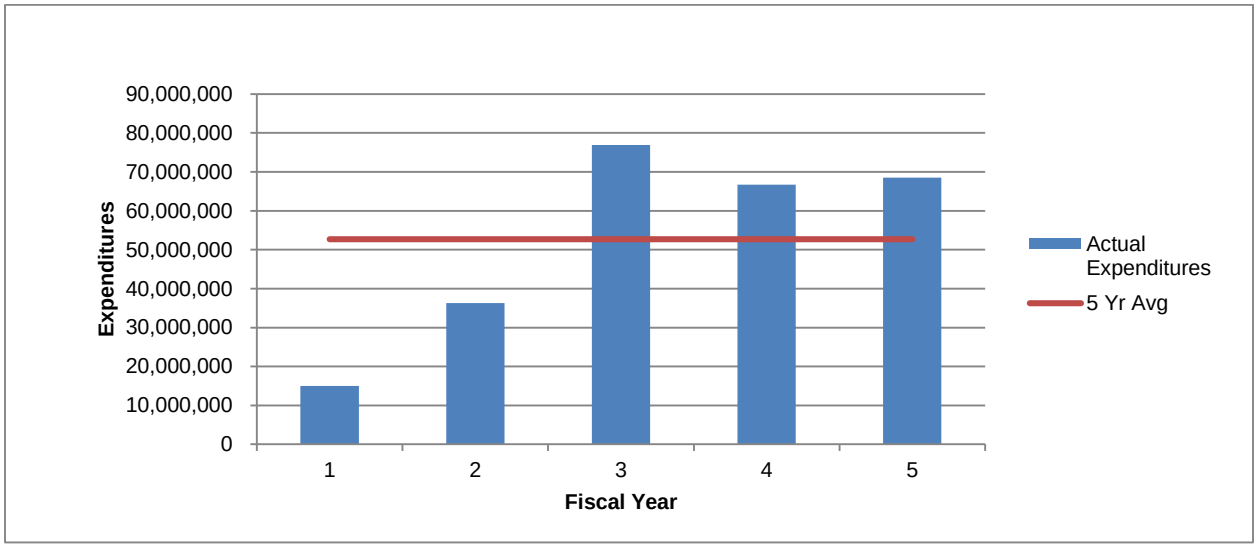
Figure 41: Non-declared event expenditures



9.1.3 Snow and ice

Snow and ice expenditures can be highly variable from year to year. The average expenditure for the previous five years is approximately $50 million with yearly expenditures ranging from $15 million to $77 million, as shown in Figure 42.

Figure 42: Snow and ice expenditures



Historically, $30 million has been allocated at the beginning of each fiscal year for snow and ice activities. However, as the average expenditures per year increases, the allocation of funds has increased as well. For example, the snow and ice allocation for the current fiscal year is $68 million. Of that amount, just over $13 million was required to cover the overdraft from the prior year, leaving approximately $55 million to cover activities in the current fiscal year.

10 Appendix B: Pavements

Figure 43: Interstate System Pavement Condition, 2013-2015

Year	Division	Total LM	Good LM	Fair LM	Poor LM	% Good	% Fair	% Poor	Weighted Average Rating
2013	1	30	30	0	0	100%	0%	0%	98.2
2014	1	30	30	0	0	100%	0%	0%	97.5
2015	1	30	30	0	0	100%	0%	0%	98.5
2013	3	343	263	70	10	77%	20%	3%	88.0
2014	3	340	299	23	18	88%	7%	5%	93.1
2015	3	340	279	34	27	82%	10%	8%	90.8
2013	4	609	469	114	25	77%	19%	4%	87.9
2014	4	609	497	77	36	81%	13%	6%	89.6
2015	4	619	516	90	13	83%	15%	2%	91.0
2013	5	840	776	61	4	92%	7%	0%	93.8
2014	5	838	795	43	0	95%	5%	0%	94.5
2015	5	823	741	70	13	90%	8%	2%	92.6
2013	6	446	437	8	0	98%	2%	0%	94.1
2014	6	448	387	53	8	86%	12%	2%	93.0
2015	6	445	411	27	7	92%	6%	2%	95.1
2013	7	876	819	54	3	93%	6%	0%	91.6
2014	7	870	809	57	4	93%	7%	0%	93.6
2015	7	872	838	30	4	96%	3%	0%	95.0
2013	8	315	291	24	0	92%	8%	0%	95.2
2014	8	318	298	20	0	94%	6%	0%	96.3
2015	8	318	290	28	0	91%	9%	0%	95.2
2013	9	580	494	73	13	85%	13%	2%	89.5
2014	9	601	548	44	10	91%	7%	2%	92.9
2015	9	614	543	63	8	88%	10%	1%	93.0
2013	10	759	554	149	56	73%	20%	7%	83.5

Year	Division	Total LM	Good LM	Fair LM	Poor LM	% Good	% Fair	% Poor	Weighted Average Rating
2014	10	752	576	147	30	77%	19%	4%	86.4
2015	10	828	675	126	27	82%	15%	3%	89.2
2013	11	199	167	21	10	84%	11%	5%	88.0
2014	11	199	176	19	4	89%	9%	2%	91.4
2015	11	198	198	0	0	100%	0%	0%	96.3
2013	12	441	393	41	7	89%	9%	2%	93.8
2014	12	441	391	48	1	89%	11%	0%	94.9
2015	12	440	417	12	11	95%	3%	3%	96.8
2013	13	505	474	15	16	94%	3%	3%	92.8
2014	13	506	494	10	2	98%	2%	0%	95.4
2015	13	501	489	8	4	98%	2%	1%	96.7
2013	14	272	218	10	44	80%	4%	16%	81.6
2014	14	272	268	4	0	99%	1%	0%	95.5
2015	14	272	262	6	4	96%	2%	2%	96.1

Figure 44: Primary System Pavement Condition, 2013-2015

Year	Division	Total LM	Good LM	Fair LM	Poor LM	% Good	% Fair	% Poor	Weighted Average Rating
2013	1	3,309	2,533	615	161	77%	19%	5%	88.4
2014	1	3,284	2,356	812	116	72%	25%	4%	87.5
2015	1	3,258	2,466	707	85	76%	22%	3%	88.4
2013	2	2,872	2,036	585	250	71%	20%	9%	85.7
2014	2	2,902	1,851	803	248	64%	28%	9%	83.4
2015	2	2,917	1,975	662	280	68%	23%	10%	84.3
2013	3	3,034	1,979	745	310	65%	25%	10%	83.8
2014	3	3,019	1,854	847	318	61%	28%	11%	82.0
2015	3	3,033	1,971	716	347	65%	24%	11%	83.1
2013	4	3,202	2,240	826	136	70%	26%	4%	85.8
2014	4	3,297	2,009	1,129	159	61%	34%	5%	83.8
2015	4	3,298	2,066	1001	230	63%	30%	7%	83.7
2013	5	2,666	1,912	627	126	72%	24%	5%	86.3
2014	5	2,660	1,660	871	129	62%	33%	5%	83.8
2015	5	2,698	1,920	649	130	71%	24%	5%	86.0
2013	6	3,028	2,210	590	228	73%	19%	8%	85.6
2014	6	3,057	2,072	801	184	68%	26%	6%	85.6
2015	6	3,066	2,203	685	178	72%	22%	6%	86.6
2013	7	1,917	1,533	326	58	80%	17%	3%	90.5
2014	7	1,912	1,517	369	26	79%	19%	1%	89.7

Year	Division	Total LM	Good LM	Fair LM	Poor LM	% Good	% Fair	% Poor	Weighted Average Rating
2015	7	1,915	1,593	286	35	83%	15%	2%	90.2
2013	8	2,696	1,950	608	139	72%	23%	5%	87.1
2014	8	2,759	1,804	777	178	65%	28%	6%	84.0
2015	8	2,760	1,691	866	202	61%	31%	7%	82.4
2013	9	1,648	1,259	283	105	76%	17%	6%	87.7
2014	9	1,637	1,134	409	94	69%	25%	6%	86.2
2015	9	1,654	1,242	320	92	75%	19%	6%	87.6
2013	10	2158	1,582	482	94	73%	22%	4%	88.1
2014	10	2,163	1,569	501	93	73%	23%	4%	87.7
2015	10	2,145	1,600	463	82	75%	22%	4%	88.2
2013	11	2,112	1,466	480	166	69%	23%	8%	85.2
2014	11	2,109	1,309	631	168	62%	30%	8%	83.3
2015	11	2,118	1,439	536	143	68%	25%	7%	85.2
2013	12	2,181	1,663	432	87	76%	20%	4%	88.3
2014	12	2,202	1,595	540	67	72%	25%	3%	87.2
2015	12	2,204	1,705	430	70	77%	20%	3%	88.3
2013	13	2,104	1,429	605	70	68%	29%	3%	85.6
2014	13	2,097	1,475	564	59	70%	27%	3%	86.4
2015	13	2,107	1,748	338	21	83%	16%	1%	89.7
2013	14	2,388	1,569	618	201	66%	26%	8%	85.3
2014	14	2,376	1,494	690	192	63%	29%	8%	83.9
2015	14	2,374	1,702	571	102	72%	24%	4%	87.0

Figure 45: Secondary System Pavement Condition, 2014-2015 (note surveys were conducted every two years prior to 2014 therefore, 2013 is not available)

Year	Division	Total LM	Good LM	Fair LM	Poor LM	% Good	% Fair	% Poor	Weighted Average Rating
2014	1	6,974	5,278	1,249	447	76%	18%	6%	87.5
2015	1	6,997	4,680	1,639	678	67%	23%	10%	82.6
2014	2	7,491	4,932	1,592	966	66%	21%	13%	82.1
2015	2	7,495	4,564	1,834	1,098	61%	24%	15%	80.3
2014	3	8,479	5,778	1,634	1,066	68%	19%	13%	83.1
2015	3	8,501	5,195	1,878	1,428	61%	22%	17%	80.8
2014	4	9,666	7,727	1,642	297	80%	17%	3%	87.6
2015	4	9,693	6,509	2,582	602	67%	27%	6%	83.8
2014	5	10,958	6,753	2,226	1,979	62%	20%	18%	79.9
2015	5	11,069	5,881	2,366	2,822	53%	21%	25%	75.5
2014	6	9,450	7,847	1,323	280	83%	14%	3%	89.7

Year	Division	Total LM	Good LM	Fair LM	Poor LM	% Good	% Fair	% Poor	Weighted Average Rating
2015	6	9,510	7,439	1,702	368	78%	18%	4%	88.4
2014	7	8,930	5,099	2,343	1,488	57%	26%	17%	79.0
2015	7	8,998	5,309	2,331	1,358	59%	26%	15%	79.7
2014	8	10,918	7,064	2,652	1,201	65%	24%	11%	82.5
2015	8	10,943	6,639	2,903	1,402	61%	27%	13%	80.7
2014	9	8,369	6,317	1,474	579	75%	18%	7%	86.5
2015	9	8,429	5,281	2,413	735	63%	29%	9%	81.7
2014	10	8,273	4,148	2,171	1,953	50%	26%	24%	75.3
2015	10	8,283	4,506	1,922	1,856	54%	23%	22%	76.5
2014	11	8,549	5,442	2,351	756	64%	28%	9%	82.1
2015	11	8,578	4,970	2,842	766	58%	33%	9%	80.3
2014	12	10,076	6,070	2,567	1,440	60%	25%	14%	80.6
2015	12	10,119	6,338	2,731	1,050	63%	27%	10%	81.4
2014	13	7,530	4,333	2,108	1,089	58%	28%	14%	78.8
2015	13	7,540	5,042	1,871	627	67%	25%	8%	82.6
2014	14	6,739	3,688	2,072	979	55%	31%	15%	78.9
2015	14	6,786	3,526	2,042	1,218	52%	30%	18%	77.2

10.1.1 Pavement Planned vs. Actuals (2015)

Figure 46: Contract Resurfacing – Primary System

Division	Primary System Inventory	Planned	% of system treated	Cycle Time	Completed + Under Contract	% of system treated	Cycle Time
1	**3,246**	116	4%	28	143	4%	23
2	**2,865**	66	2%	44	70	2%	41
3	**2,986**	88	3%	34	46	1%	65
4	**3,222**	106	3%	30	174	5%	18
5	**2,622**	209	6%	13	177	5%	15
6	**2,972**	258	8%	12	211	6%	14
7	**1,849**	69	2%	27	127	4%	15
8	**2,663**	235	7%	11	240	7%	11
9	**1,618**	81	3%	20	108	3%	15
10	**2,146**	52	2%	41	87	3%	25
11	**2,094**	136	4%	15	128	4%	16
12	**2,115**	120	4%	18	110	3%	19
13	**2,048**	105	3%	20	137	4%	15
14	**2,271**	49	2%	46	59	2%	39
Statewide	**34,719**	**1,688**	**52%**	**21**	**1,817**	**56%**	**19**

Figure 47: Contract Resurfacing – Secondary System

Division	Secondary System Inventory	Planned	% of system treated	Cycle Time	Completed + Under Contract	% of system treated	Cycle Time
1	6,969	223	3%	31	394	6%	18
2	7,415	140	2%	53	175	2%	42
3	8,493	273	3%	31	199	2%	43
4	9,640	97	1%	99	189	2%	51
5	10,886	232	2%	47	257	2%	42
6	9,403	177	2%	53	207	2%	45
7	8,911	255	3%	35	273	3%	33
8	10,969	283	3%	39	238	2%	46
9	8,353	171	2%	49	149	2%	56
10	8,273	150	2%	55	216	3%	38
11	8,629	95	1%	91	92	1%	94
12	10,114	204	2%	50	185	2%	55
13	7,585	152	2%	50	287	4%	26
14	6,820	113	2%	60	241	4%	28
Statewide	122,460	**2,566**	**2%**	**48**	**3,102**	**3%**	**39**

Figure 48: Pavement Preservation – Secondary System

Note condition surveys on the secondary roads were previously conducted very two years however, since 2014 surveys have been conducted annually.

Division	Secondary System Inventory	Planned	% of system treated	Cycle Time	Completed + Under Contract	% of system treated	Cycle Time
1	6,969	186	3%	38	244	3%	29
2	7,415	277	4%	27	1,221	16%	6
3	8,493	155	2%	55	178	2%	48
4	9,640	249	3%	39	450	5%	21
5	10,886	222	2%	49	681	6%	16
6	9,403	491	5%	19	729	8%	13
7	8,911	269	3%	33	309	3%	29
8	10,969	359	3%	31	757	7%	14
9	8,353	455	5%	18	329	4%	25
10	8,273	75	1%	110	306	4%	27
11	8,629	465	5%	19	677	8%	13
12	10,114	239	2%	42	418	4%	24
13	7,585	326	4%	23	793	10%	10
14	6,820	375	6%	18	871	13%	8
Statewide	122,460	**4,142**	**3%**	**30**	**7,962**	**7%**	**15**

Figure 49: List of Most Deficient Pavements – Primary System

Most deficient pavement on the primary system are defined as routes that have an average Pavement Condition Score (PCS) of less than 60%. Our primary routes are considered drivers of economic activity, and therefore, a PSC threshold of 60% or “poor” is considered deficient.

Division	County	System	Route	Length (miles)
2	007-Beaufort	Primary	US 17 Bus	6.036
2	040-Greene	Primary	US 264 Alt	5.564
2	054-Lenoir	Primary	US 70 Bus	4.783
3	031-Duplin	Primary	NC 24 Bus	4.132
3	031-Duplin	Primary	US 117 Alt	2.227
3	082-Sampson	Primary	US 701 Bus	5.704
4	064-Nash	Primary	NC 43 Bus	0.25
5	039-Granville	Primary	US 158 Bus	3.741
6	043-Harnett	Primary	NC 87	8.609
10	090-Union	Primary	NC 75	12.651
11	086-Surry	Primary	US 21	4.658
11	086-Surry	Primary	US 21 Bus	3.579
11	097-Wilkes	Primary	US 21	7.42

Figure 50: List of Most Deficient Pavement – Secondary System

Most deficient pavements on the secondary system are defined as routes with an average PCS less than 40% and a maximum AADT of 5,000 (note 94% of the secondary system is within an AADT range of 0-5,000), and includes subdivisions. Given that roads are less traveled compared with the primary system, the PCS threshold is appropriately lower.

Division	County	System	Route	Length (miles)
2	025-Craven	Secondary	SR 1402	1.12
4	098-Wilson	Secondary	SR 1515	0.99
5	032-Durham	Secondary	SR 2295	1.56
5	039-Granville	Secondary	SR 1207	0.55
5	091-Vance	Secondary	SR 1165	2.40
5	092-Wake	Secondary	SR 1314	1.18
5	092-Wake	Secondary	SR 1315	0.21
5	092-Wake	Secondary	SR 2794	0.42
5	092-Wake	Secondary	SR 2900	0.14
5	092-Wake	Secondary	SR 4363	2.67
5	092-Wake	Secondary	SR 5418	0.26
5	092-Wake	Secondary	SR 5809	0.63
10	013-Cabarrus	Secondary	SR 2902	0.36
10	060-Mecklenburg	Secondary	SR 1105	0.84
10	060-Mecklenburg	Secondary	SR 2189	1.82
10	060-Mecklenburg	Secondary	SR 2540	4.27
10	090-Union	Secondary	SR 1515	1.05
12	036-Gaston	Secondary	SR 1136	4.46
12	036-Gaston	Secondary	SR 2481	1.02

11 Appendix C: Bridges

Figure 51: Most deficient bridges

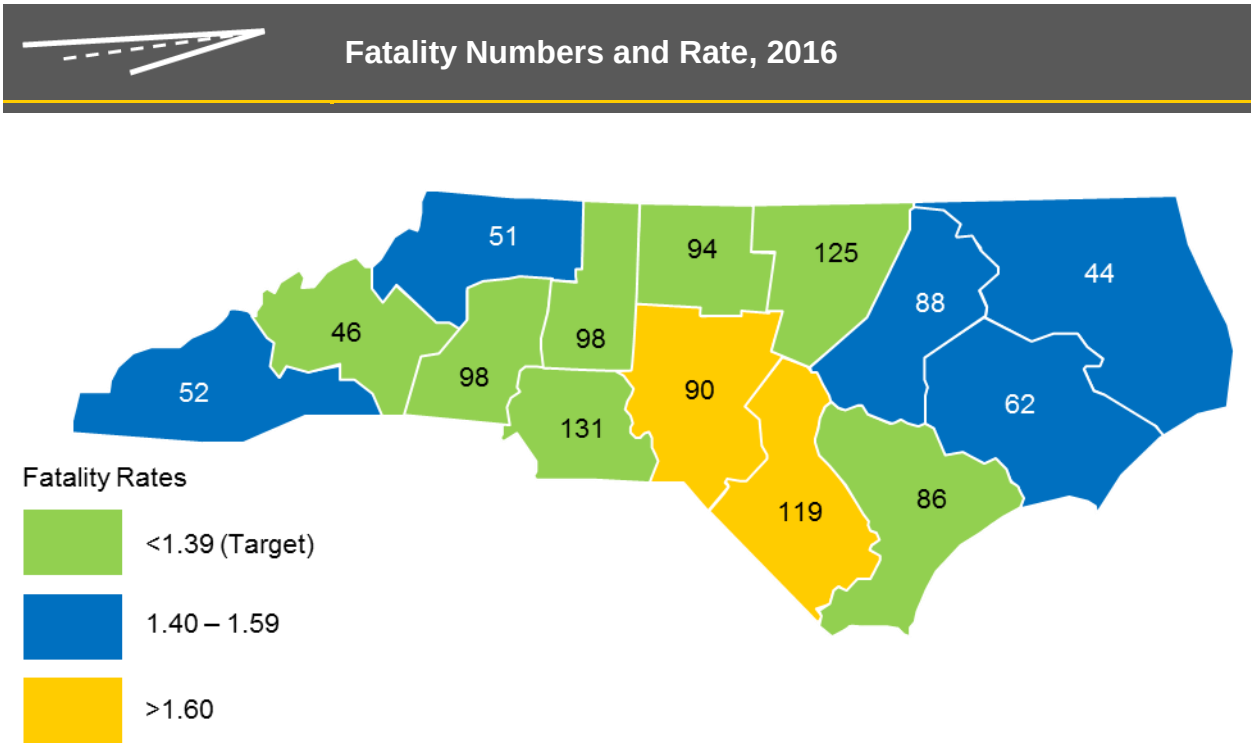
For the most deficient bridges listed below, all three of the major components (deck, substructure, and superstructure) are in poor condition or worse.

Division	County	System	Structure#	Route	Crossing
1	Northampton	Secondary	650010	Sr1341	Corduroy Swamp
1	Dare	Primary	270011	Nc12	Oregon Inlet
1	Northampton	Secondary	650044	Sr1356	Br. of Kirby's Creek
2	Carteret	Secondary	150073	Sr1335	The Straits
3	Duplin	Secondary	300352	Sr1004	Outlaws Pond Spillway
4	Nash	Primary	630173	Us301byp N	Stoney Creek
5	Wake	Secondary	910195	Sr1001	Mocassin Creek
6	Robeson	Secondary	770026	Sr1955	Ten Mile Swamp
7	Rockingham	Primary	780001	Sr2817	Us29
7	Rockingham	Primary	780023	Us29 Bus.	Us29
7	Rockingham	Primary	780027	Us311	Reed Creek
7	Orange	Primary	670032	Us70	Eno River
7	Guilford	Secondary	400052	Sr1332	Branch
7	Guilford	Secondary	400067	Sr1523	Deep River
7	Rockingham	Secondary	780080	Sr1929	Wolf Island Creek
7	Rockingham	Secondary	780085	Sr2600	Southern Railroad
7	Orange	Secondary	670086	Sr1005	University Lake
7	Rockingham	Primary	780170	Sr1360	Us220
7	Rockingham	Secondary	780238	Wentworth St.	S. Prong Terry's Creek
7	Guilford	Primary	400342	Phillips Avenue	Us29 and Sr2526 Nbl
8	Randolph	Secondary	750125	Sr2106	Little Polecat Creek

8	**Chatham**	Secondary	180306	Sr1303	N. Prong Of Rocky Rvr
9	**Davidson**	Primary	280027	Nc8	Us29&70/I85bus. Loop
9	**Forsyth**	Primary	330049	Sr4326	Us52, Us311 and Nc8
9	**Davidson**	Primary	280118	I85 Nbl,Us29,Us70	Sr3346
9	**Forsyth**	Secondary	330229	Sr2264	Norfolk and Western Rr
9	**Stokes**	Secondary	840253	Sr1402	Big Creek
9	**Forsyth**	Primary	330286	S.Green St(Closed)	I40 Bus
9	**Forsyth**	Primary	330305	Sr1725	I40 Bus
9	**Forsyth**	Interstate	330312	I40 Bus	Sr4315 (Liberty St)
9	**Davidson**	Secondary	280459	Sr2160	Branch Of Hamby Creek
10	**Cabarrus**	Secondary	120056	Sr2000 (Closed)	Lake Fisher
10	**Cabarrus**	Primary	120132	Nc73	Dutch Buffalo Creek
10	**Union**	Secondary	890224	Sr1301	Twelve Mile Creek
11	**Yadkin**	Secondary	980010	Sr1710	South Deep Creek
11	**Ashe**	Secondary	40321	Sr1526	Helton Creek
11	**Alleghany**	Primary	20021	Nc18	Little River
11	**Ashe**	Primary	40049	Nc88	Buffalo Creek
11	**Alleghany**	Secondary	20150	Sr1171	Bledsoe Creek
11	**Avery**	Secondary	50152	Sr1169	Cranberry Creek
11	**Ashe**	Primary	40055	Nc88,194	Buffalo Creek
11	**Alleghany**	Secondary	20061	Sr1143	UT to Meadow Fork
11	**Ashe**	Primary	40063	Nc88	Cranberry Creek
11	**Ashe**	Secondary	40079	Sr1118	Hoskin Fork Creek
11	**Alleghany**	Secondary	20191	Sr1462	Ramey Creek
11	**Caldwell**	Secondary	130115	Sr1310	Greasy Creek
11	**Wilkes**	Secondary	960151	Sr1728	Dungeon Creek
11	**Watauga**	Secondary	940278	Sr1540	Middle Fork S.Fork New R
12	**Alexander**	Secondary	10269	Sr1433	Creek
12	**Alexander**	Secondary	10291	Sr1348	Duck Creek
13	**Mitchell**	Secondary	600005	Sr1349	Pigeonroost Creek
13	**Madison**	Primary	560008	Nc251 Nbl	Ivy Creek
13	**Madison**	Primary	560009	Nc251 Sbl	Ivy Creek
14	**Haywood**	Secondary	430401	Sr1236	Little E.Frk.Pigeon Riv

12 Appendix D: Safety and Mobility

Figure 52: Crashes and Fatality Rates 2016



- Color shows fatality rate for 2016 (January – October 2016)
- Number indicates total number of fatalities (January – October 2016)

Figures