2045 Mississippi Statewide Long Range Transportation Plan

MDOT
MISSISSIPPI DEPARTMENT OF TRANSPORTATION

2045
MULTIPLAN
THE FUTURE IN MOTION

Transportation Asset Management Plan

August 2019

Transportation Asset Management Plan

prepared for

Mississippi Department of Transportation

prepared by

Cambridge Systematics, Inc.

Table of Contents

List of Tables

List of Figures

Executive Summary

Introduction

The Mississippi Department of Transportation (MDOT) has been active in transportation asset management (TAM) for many years. TAM is a process to strategically manage transportation systems in a cost-effective, safe, efficient, and environmentally sensitive manner. This approach focuses on performance to manage systems for optimal results. This Transportation Asset Management Plan (TAMP) outlines the existing and planned state of TAM practice in the State of Mississippi.

The *2045 Mississippi Unified Long-Range Transportation Plan (MULTIPLAN)*, MDOT's long-range transportation plan, will discuss the need for a well-performing transportation network to support Mississippi families, jobs, and businesses. It will note that inadequate infrastructure investment can result in increased costs of doing business and higher costs of living. Asset management will be a critical component of reaching the long-range goals to be established in MULTIPLAN. This TAMP will serve as a valuable counterpart to long-range goals in implementing the strategies necessary for operating, maintaining, and improving physical assets in a cost-effective manner throughout their life-cycle.

With this in mind, the development of this TAMP aims to outline the strategies currently used to set performance targets and select projects. Furthermore, planned enhancements to MDOT's methodology, such as the incorporation of life-cycle optimization models, are described. The Plan provides a summary of the assets maintained by MDOT, discusses strategies to manage risks, provides a 10-year financial plan with investment strategies, and concludes with a discussion of TAM enhancements. It provides a framework for the MDOT staff to carry out the strategic direction that ensures the most effective and efficient way to preserve the highway network through specific asset management goals and objectives.

MDOT has been monitoring the asset condition of the State-maintained pavements and bridges and investing in maintenance and preservation for decades. As a result of the passage of Moving Ahead for Progress in the 21st Century Act (MAP-21) and, subsequently, Fixing America's Surface Transportation Act (FAST Act), enacting new asset management requirements, efforts have been made to ensure current TAM activities meet the new Federal objectives. Some of these efforts, aiming to ensure successful implementation of Federal requirements, include:

- Creating a working group that represents all aspects of MDOT responsibilities that actively meets on TAM issues.
- Establishing a steering committee of MDOT leadership as the decision-making body to guide asset management efforts.
- Reviewing data collection and maintenance procedures to ensure best practices are in place.

Goals

MDOT, in conjunction with its stakeholders, identified a series of goals to guide the development of strategies to preserve the transportation system.

The MDOT TAMP has the goals of:

- Informing decision-makers, both internal and external, and the public about MDOT's TAM processes and the Agency's commitment to TAM.
- Documenting detailed TAM processes and resources.
- Documenting asset needs for pavements and bridges on the National Highway System (NHS) as well as the strategies to meet those needs.

The **Mississippi Department of Transportation** is responsible for providing a safe intermodal transportation network that is planned, designed, constructed and maintained in an effective, cost efficient, and environmentally sensitive manner.

- Laying a foundation to support MDOT's goals in data access and sharing.
- Providing a resource of information on asset condition and MDOT's plans to address infrastructure condition and needs.
- Guiding MDOT decision-making to unlock the benefits of TAM, including lower long-term costs for infrastructure preservation, improved performance, and service to customers, and better cost-effectiveness and use of available resources.
- Fulfilling Federal requirements for TAMP development and implementation.

Managing Infrastructure

This plan primarily focuses on the management of pavement and bridge assets on the NHS, as required by Federal regulations, but also describes how asset management is carried out on all Mississippi roads and bridges. Mississippi has about 13,600 lane-miles of highway and more than 2,700 bridges on the National Highway System (NHS). Mississippi's transportation infrastructure supports both the State's economy and the active lifestyles of residents and visitors. Highways, bridges, and other infrastructure connect people to activities and businesses to markets.

Managing Pavements

MDOT integrates life-cycle planning in the development of rehabilitation and reconstruction project recommendations. The Department is currently in the process of implementing a new pavement management system (PMS) with improved analytics to add more capabilities to the Department's current business processes. The new system will provide greater flexibility to

conduct budget scenario planning and is based on updated pavement treatment decision trees and performance prediction models.

Current Federal regulations require measures that are applicable to all Interstates and non-Interstate-NHS pavements regardless of ownership or maintenance responsibility. This network in Mississippi consists of about 13,600 lane-miles with about 12,800 lane-miles being maintained by MDOT and the remaining 770 lane-miles under the maintenance jurisdiction of cities, counties, or other State or Federal agencies.

The Federal rule established a minimum condition threshold of five percent poor for pavements on the Interstate. The rule did not provide a minimum threshold for non-Interstate NHS pavements. MDOT established its own targets for Interstate pavements. The targets include reaching more than 55 percent good and less than five percent poor on Interstates within four years and more than 25 percent good and less than 10 percent poor on non-Interstate NHS within two years. These targets are based on the Federal pavement performance measure, which is based on the International Roughness Index (IRI) (a ride quality factor), cracking, faulting, and rutting. Using the Federal measure, 69 percent of Interstates are in good condition, 30 percent are in fair condition, and 1 percent are in poor condition. Using the Federal measure, 61 percent of non-Interstate-NHS roads are in good condition, 35 percent are in fair condition, and 4 percent are in poor condition.

For MDOT purposes, pavement condition is assessed using the Pavement Condition Rating (PCR), a function of ride smoothness, IRI, and distress data. The PCR is represented with a number from 0 to 100, with 100 being the best possible condition. MDOT has established a goal of maintaining Interstate pavements in good condition, a PCR of 82 or greater, and all other State-maintained highways at a minimum fair condition, a PCR of 72 or greater. Currently, approximately 67 percent of the two-lane routes and 71 percent of the four-lane routes meet this criterion. State-maintained highways in poor condition have increased by approximately 14 percent over the last decade. Based on 2016 pavement condition data, one-third of all State-maintained highways are in poor condition.

MDOT spends about $210-$225 million on an annual basis to preserve and maintain the State-maintained pavement network, not counting engineering, right-of-way, preconstruction, and additional maintenance costs for both pavement and bridges of approximately $125 million per year. Based on the needs analysis and the current level of spending, there is a large performance gap for state-maintained pavement. An estimate of the total gap is not yet available, and will be estimated as part of MDOT's upcoming long range transportation plan. However, pavement needs for the entire state-maintained highway system were estimated in 2016 at approximately $2 billion or greater. This is due to the large amount of non-NHS mileage in a largely rural state. The $2 billion figure has likely increased with more pavement falling into Poor or Very Poor condition. 2019 estimates are currently unavailable.

Due to restricted funding, MDOT has minimal resources to invest in locally-maintained pavements. Therefore, local programs that support improvements to the NHS are encouraged. One practice that MDOT recognizes as supporting the Federal requirements by a local entity is the adoption of selection criteria by the Jackson Metropolitan Planning Organization (MPO) that

places emphasis on NHS routes. According to the MPO's project submittal guidelines "In the event, two or more projects rank equally, priority shall be given to the project located on the National Highway System." This tie-breaking criterion encourages jurisdictions to consider projects on NHS bridges or roadways in order to secure funding.

Managing Bridges

As of the 2018 NBI submittal, Mississippi had a total of 16,598 structures subject to the National Bridge Inventory Standards (NBIS). Approximately one-third of these structures are State-maintained, with the remaining two-thirds locally-maintained. Not all of the structures are addressed in the TAMP. The plan focuses only on bridges located on the NHS and on Non-NHS bridges owned and maintained by MDOT.

Of the 16,598 structures subject to the NBIS, 2,717 structures are State-maintained and support the NHS; 3,090 structures are State-maintained and support non-NHS roads; 83 structures are locally-maintained and support the NHS; and 10,708 structures are locally-maintained and support non-NHS roads.

The Federal rule establishes a minimum standard for NHS bridge conditions, stating that no more than 10 percent of the total deck area on NHS bridges may be classified as poor for three consecutive years. MDOT's minimum performance target requires that more than 60 percent of bridge by deck area should be in good condition and less than 5 percent of bridges by deck area should be in poor condition within two years.

$105 million per year is needed for the condition of the NHS and Non-NHS State-maintained bridge network to meet performance targets. MDOT plans to invest about $50 million for the NHS and $55 million for the Non-NHS in Federal and State funds on an annual basis to preserve and maintain the entire State-maintained bridge network.

Investments at the local level will be determined by the jurisdictions with maintenance responsibility of locally-maintained NHS bridges. With the portion of locally maintained NHS bridges being less than 3 percent, MDOT will focus its resources on State-maintained bridges which typically carry higher traffic volumes and include larger structures. Even maintaining the current investment level in constant dollars (adjusted for inflation) over the next 10 years, the percent of deck area on poor State-maintained bridges is expected to increase by 2027.

Risk

A comprehensive risk register was developed as part of the MDOT/FHWA Stewardship and Oversight Agreement. This served as a starting point for the development of a risk register specific to the assets discussed within this TAMP (NHS pavements and bridges). MDOT found that the highest priority risks for pavements and bridges share some common threads such as:

- Flat or uncertain funding/rising project costs.
- Differing sources of data and the potential for inconsistencies.

- Knowledge continuity within MDOT.
- Meeting compliance requirements of Federal regulations.

Financial Plan and Investment Strategies

The TAMP discusses MDOT's funding sources, steps that MDOT has taken to balance needs and funding, and the anticipated funding needs for pavements and bridges over the next 10 years for asset management.

MULTIPLAN 2045 will set the vision of Mississippi's future transportation network and describes how MDOT will strategically allocate resources to address the challenges and strive to meet its transportation goals. Based on extensive feedback received from participants and stakeholders of MULTIPLAN, MDOT will select investment strategies to achieve the desired level of asset condition and system performance.

MDOT anticipates that NHS bridges and pavements will remain a priority and that the remainder of the State-maintained system will continue to deteriorate. Table 1 summarizes the funding needs for the NHS pavement and bridge system.

Table 1. NHS Bridge and Pavement Performance Gap Summary

	Interstate Pavement	Non-Interstate NHS Pavement	NHS Bridges
2017 Spend	$123 m	$33 m	$51 m
Current Condition (Federal Measure)	0.5% poor 67% good	4% poor 35% good	2% poor 62% good
Four-Year Target (Federal Measure)	*<5% poor* *>55% good*	*<10% poor* *>25% good*	*<5% poor* *>60% good*
Estimated 10-Year Annual Spend Based on Reasonable Budget	$110 m	$50 m	$50 m
Condition After 10-Years Based on Reasonable Budget	0.3% poor 36% good	16% poor 26% good	5% poor 80% good
Estimated 10-Year Annual Spend to Meet Target	$110 m	$275 m	$50 m
Condition After 10-Years Based on Increased Budget	0.3% poor 36% good	10% poor 47% good	5% poor 80% good
Performance Gap	–	$225 m	–

Source: MDOT 2017 FHWA 534 report submission, Cambridge Systematics analysis. Dollar values do not include engineering, right-of-way, preconstruction, and additional maintenance costs.

Table 2 provides a performance summary for state-maintained Non-NHS pavement and bridges.

Table 2. Non-NHS Pavement and Bridge Performance Summary

	State-Maintained Non-NHS 4-Lane Pavement	State-Maintained Non-NHS 2-Lane Pavement	Non-NHS Bridge
2017 Spend	$56 m		$113 m
Current Condition	27% poor 73% fair+good	32% poor 68% fair+good	3% poor 70% good
Four-Year Target	*<25% poor*	*<25% poor*	<3% poor >60% good
Estimated 10-Year Annual Spend Based on Reasonable Budget	$4 m	$48 m	$55 m
Condition After 10-Years Based on Reasonable Budget	25% poor 75% fair+good	86% poor 14% fair+good	3% poor 85% good

Source: MDOT 2017 FHWA 534 report submission, Cambridge Systematics analysis. Dollar values do not include engineering, right-of-way, preconstruction, and additional maintenance costs.

The investment levels indicated in Tables 1 and 2 include all work types associated with maintaining pavements and bridges which include maintenance, preservation, rehabilitation, and reconstruction projects. MDOT anticipates none to very little new construction due to the expectation that funding will remain flat. The specific work types are not reported here, but will become available following the implementation of MDOT's pavement and bridge management systems discussed in Section 4. In the meantime, the five work types are being incorporated into MDOT's internal financial management and project management systems so that actual investment levels can be reported annually for each work type within the required implementation report.

MDOT currently operates on a construction budget of approximately $700 million. Of that $700 million, MDOT spends on average $450-$500 million on maintaining pavements and bridges. The remainder of the funds are spent on safety and operations and other improvements. Table 3 summarizes FY2017 expenditures that were related to maintaining pavements and bridges throughout the state.

Table 3. MDOT FY2017 Spending

Expenditure	NHS Interstate	NHS Non-Interstate	State-Maintained Non-NHS	Total
Right-of-Way and Engineering Costs	$7.8 m	$12.1 m	$46.1 m	$66.0 m
Bridges	$12.1 m	$39.1 m	$113.1 m	$164.3 m
Pavement	$122.9 m	$33.4 m	$56.1 m	$212.4 m
Maintenance	$0 m	$13.6 m	$42.2 m	$55.8 m
Total, All Maintenance and Preservation				**$498.5 m**

Source: MDOT 2017 FHWA 534 report submission.

1.0 Overview

The Mississippi Department of Transportation (MDOT) has been active in transportation asset management (TAM) for many years. This Transportation Asset Management Plan (TAMP) outlines the existing and planned state of TAM practice in the State of Mississippi. It begins with an overview of TAM and why it is important for the State. The Plan then discusses the management of pavement and bridge assets on the National Highway System (NHS) as well as the State-maintained Highway System. It discusses life-cycle planning, strategies to manage risks, provides a 10-year financial plan with investment strategies, and concludes with a discussion of TAM enhancements.

Transportation Asset Management is a process to strategically manage transportation systems in a cost-effective, safe, efficient, and environmentally sensitive manner.

This approach focuses on performance to manage systems for optimal results.

1.1 The Need for Transportation Asset Management

The United States and its States, including Mississippi, have built one of the world's most extensive transportation systems, representing trillions of dollars of public investment. This transportation network supports the economy and directly impacts the competitiveness of the Nation and the State of Mississippi. Transportation agencies turn to TAM strategies to maintain and improve the system. TAM ensures that the integrity of the infrastructure is preserved in the short- and long-term.

At its core, TAM supports the ability of transportation agencies to operate rationally and comprehensively with clear strategies to sustain a desired state of good repair over the life-cycle of the assets at a minimum practicable cost. Agencies that implement TAM principles can reap many benefits, including lower long-term costs for infrastructure preservation, improved performance, improved service to customers, and better use of available resources. TAM's focus on performance and outcomes can ultimately result in improved credibility and accountability for decisions and expenditures.

1.2 TAMP Development

The 2040 Mississippi Unified Long-Range Transportation Plan (MULTIPLAN), MDOT's last long-range transportation plan, discussed the need for a well-performing transportation network to support Mississippi families, jobs, and businesses. It noted that inadequate infrastructure investment increases the cost of doing business and the cost of living.

MDOT currently is developing a full update to the MULTIPLAN and extending the horizon year from 2040 to 2045. It intends to reaffirm its commitment to TAM as a strategy for improving the performance of the system, update statewide targets, and re-establish its investment strategy.

TAM is a critical component of reaching the goals established in MULTIPLAN. This TAMP supports MULTIPLAN goals by articulating the strategies necessary to operate, maintain, and improve physical assets in a cost-effective manner throughout their life-cycle.

TAM is not new to MDOT. MDOT has been monitoring and managing its State-maintained pavements and bridges for decades. Recently, MDOT revised its activities to meet the Final Rule for Transportation Asset Management Plans (23 CFR Part 515.7), released on October 24, 2016.

This risk-based TAMP fulfills the requirements of the Final Rule, which calls for State DOTs to develop and implement a risk-based asset management plan with a 10-year planning horizon for bridges and pavement on the NHS. The rule establishes the minimum process elements State DOTs must use to develop their asset management plans. These include:

- **A summary listing of assets and a description of their condition |** See Section 2.1 for pavements and Section 3.1 for bridges.
- **Discussions covering the State DOT's asset management objectives, asset management measures, and State DOT targets for asset condition |** See Section 1.3.
- **Identification of performance gaps |** See Chapter 6.
- **A life-cycle planning analysis |** See Chapter 4.
- **A risk management analysis |** See Chapter 5.
- **A discussion of the results of the financial planning process** | See Chapter 7.
- **A description of investment strategies that collectively would make or support progress toward |** See Chapters 4 (life-cycle planning), 7 (financial plan), and 8 (investment strategies).
  - Achieving and maintaining a state-of-good-repair over the life cycle of the assets.
  - Improving or preserving the condition of the assets and the performance of the NHS relating to physical assets.
  - Achieving the State DOT targets for asset condition and performance of the NHS, as well as established national goals.

1.3 Goals

Mississippi currently is developing MULTIPLAN 2045. It anticipates keeping the same goal structure as MULTIPLAN 2040. MDOT develops TAM strategies to meet the maintenance and preservation goal. The seven Statewide transportation goals are described below.

Safety

Creating a safe transportation network for all users is a vital goal of MDOT. With an average of 70,000 crashes per year, 28 percent of which result in a fatality or serious injury, MDOT, local governments, and Mississippians all need to collaborate to improve the safety of the roadways. Specific strategies to improve system-wide safety focus on the "4 E's" of safety: **E**ngineering (infrastructure improvements), **E**ducation (awareness campaigns), **E**nforcement (working with local authorities), and **E**mergency services (reducing response times).

Maintenance & Preservation

Deferring maintenance of the existing transportation network can lead to safety concerns, increased maintenance costs, and increased transportation costs for businesses and motorists. The existing transportation infrastructure will need repair and upkeep throughout the horizon of this plan.

MULTIPLAN 2040 notes that MDOT has opportunities to use TAM to extend life of the asset; reduce cost of reconstruction; create safer roadways; reduce driving costs and improve ride quality; and support economic development.

Accessibility & Mobility

Mobility and accessibility are defined as the ease, ability, and quality of travel to and from destinations. Access to community resources, employment opportunities, and commerce strengthens a community, while excessive traffic congestion and an unreliable transportation system can have negative impacts on the State's residents and businesses.

Economic Development

Transportation is vital for Mississippi businesses, allowing the commerce and movement of goods to, from, and throughout the State. A strong transportation network supports economic development by decreasing the cost of doing business while improving efficiency.

Environmental Stewardship

Transportation has a notable impact on the overall natural and human environment. Reducing that impact is an important goal. The expansion and modernization of the transportation network should be mindful of its effect on the environment and attempt to mitigate short- or long-term impacts.

Awareness, Education & Cooperative Processes

Efficient and successful transportation relies on effective partnerships and cooperative processes across jurisdictions and modes. MDOT strives to increase the awareness of the transportation system's benefits and unmet funding needs, as well as to encourage cooperation and resource sharing among public officials, stakeholders, and transportation professionals to improve overall project delivery and system performance.

Funding and Finance

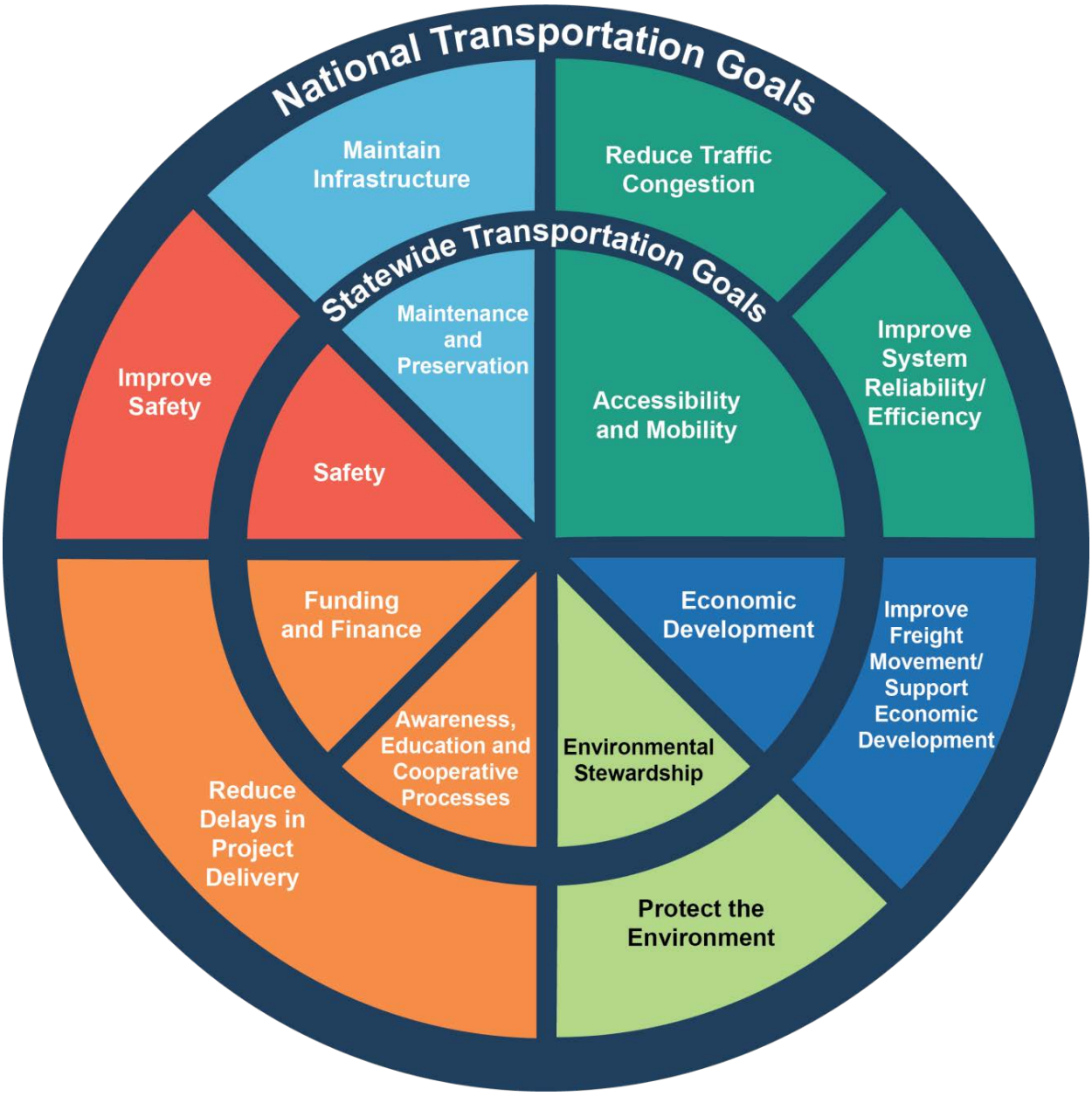
A stable and appropriate funding source for transportation infrastructure is required to ensure adequate maintenance, modernization, and expansion of the transportation network. Without sufficient funding to meet the most critical needs, funding allocation should benefit the greatest number of residents, represent the desires of stakeholders, and help to further Statewide transportation goals. Additional revenue and financing opportunities should be explored when possible, and funding allocation should incentivize cost efficiency and timely project delivery.

In compliance with the Federal Rule, these goals relate to national transportation goals. Figure 1 displays how MDOT's goals align with national transportation goals.

The goals of this TAMP have been established not only to fulfill specific Federal initiatives but also support the seven Statewide transportation goals previously mentioned, ensure transparency for the traveling public and policymakers, and assist in the decision-making process. These goals are:

- Informing decision-makers, both internal and external, and the public about MDOT's TAM processes and the Agency's commitment to TAM.
- Documenting detailed TAM processes and resources.
- Documenting asset needs for pavements and bridges on the NHS as well as the strategies to meet those needs.
- Laying a foundation to support MDOT's goals in data access and sharing.
- Providing a resource of information on asset condition and MDOT's plans to address infrastructure condition and needs.
- Guiding MDOT decision-making to unlock the benefits of TAM, including lower long-term costs for infrastructure preservation, improved performance and service to customers, and better cost-effectiveness and use of available resources.
- Fulfilling Federal requirements for TAMP development and implementation.

Figure 1. National and State Goals



Source: MDOT.

2.0 Pavement Inventory, Condition, and Targets

Mississippi actively manages its State-maintained pavements using a state pavement condition measure – Pavement Condition Rating (PCR). To meet Federal requirements, this plan addresses pavements on the NHS using the Federal pavement condition measure. While the approaches to analyzing the data are different, the intent is the same – to make the most efficient use of tax dollars to deliver the best transportation system.

The section details:

- The pavement inventory on the NHS and other State-maintained roads.
- How MDOT and FHWA measure pavement condition.
- Pavement goals and performance targets.

Unless otherwise noted, the data in this plan reflects the NHS using Mississippi's submission of its 2017 Highway Performance Monitoring System (HPMS) dataset. The TAMP uses this data because it is the same data that FHWA will use to report on its Federal measures. MDOT will continue to monitor its pavement condition and make investment decisions based on PCR using its own dataset.

State and Federal Pavement Perspectives

Mississippi and the FHWA both work every day to deliver an efficient, effective, and safe transportation system.

Mississippi understands that there is power in measuring and managing performance. MDOT has been collecting and using its pavement condition measure to make decisions for years.

Recently, FHWA published rules requiring State DOTs to report on a different network of pavement assets using a different measure. While they are different, the purpose is the same – to manage the performance of the pavements in Mississippi and the Nation.

As a result, some of the pavement measures Mississippi has traditionally reported may look a little different when represented using the Federal measure. The actual pavement conditions have not changed – the differences reflect the differences in how the data is being collected and analyzed.

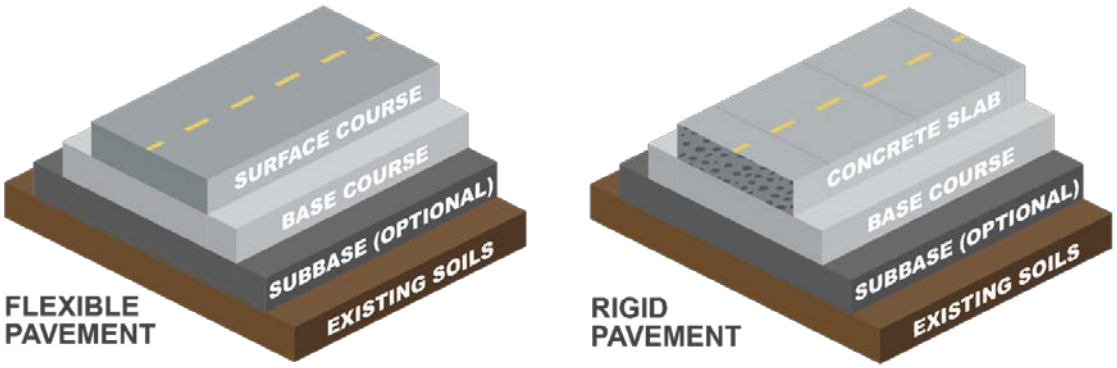
No matter what measure is reported, MDOT will use it to make the best use of tax dollars.

2.1 Pavement Inventory

There are about 162,100 lane-miles of publicly maintained roads and highways in the State of Mississippi. Of these, MDOT has maintenance jurisdiction over about 28,200 lane-miles. The remaining 133,900 miles of public roads are under the maintenance jurisdiction of cities, counties, or other State or Federal agencies. The MDOT network consists of the most critical roadways, including the Interstate system and most of the NHS. It carries 60% of all passenger vehicle traffic and 90% of all truck traffic.

The major structural components of flexible and rigid pavement systems are shown in Figure 2.

Figure 2. Structural Components of Pavement



Source: Cambridge Systematics.

The NHS in Mississippi includes about 13,600 lane-miles of road:

- **Interstate:** About 800 miles and 3,500 lane-miles.
- **Non-Interstate NHS:** About 2,800 miles and 10,100 lane-miles of pavement. Of this, Mississippi maintains about 2,700 miles and 9,350 lane-miles – the other 770 lane-miles of roads are maintained by counties, towns, cities, the Mississippi Department of Wildlife, Fisheries, and Parks, or the National Park Service.

Table 4 shows the breakdown of NHS pavement lane-miles by ownership. For comparison, it includes a column that shows the Non-NHS pavement miles maintained by the State and other agencies.

Table 4. NHS and Non NHS Pavement Lane-Miles by Ownership, 2018

Ownership	Interstate NHS	Non-Interstate NHS	Non-NHS	Total
Mississippi DOT	3,482	9,350	15,401	28,234
Other Local, State, and Federal Agencies	0	769	133,098	133,867
Total	**3,482**	**10,119**	**148,499**	**162,101**

Source: MDOT.

2.2 Collecting Pavement Condition Data

MDOT collects pavement inventory and condition data using in-house and contract forces. Pavement surveyors drive data collection vehicles with cameras and lasers in the rightmost through lane annually on Interstates and biannually on Non-Interstate NHS highways and other State-maintained highways. Surveyors collect the following distresses (and more):

- Transverse cracking.
- Longitudinal cracking.
- Alligator/fatigue cracking.
- Patching/potholes.
- Rutting (on asphalt).
- Faulting (on jointed concrete).
- Roughness.

2.3 Measuring Pavement Condition

State-Maintained Highway System

To manage the State-maintained highways, MDOT combines IRI with the other distresses (e.g., transverse cracking, longitudinal cracking, alligator/fatigue cracking, patching/potholes, rutting (on asphalt), and faulting (on jointed concrete)) into a composite measure called the Pavement Condition Rating (PCR). PCR is a State-specific measure tailored to Mississippi's unique weather and soil conditions. Because MDOT has been using the measure since 1991 to understand its needs and articulate how it makes decisions, it has become part of the narrative, and many in the State understand the measure intuitively.

The condition thresholds for good, fair, and poor pavement based on PCR are listed in Table 5. Pavement Condition Rating (PCR), which is a function of the smoothness of the ride (IRI) and distress data, is represented with a number from 0 to 100 with 100 being the best possible condition. PCR equations differ by pavement type because different distresses appear on different pavement types. For example, MDOT measures faulting on jointed concrete and alligator cracking and rutting on flexible asphalt. PCR serves well as a composite index for network reporting as it is easily understood and explained.

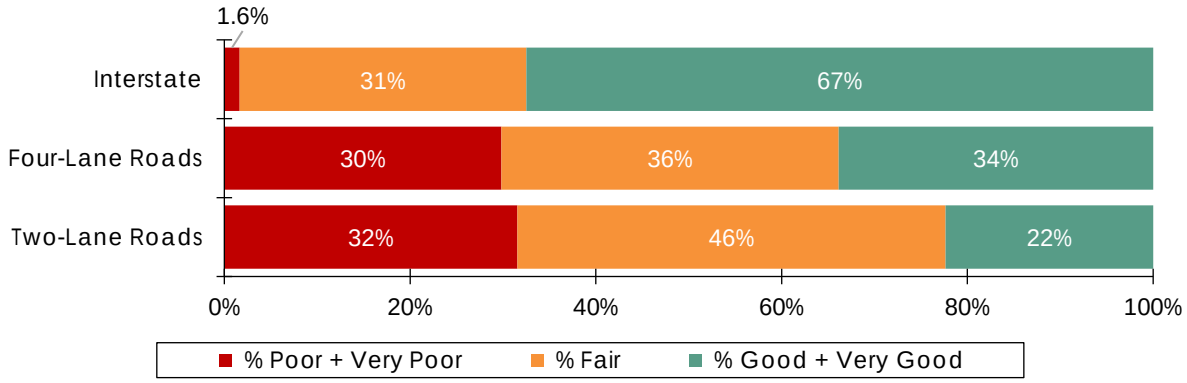
Table 5. State Pavement Condition Rating (PCR) Condition Thresholds for the State-Maintained Highway System

Pavement Condition Rating (PCR)	State-Maintained Pavement
Very Good	89≤
Good	82-89
Fair	72-82
Poor	63-72
Very Poor	<63

Source: MDOT.

Figure 3 shows the pavement condition for the State-maintained roads based on PCR, regardless of whether it is on the NHS. Based on a review of MDOT pavement management historical data, pavement condition was predicted to drop approximately three percent every year at historical surface treatment funding levels. However, actual network deterioration in recent years has been one to two percent per year because of additional unanticipated surface treatment revenues and effective regional planning.

Figure 3. State-Maintained Pavement Condition Using Pavement Condition Rating (PCR), 2018



Source: MDOT.

The National Highway System

MDOT collects pavement condition data annually for the Interstate and biennially for the non-Interstate NHS. It also is responsible for collecting and reporting pavement condition data on the 770 lane-miles of NHS that it does not maintain.

The Federal rule established national condition thresholds for good, fair, and poor pavements that are consistent across states. In order for a pavement section to be rated as good, it must be rated as good in all three categories. If two or more categories are poor, the overall condition of the pavement is considered poor. All other combinations are considered fair. Table 6 shows the condition thresholds for asphalt, jointed concrete, and continuously reinforced concrete pavement (CRCP).

State and Federal Pavement Perspectives

The Federal measure is fundamentally different from MDOT's PCR. While MDOT appreciates the need for a common Federal measure among states, it does not give the level of detail necessary to manage the State's pavements.

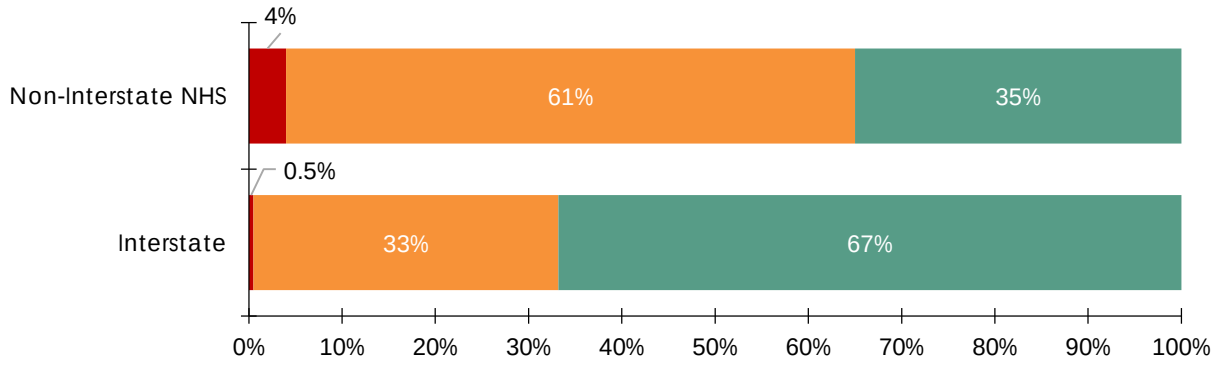
Table 6. Federal Pavement Condition Thresholds for NHS

	Asphalt			Jointed Concrete Pavement			Continuous Reinforced Concrete Pavement	
	IRI (inches/mile)	Cracking (%)	Rutting (inches)	IRI (inches/mile)	Cracking (%)	Faulting	IRI (inches/mile)	Cracking (%)
Good	<95	<5	<.20	<95	<5	<.10	<95	<5
Fair	95-170	5-20	.20-.40	95-170	5-15	.10-.15	95-170	5-10
Poor	>170	>20	>.40	>170	>15	>.15	>170	>10

Source: Federal Highway Administration.

Figure 4 shows the current percentages of Interstate NHS and Non-Interstate NHS in good, fair, and poor condition for 2017. MDOT prioritizes keeping roads on the NHS in a state of good repair. As a result, NHS roads are in better condition than non-NHS routes.

Figure 4. NHS Pavement Condition Using the Federal Measure, 2018



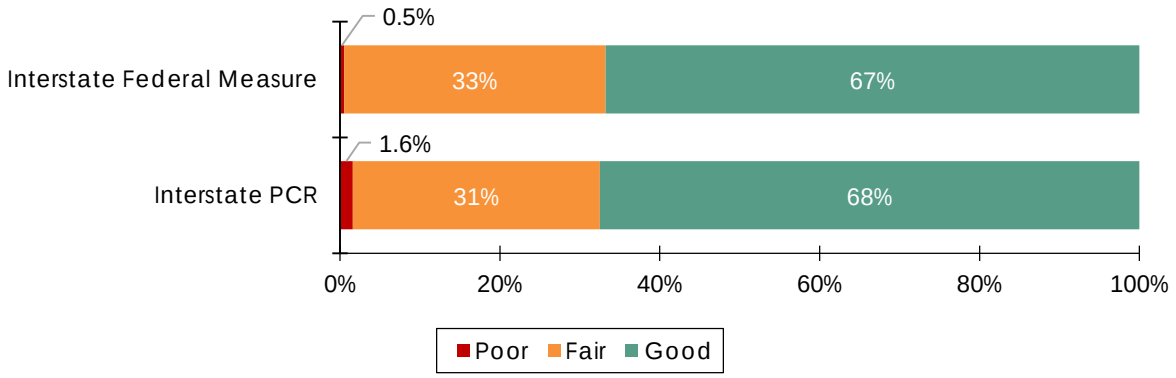
Source: MDOT.

Comparing PCR and The Federal Measure

For many States, the Federal measure tends to increase the percent of fair pavements and reduce the percent of good and poor pavements when compared to the State's own measure.

For Mississippi Interstates in 2017-2018, the percent of pavement in good, fair, and poor condition is nearly identical when using PCR or the Federal measure (Figure 5).

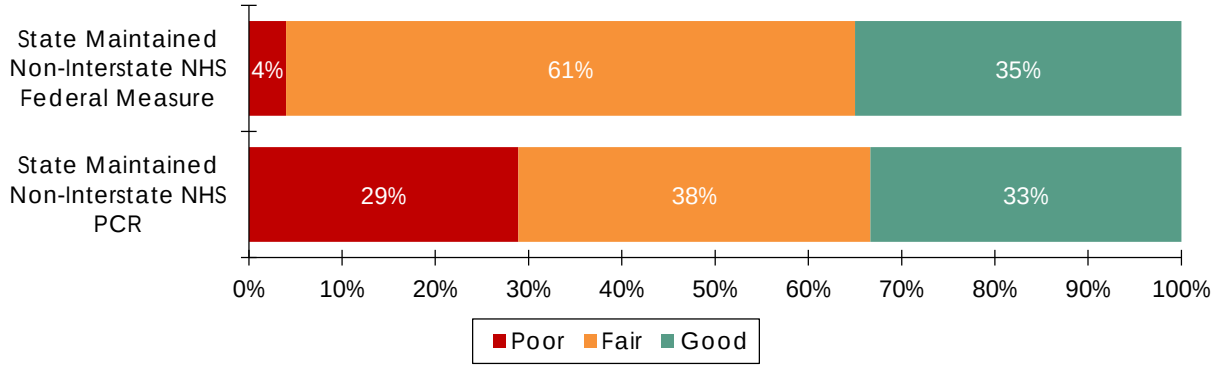
Figure 5. Comparison of PCR and the Federal Measure, Interstates



Source: Cambridge Systematics using MDOT 2018 pavement data for PCR and 2018 MDOT submission of HPMS data for the Federal Measure.

For Mississippi two- and four-lane roads in 2017-2018, the percent of pavement in good and poor condition looks substantially different. While the actual condition of the pavements has not changed on the facility, the Federal measure indicates that four percent of facilities are in poor condition while PCR indicates that there 29 percent are in poor condition. Similarly, the Federal measure indicates that 35 percent of pavements are in good condition while PCR indicates that 33 percent are in good condition. *Note: the results for the Federal measure include non-State-maintained NHS roads while the results for PCR only include State-maintained roads.*

Figure 6. Comparison of PCR and the Federal Measure, Non-Interstate NHS



Source: Cambridge Systematics using MDOT 2018 pavement data for PCR and data from the 2017 MDOT submission of HPMS for the Federal Measure.

2.4 Pavement Performance Targets

MDOT has established a goal of maintaining Interstate pavement in good condition, a PCR of 82 or greater, and all other State-maintained highways at a minimum Fair condition, a PCR of 72 or greater. Table 7 lists the performance targets for State-maintained roads.

Table 7. State-Maintained Pavement Performance Targets

Road Category	MDOT Target
Interstate	≥ 82 PCR
Two- and Four-Lane Roads	≥ 72 PCR

Source: MDOT.

The Federal rule sets a minimum condition threshold for Interstate pavements, requiring that no more than five percent of Interstate lane-miles are in poor condition. There is no analog requirement for Non-Interstate NHS pavements. The rule also requires States to develop performance two- and four-year performance targets for the entire NHS. Table 8 enumerates MDOT's adopted Federal targets.

Table 8. Federal Pavement Performance Targets (Federal Measure)

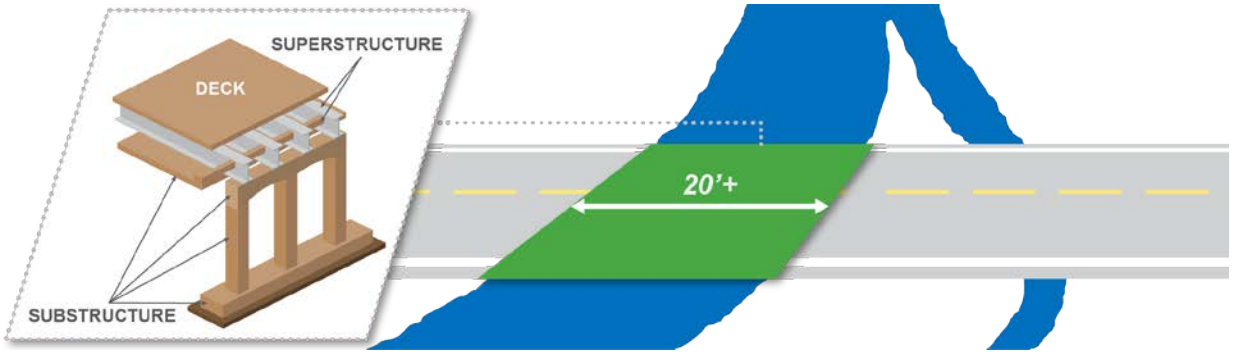
Road Category	Federal Minimum Threshold	Two-Year Target	Four-Year Target
Interstate	<5% Poor	No Federal Requirement	>55% Good
		No Federal Requirement	<5% Poor
Non-Interstate NHS	No Federal Requirement	>25% Good	>25% Good
		<10% Poor	<10% Poor

Source: MDOT.

3.0 Bridge Inventory, Condition, and Targets

To meet Federal requirements, this plan addresses National Bridge Inventory (NBI) bridges on the NHS. NBI bridges are bridges or culverts that span more than 20 feet, regardless of ownership. Each NBI bridge includes three components (i.e., deck, superstructure, and substructure). This definition of a bridge is illustrated in Figure 7.

Figure 7. Definition of a Bridge



Source: Cambridge Systematics.

The section details:

- The bridge inventory on the NHS and other State-maintained bridges.
- How MDOT and FHWA measure bridge condition.
- Bridge goals and performance targets.

Since Federal regulations only require this TAMP to include NHS bridges, any discussion of State-maintained bridges is included for illustrative purposes only. Unless otherwise noted, the data in this plan reflects the NHS using Mississippi's submission of its 2018 National Bridge Inventory (NBI) dataset. The TAMP uses this data because it is the same data that FHWA will use to report on its Federal measures.

3.1 Bridge Inventory

Mississippi has 16,598 NBI bridges. Approximately one-third of these structures are State-maintained and two-thirds are maintained by other agencies. There are about 2,800 structures on the NHS and 3,000 Non-NHS structures maintained by the State. Table 9 provides a summary of the number of NBI bridges and NBI bridges by deck area on the NHS.

Table 9. NHS Bridges by Facility Category

Facility Category	Number of NBI Bridges	NBI Bridge Deck Area (sq.ft.)
Interstate	894	17,469,497
Non-Interstate NHS[1]	1,906	30,198,185
State-maintained Non-NHS	3,090	23,002,870
Total	**5,890**	**70,670,552**

[1] *Includes locally-maintained structures.*

Source: MDOT's 2018 NBI submittal.

3.2 Collecting Bridge Condition Data

MDOT inspects the condition of the State-maintained bridges while local governments inspect the locally-maintained bridges in Mississippi according to the National Bridge Inspection Standards (NBIS) – 23 CFR Part 650, Subpart C. MDOT submits both state and local data annually to FHWA as its contribution to the National Bridge Inventory (NBI).

Structures subject to the NBIS are inspected at least every two years. If needed, bridges are inspected more regularly, including:

- When required by the MDOT Bridge Inspection Program Manager, structures are inspected more frequently. This allows MDOT to identify issues and ensure the stability of structural elements proactively.
- When bridges are posted or include fracture critical elements, they are inspected every 12 months.
- When bridges are posted with a timber superstructure, they are inspected every 6 months.

3.3 Measuring Bridge Condition

FHWA defines bridge condition using the 9-point NBIS scale shown in Table 10, where higher values indicate better condition. "Good" condition begins at a rating of 7, and "Poor" is defined as "structurally deficient" (SD), a rating of 4 or lower. The full deck area of the bridge will be counted as good, fair, or poor according to the rating of the lowest scoring component (deck, superstructure, or substructure). The process used to assign these ratings is illustrated in Table 11 and Figure 8 (a flowchart of component and structure condition thresholds).

Table 10. NBI Condition Rating Scale for Bridge Components

Score	Condition Category	Description	
		Structure	Channel
9	Good	Pristine condition	No deficiencies
8		No problems noted	Banks, river control stable
7		Insubstantial flaws	Minor damage to banks
6	Fair	Minor deterioration	Banks slumping
5		Elements sound, some defects	Banks eroding, flow restricted
4	Poor	Advanced defects	Banks undermined, debris
3		Serious defects to primary structural components, local failures, fatigue cracking	Banks failed, flow shifting
2		Advanced deterioration to primary structural components, substructure support failure, closure possible	Channel has moved such that the bridge is near a state of collapse
1		Imminent failure, elements moving, bridge closed	Bridge closed due to channel failure
0		Out of service, beyond repair	Out of service, beyond repair

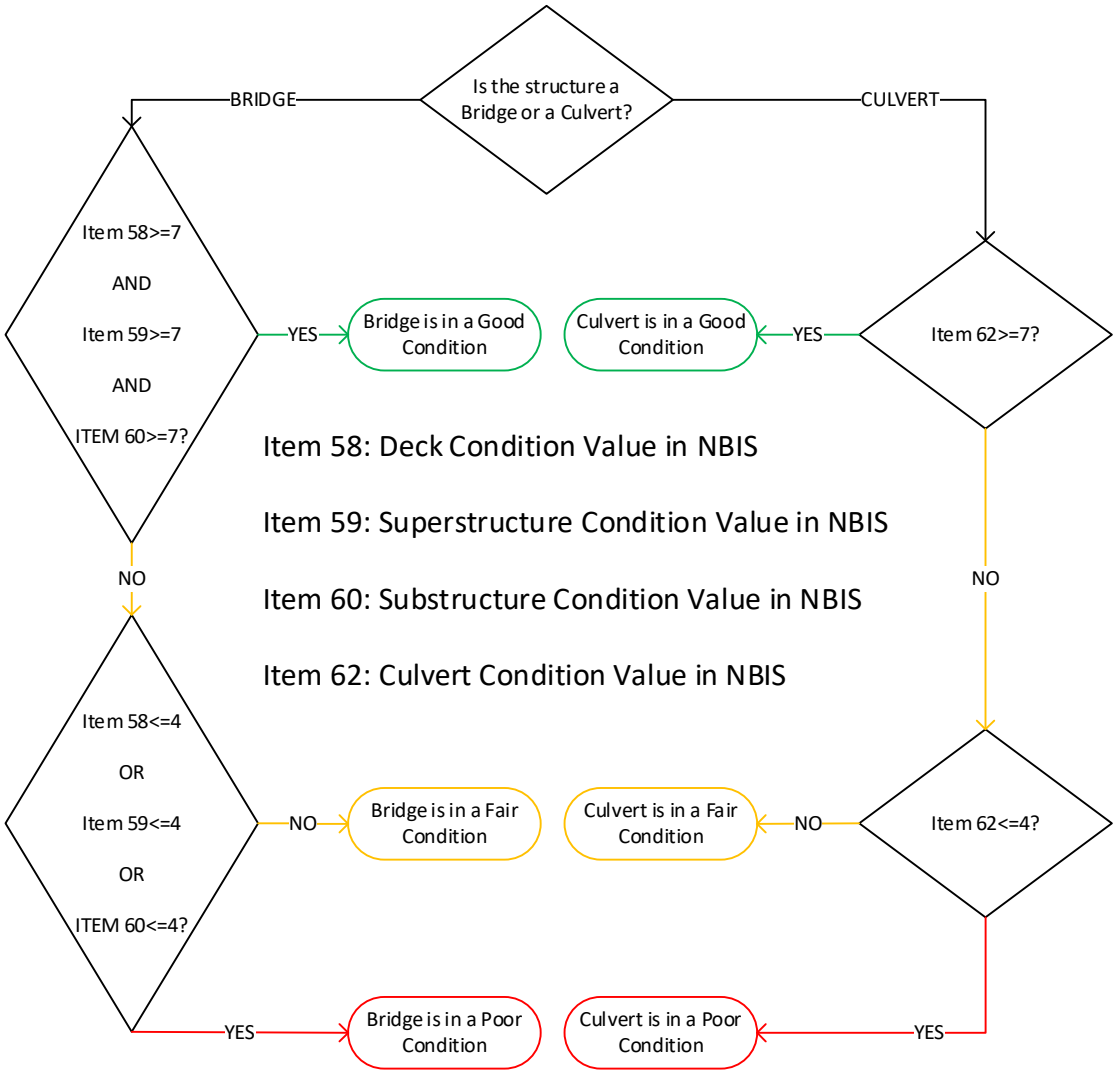
Source: Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, FHWA PD 96-001, 1995.

Table 11. NBI Condition Classification for Bridges

NBI Condition Rating	Condition Classification
Bridges: All of the 3 NBI items for a bridge are ≥7. **Culverts:** The NBI Culvert Condition item is ≥7.	Good
Bridges: Lowest rating of any of the 3 NBI items for a bridge is 5 or 6. **Culverts:** The NBI Culvert Condition item is 5 or 6.	Fair
Bridges: Lowest rating of any of the 3 NBI items for a bridge is ≤4. **Culverts:** The NBI Culvert Condition item is ≤4.	Poor

Source: FHWA.

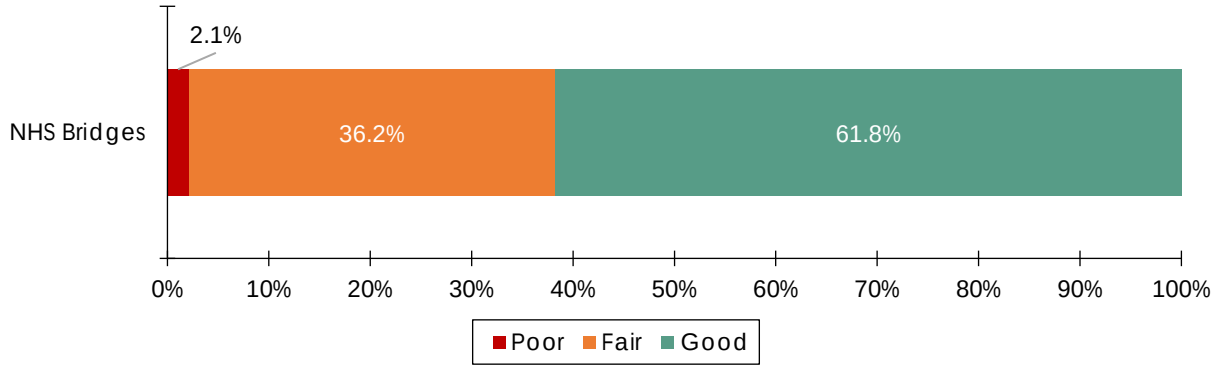
Figure 8. Flow Chart of NBI Condition Classification Process



Source: Cambridge Systematics visualization of process.

Figure 9 shows the current condition of NBI bridges on the NHS, regardless of ownership.

Figure 9. NHS Bridge Condition By Deck Area



Source: MDOT based on the 2018 National Bridge Inventory submission.

3.4 Bridge Performance Targets

The Federal rule sets a minimum condition threshold for NHS bridges, requiring that no more than 10 percent of bridges by deck area are in poor condition. The rule also requires States to develop two- and four-year performance targets for the entire NHS. Table 12 enumerates MDOT's adopted targets.

Table 12. Bridge Performance Targets

Road Category	Federal Minimum Threshold	2-Year Target	4-Year Target
All NHS	<10% Poor	>60% Good	>60% Good
		<5% Poor	<5% Poor

Source: MDOT.

4.0 Life-Cycle Planning

Life-cycle management applies data and analytics to develop a long-term strategy for managing an asset or group of similar assets at the lowest possible whole-life costs. This is accomplished by addressing all phases of an asset's life-cycle and applying the most effective treatment at each point in an asset's life. The emphasis is on long-term preservation and sustainability without sacrificing system performance or public safety.

Life-Cycle Planning

Life-cycle planning is an approach to maintaining an asset during its whole life, from construction to disposal.

Life-cycle planning emphasizes maintaining existing system performance at a constant desired level while minimizing resource consumption over the long-term.

4.1 Managing Pavements

It is important to note that much of this section describes the process for life-cycle planning and pavement project selection for the State-maintained highway system. While MDOT is responsible for nearly 95 percent of the NHS, it is the responsibility of local jurisdictions to preserve and maintain the condition of the remaining five percent. In order to ensure NHS routes remain in a state of good repair, MDOT encourages local programs that support the NHS.

One practice that MDOT recognizes as supporting the Federal requirements by a local entity is the adoption of selection criteria by the Jackson Metropolitan Planning Organization (MPO) that places emphasis on NHS routes. According to the MPO's project submittal guidelines "In the event that two or more projects rank equally, priority shall be given to the project located on the National Highway System." This tie-breaking criterion encourages jurisdictions to consider projects on NHS bridges or roadways in order to secure funding.

Identification and Selection of Pavement Projects

MDOT has a structured process for using the pavement condition data it collects to assess needs and make project recommendations.

The Project Identification and Selection Process

This project generation process makes no distinction between NHS and non-NHS. To identify and select pavement projects, MDOT:

- **Organizes pavements inventory and condition data.** The MDOT Research Division uses a pavement management system (PMS) to save and organize the pavement inventory and condition.
- **Develops analysis sections.** The MDOT Research Division used its PMS to divide the roadways into homogeneous pavement analysis sections of various lengths using geometric

characteristics, county, route, and construction history. As of 2018, there were approximately 5,900 analysis sections.

- **Generates decision trees.** The MDOT Research Division created the first decision trees in 1993 and adjusted them through a piloting process from 2009 to 2013 based on feedback from MDOT District maintenance staff.

- **Generates projects for two- and four-lane roads.** The MDOT Maintenance Division works with the Districts to generate projects:

  - The MDOT Research Division uses decision trees to recommend treatments analysis sections based on the pavement type and the distresses observed in the field.

  - The MDOT Research Division sends the treatment recommendations to the Districts and to the Interstate Rating Committee (IRC) for their use in developing the three-year plans.

  - The Districts develop three-year plans for two- and four-lane roads. The Districts are not required to follow the Research Division treatment recommendations (e.g., the pavement condition may have changed since the last data collection cycle), but they do need to justify why they wish to treat a pavement section if the recommendation is to 'do nothing.'

  - The Maintenance Division approves the project list.

- **Generates projects for Interstates.** The MDOT Maintenance Division works with the Interstate Rating Committee (IRC) to develop projects. The IRC includes staff from the Construction Division, the Research Division, FHWA, and Districts (non-voting). It is chaired by the State Maintenance Engineer. To develop projects on the Interstate:

  - The Interstate Rating Committee (IRC) gathers to drive the Interstates with data sheets informing them of the segment's PCR, rutting, IRI, and faulting. As they drive, they take notes and record a visual condition rating for comparison. Once complete, the IRC sends the notes to the Maintenance Division.

  - The Maintenance Division generates a recommended project list from the segment condition ratings and IRC notes. The IRC reviews the recommendations, makes changes as needed, and sends the prioritized list of project recommendations to upper management and FHWA for validation.

- **Approves the project list.** The Chief Engineer approves the priority list based on funding, availability of contractors, and regional equity.

Decision Trees and Treatments

The decision trees recommend treatments based on each pavement section's characteristics, condition, and distresses. There are decision trees for each pavement surface type, route type, and truck weight limit (for two-lanes only). There are over 200 unique treatment combinations.

MDOT has created decision trees for the following facility types:

- Interstates.
- Four-lane roads.
- Two-lane 80,000lb. truck weight limit roads.
- Two-lane 57,650 lb. truck weight limit roads.

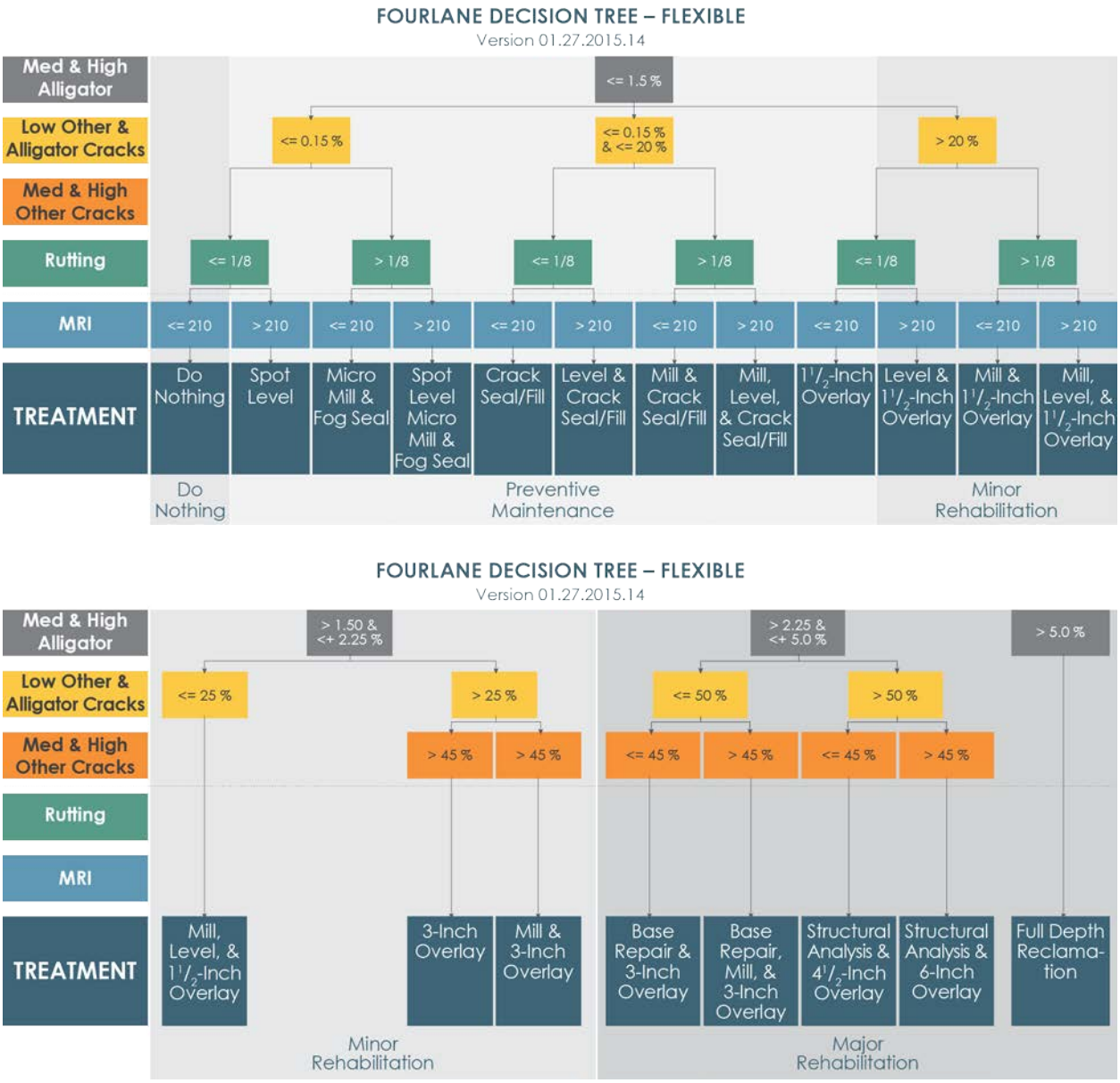
For each facility type, MDOT has created decision trees for the following "families":

- Flexible (FLEX).
- Composite (COMP).
- Jointed Concrete (JCP).
- Continuously Reinforced Concrete (CRCP).

Figure 10 illustrates a decision tree for a four-lane FLEX. The trees recommend treatments based on parameters such as rural vs. urban, average annual daily traffic (AADT), levels of rutting, faulting, several types of cracking, roughness, etc. There are four treatment categories:

- Do Nothing.
- Preventive Maintenance. Includes fog, chip and scrub seals, and treatments up to a 1.5" overlay.
- Minor Rehabilitation. Begins with mill and overlay (approximately 3" overlay).
- Major Rehabilitation. Includes such treatments as concrete pavement rehabilitation/ overlay, base repair, and 4.5" overlay, up to full-depth reclamation (FDR).

Figure 10. Four-lane Flexible Pavement (FLEX)



Source: MDOT.

Pavement Management System (PMS)

MDOT is currently migrating to the Deighton Total Infrastructure Management System (dTIMS) software for housing, updating, and analyzing PMS data. dTIMS will offer optimization and cost/benefit capabilities. Whereas the decision trees identify needed treatment to a certain pavement at the moment based on the most recent condition survey, dTIMS will introduce time and money into the analysis. In other words, the new software will enable MDOT to forecast deterioration and recommend optimized future treatments based on condition and available funds.

An estimated timeline for dTIMS implementation is shown in Table 13. MDOT's new PMS will support life-cycle management activities in two stages:

- In the first stage, multiple treatment strategies will be generated for each analysis segment (the current process only allows for one potential treatment).
- In the second stage, dTIMS will select the optimal treatment that minimizes the life-cycle cost of the pavement. The optimization is based on a specific goal, called an objective function, that defines what is to be maximized or minimized across the road network as a whole. Objective functions include maximizing an overall PCR, minimizing a pavement condition such as roughness, or minimizing risk. An optimization also can maximize or minimize an objective given a budget constraint.

Table 13. Estimated Timeline for dTIMS Pavement Management System Implementation

Task	Estimated Completion Date	Responsible Parties
Receipt of specifications for BA version upgrade, Project History Application (PHA) updates, and other changes	Aug. 2019	Deighton Associates
Approval of specs and acceptance criteria	Sept. 2019	PMS Staff
Upgrades and changes	Nov. 2019	Deighton Associates
Testing of changes	Winter 2019-2020	PMS/Deighton for fixes
Begin use of revamped dTIMS/PMS	Early 2020	PMS Staff
Updates to costs	Early 2020	PMS Staff, with ISD
Begin running budget scenarios/optimizations	Winter 2019-2020	PMS Staff, upper management review
Data visualization	Ongoing	ISD, PMS Staff
Synching PMS and project data	Ongoing	ISD, PMS Staff
Improvements to MDOT QA of vendor-collected condition data	Spring 2020	PMS, ISD
Adjust decision tree parameters	Fall 2020	PMS staff
Adjust models to match updated decision trees	Late 2020	PMS staff
Test models developed as part of University of Mississippi's artificial neural networks study	Late 2020	PMS staff

Source: MDOT.

4.2 Managing Bridges

Identification and Selection of Bridge Projects

The Project Identification and Selection Process

MDOT has a structured process for using the bridge condition data it collects to assess needs and make project recommendations. The process applies to all State-maintained bridges. MDOT:

- **Organizes bridge inventory and condition data.** The MDOT Bridge Division uses their records of bridge inventory and condition as the first step.
- **Identifies replacement projects.** To develop a project list for bridge replacements, the MDOT has formed a Bridge Priority List Team. The team includes the Assistant Chief Engineer - Pre-Construction, Director of Structures – State Bridge Engineer, Deputy Director of Structures – Assistant State Bridge Engineer, State Bridge Inspection Program Manager, Bridge Management Engineer, Bridge Design Section Engineers, and the State Hydraulics Engineer. The Bridge Priority List Team and Districts work together to develop and refine the list.
  - The Initial Priority List Team calculates the bridge Replacement Index (RI) and sorts bridges from high to low into the Initial Bridge Replacement Priority List. The RI is intended to show the relative importance of a bridge to the traveling public. The method used to calculate RI is described later in this section.
  - The Initial Priority List Team describes the reason for/against replacing every structure. In some cases, the team also will recommend repairs, maintenance, or other treatments.
  - The Initial Priority List Team develops an Initial Bridge Replacement Priority List. The team sorts the projects into fiscal years to match anticipated funding. It also considers any special structural issues not quantifiable by RI, updated inspection reports, or other supporting documentation. The list extends for five fiscal years.
  - The Initial Priority List Team sorts the Initial Bridge Priority List and truncates the list to include only bridges that fall within the five fiscal years. The team sends the list to MDOT Districts for review as the Recommended Bridge Replacement Priority List. The team supplements the RI with information from the State Bridge Inspection Program Manager and the District Bridge Inspection Engineers to ensure that bridges in similar structural condition on the same route are considered for replacement in the same fiscal year.

- The Districts provides information that cannot be calculated, such as anticipated growth areas, corridor improvement initiatives, environmental issues that may delay construction, and socioeconomic factors. Districts are required to provide documentation, such as traffic data and accident reports to support recommended deviations from the projects provided in the Recommended Bridge Replacement Priority List. The District sends the list back to the Initial Bridge Priority List Team.

- The Priority list team reviews the District recommendations and develops a Final Bridge Replacement Priority List. The Team drafts a Final Bridge Replacement Priority Report that combines the Final List with District recommendations and supporting documentation. This report indicates the replacement indices for each bridge, as well as relevant information for bridge replacement projects such as the programmed cost.

- **Identifies maintenance and preservation projects.** Regular maintenance on bridges can extend the bridge service life, reducing the life-cycle cost. To identify maintenance work, the MDOT Bridge Division:

  - Identifies **Interstate bridges for widening and preservation** projects. The State has funds for Interstate bridge widening and preservation.

  - Identifies **bridge painting** projects by prioritizing a Statewide list of painting needs.

  - Develops a list of bridges with specific deteriorated elements for **cyclical maintenance**. Examples of cyclical maintenance would be joint repair at five to ten years and painting at 20 to 25 years, if warranted and depending on the condition of these elements.

  - Develops a list of **corrective maintenance** treatments based on bridge inspection data. Corrective maintenance involves repairs to deteriorated elements of bridges that are otherwise in good structural condition. During the bridge prioritization process, if it is determined that a structure can be repaired using corrective actions at no more than 20 percent of the replacement cost and result in an extension of service life, then this strategy may be employed in lieu of replacement.

Bridge Replacement Index

The Replacement Index (RI) represents the significance of a bridge to the traveling public relative to the significance of all other bridges in the State inventory. MDOT calculates the RI based on average daily traffic (ADT), bypass/detour length, and structural evaluation. A higher value indicates a higher priority to the public, which makes it a higher priority for replacement. The various components of the Replacement Index Model are discussed further here.

Traffic-Detour Factor

For the first part of the model, MDOT accounts for the effects of the traffic and how far the traffic would have to travel in order to detour the bridge in the event that it was closed. This is

accomplished by multiplying the bridge's Average Daily Traffic (ADT) (NBI item 29) with the bridge's bypass detour length (NBI item 19). However, the result of this product varies widely. In order to keep provide both practical and manageable values, MDOT created the Traffic-Detour Factor which varies from 0 to10. A range of factors for the product of the ADT and Bypass Detour Length was established (Table 14), and interpolations are used to obtain an actual Traffic-Detour Factor.

Table 14. Traffic Detour Factor

(ADT) X (Bypass Detour Length)	Traffic-Detour Factor
0	0
3,000	2.5
10,000	5
30,000	7.5
90,000	10

Source: MDOT.

Bridges with a product of ADT and Bypass Detour Length greater than 90,000 have a Traffic-Detour Factor of 10. As example of the interpolations that are used, for a bridge with an ADT of 1,500 and Bypass Detour Length of 10 miles, the interpolated Traffic-Detour Factor is 5.625.

Traffic Weight and Structure Evaluation Weight

The "Replacement Index" is computed considering a combination of the effects of the Traffic-Detour Factor and the Structure Evaluation (NBI item 67). In computing this, MDOT decided that for bridges in worse structural condition, the "traffic effects" should take on more significance. This means that as a bridge's structural condition worsens, traffic has an exponential effect on the bridge's deterioration and possible failure. In order to model this behavior, a range of weights was established for the effects that the Traffic-Detour Factor and Structure Evaluation can have on the Replacement Index based on a range of Structural Evaluation values (Table 15). As with the Traffic-Detour Factor, interpolation is required to obtain the actual Traffic Weight and Structure Evaluation Weight.

Table 15. Traffic Weight and Structure Evaluation Weight

Structure Evaluation	Traffic Weight	Structure Evaluation Weight
0	35	65
3	30	70
5	25	75
7	10	90
10	10	90

Source: MDOT.

For example, a bridge with a Structure Evaluation of 4, the Traffic Weight is 27.5 and the Structure Evaluation Weight is 72.5.

The "Replacement Index" is computed as follows:[1]

$$RI = (TDF \times \left(\frac{TW}{100}\right) + (10 - SE) \times (\frac{SEW}{100})) \times 10$$

RI = Replacement Index

TDF = Traffic-Detour Factor

TW = Traffic Weight (e.g., 27.5)

SE = Structure Evaluation

SEW = Structure Evaluation Weight (e.g., 72.5)

For example, a bridge with an ADT of 1,500, Bypass Detour Length of 10 miles, and Structure Evaluation of 4:

$$RI = \left(5.625 \times \left(\frac{27.5}{100}\right) + (10 - 4) \times \left(\frac{72.5}{100}\right)\right) \times 10 = 58.97$$

Bridge Maintenance Treatments

Table 16 lists the MDOT cyclical and corrective bridge maintenance treatments.

Table 16. Bridge Maintenance Treatments

Element	Type of Maintenance	Treatments
Deck	Cyclical Maintenance	• Joint repair or replace 5 to 10 years. • Deck healer/sealer treatments 15 years. • Deck overlays (new and replacement) 20 to 25 years. • Drainage system cleaning and repair (including bridge scuppers) Annually. • Bridge washing annually.
	Corrective Maintenance	• Deck replacement (to current width). • Approach slab replacement or repair. • Minor deck rehabilitation. • Crack sealing or patching.
Superstructure	Cyclical Maintenance	• Bearing replacement 50 years.

[1] MDOT Bridge Prioritization Process Overview.

Element	Type of Maintenance	Treatments
	Corrective Maintenance	• Retrofit of fatigue-prone details. • Retrofit of Fracture Critical Members. • Bearing reset. • Bearing lubrication.
Substructure	Cyclical Maintenance	• Clean bridge seats and abutments 5 years.
	Corrective Maintenance	• Replace or repair damaged elements. • Scour remediation/countermeasures.
Painting	Cyclical Maintenance	• Bridge painting 20 to 25 years.

Source: MDOT.

Bridge Management System (BMS)

To aid in making further improvements to the prioritization process, MDOT has been working with a consultant for several years to implement AASHTOWare Bridge Resource Management (BrM) and to develop bridge element deterioration models and incorporate life-cycle cost optimization models. BrM is designed to use element-level condition ratings, probability, cost data, deterioration models, benefit/cost analysis, and optimization algorithms to help MDOT select the right treatments at the right time to minimize the life-cycle cost of its network of bridges. This approach utilizes Element Level Bridge Inspection, which breaks down each structure into individual elements that provide a more detailed assessment of the bridge. By using element level data, structure performance can be more accurately analyzed by predicting structure deterioration based on the average condition ratings collected for each bridge component. The estimated schedule for BMS implementation is shown in Table 17.

In support of this, MDOT has updated its inspection procedures to include bridge element detail and has been collecting maintenance cost data to make its predictions as accurate as possible.

Table 17. Estimated Timeline for Bridge Management System Implementation

Task	Estimated Completion	Responsible Parties
Complete the testing, vetting, and setup of AASHTO Bridge Management	June 2020	Bridge Group and Software Vendor
Finalize the data sync between InspectTech and AASHTO Bridge Management	June 2020	Bridge Group and Software Vendor
Develop cost models, deterioration curves and other data needed for operation of AASHTO Bridge Management	Dec. 2020	Bridge Group
Test, review, and configure AASHTO Bridge Management on real inspection data	June 2021	Bridge Group
AASHTO Bridge Management fully operational for recommending bridge replacement prioritization, repair, and preservation	June 2022	Bridge Group
Obtain senior leadership and commission approval of revised preservation program	June 2022	Bridge Group and Administrative Branch
Adjust funding for bridge preservation based on life cycle cost analysis	Dec. 2022	Bridge Group and Administrative Branch
Incorporate AASHTO Bridge Management outputs into STIP development process	Dec. 2022	Bridge Group and Administrative Branch
Report revised targets to FHWA and local agencies	Dec. 2022	Bridge Group and Administrative Branch
Further evaluation and improvement	Ongoing	Bridge Group

Source: MDOT.

5.0 Managing Risk

Risk refers to events, such as performance failure, weather events, cost controls, the selection of suboptimal preservation projects, regulatory delays, construction delays, etc., which have the potential to interfere in MDOT's ability to perform its mission and reach SOGR targets.

As part of the development of a comprehensive risk register, MDOT took the following steps:

- **Establish a risk context.** Goals, objectives, and targets were considered to ensure they were supported by efforts to manage risks.
- **Identify risks.** MDOT identified events that could impact MDOT's ability to manage Mississippi's bridges and pavements effectively.
- **Assess risks.** MDOT assessed the likelihood of an event happening and the consequences if that event does occur.
- **Prioritize risks.** MDOT determined, based on the risk assessment, where to focus attention and resources.
- **Identify risk treatments.** MDOT identified a strategy or set of strategies to address each priority risk.
- **Monitor risks.** MDOT assigned risk monitoring and review duties to ensure MDOT is monitoring and responding to possible events, evaluating the effectiveness of treatments, and periodically updating risk priorities.

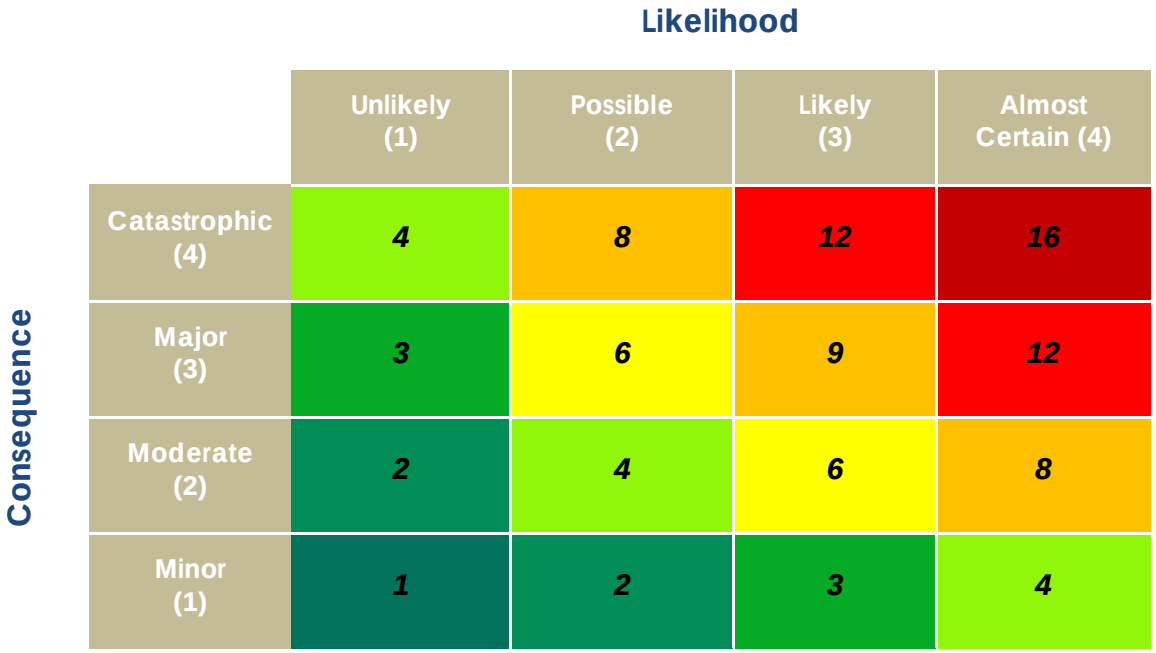
5.1 Risk Register

A comprehensive risk register was developed as part of the MDOT/FHWA Stewardship and Oversight Agreement. This served as a starting point for the development of a risk register specific to the assets discussed within this TAMP (NHS pavements and bridges).

There are two elements in the quantitative assessment of risk: likelihood and consequence. The likelihood of an event occurring was determined to be within one of four categories: Unlikely, Possible, Likely, and Almost Certain. The consequences of an event occurring were determined to be minor, moderate, major, and catastrophic. An overall risk score was calculated by multiplying the quantitative values assigned to each consequence and likelihood category (a simple one to four range).

Figure 11 shows how overall risk score is a factor of both likelihood and consequences. The lowest risks are in the bottom left with a likelihood category of Unlikely and a consequences category of Minor. The highest theoretical risk would have a likelihood category of Almost Certain and a consequences category of Catastrophic.

Figure 11. Risk Assessment Scoring



Source: MDOT.

In addition to the quantitative scoring, MDOT prioritized each list of risks for pavement and bridges. This priority rating not only reflects the importance of the risk. It also reflects MDOT's ability to mitigate that risk through its actions. MDOT found that the highest priority risks for pavements and bridges share some common threads such as:

- Flat or uncertain funding/rising project costs.
- Differing sources of data and the potential for inconsistencies.
- Knowledge continuity within MDOT.
- Meeting compliance requirements of Federal regulations.

Some of MDOT's greatest concerns are tied to the Federal requirements for performance reporting. MDOT has traditionally focused on State-maintained roads and bridges but is now responsible for performance reporting and management on the entire NHS. Non-State-maintained roads and bridges have the potential to impact the overall system performance negatively. Additionally, MDOT's preferred pavement performance measure is PCR. The latest Federal guidelines on reporting use IRI, rutting, faulting, and cracking as primary pavement measures. MDOT is concerned over the potential for misrepresentation and/or inconsistency as these measures do not capture the full story of pavement condition.

At the present time, MDOT has assigned responsibility for oversight of the risk registers to each of the asset type leads. They will be responsible for the integration of the risk registers into ongoing decision-making and their upkeep, which may include annual or biannual updates. The pavement risk register will be maintained and overseen by the Research Division, which is leading pavement data collection and reporting as well as the implementation of the PMS. The bridge risk register will be maintained by the Bridge Division.

Table 18 contains the **pavement** risks, their quantitative rating, and MDOT's response strategies. The list is ordered from **highest priority to lowest priority** based on an assessment by MDOT staff. This priority rating does not necessarily correspond to the quantitative rating. In the tables, "L" refers to Likelihood, "C" refers to Consequences, and "V" refers to the Value or overall risk score.

Table 18. Pavement Risk Register

Risk Statement	Ratings	Risk Mitigation Plan
If flat/uncertain funding continues, the condition of the State-maintained pavement will continue to deteriorate.	L: Likely C: Moderate V: 6	Effectively communicate to the public and lawmakers the consequences of inadequate funding for pavements.
If project costs continue to rise, the ability to maintain the condition of pavements could force the Department into "worst-first" decision-making.	L: Likely C: Moderate V: 6	Same as above.
If an unexpected event occurs (for example, a temporary funding cut), deterioration of pavement condition will accelerate.	L: Possible C: Moderate V: 4	Same as above.
If the public and elected officials take data from different reports and are not aware of why the data differ, a loss of faith in the data and our credibility could suffer.	L: Likely C: Moderate V: 6	Thoroughly document data sources (HPMS, PMS, State-maintained/NHS, etc.). Educate TAM staff in committee meetings. Keep upper management aware.
If long-term employee retention is compromised, by staff leaving for other jobs and/or retirements, knowledge continuity will suffer.	L: Likely C: Moderate V: 6	Cross-train employees and capture knowledge. Mentor new staff.
If quality pavement management data is not collected in a timely manner, then selection, prioritization, and programming of pavement projects may be adversely affected.	L: Possible C: Moderate V: 4	Implement a pavement management QA/QC plan (underway). Closely monitor data collection timelines and milestones.
If data gaps on Non-State-maintained routes continue, the continuity of reporting and performance target setting between State-maintained NHS and Non-State-maintained NHS could be compromised.	L: Almost Certain C: Minor V: 4	MDOT is in the process of identifying data gaps and adding any necessary segments to the pavement condition survey as necessary.

Source: MDOT.

Table 19 contains the **bridge** risks, their quantitative rating, and MDOT's response strategies. As before, the list is ordered from **highest priority to lowest priority** based on an assessment by MDOT staff.

Table 19. Risk Register for All Bridges

Risk Statement	Ratings	Risk Mitigation Plan
If a temporary funding cut occurs, deterioration of bridge condition will accelerate. Cuts to either Federal or State funding are risks to be considered.	L: Possible C: Catastrophic V: 8	Conduct performance-based needs analyses to estimate the impact of reduced funding; Effectively communicate to the public and lawmakers the consequences of inadequate funding for bridges.
If local bridges are not properly load rated, posted, and closed, then the potential for bridge failure could put the motoring public at risk.	L: Likely C: Major V: 9	Ensure local bridge annual NBI data submittal is updated in a timely manner to reflect current postings and closings; Review/Refine tracking system to ensure local bridges are posted and closed in a timely manner; Continue to implement State Aid's Load Rating Plan of Action (POA).
If the local bridge inspection program does not comply with the Federal regulations, then the condition of the bridges could potentially put the motoring public at risk, and a loss of Federal funds could occur.	L: Possible C: Catastrophic V: 8	Continue to implement State Aid's NBIS Improvement Plan; Conduct Annual NBIS Review of State Aid's bridge program as required by FHWA.
If long-term employee retention is compromised, by staff leaving for other jobs and/or retirements, knowledge continuity will suffer.	L: Likely C: Moderate V: 6	Cross-train employees and capture knowledge; Mentor new staff.
If project costs rise at a faster rate than revenues, the ability to maintain the condition of our bridges could force the Department into "worst-first" decision-making.	L: Likely C: Moderate V: 6	Conduct performance-based needs analyses to estimate the impact of reduced funding; Effectively communicate to the public and lawmakers the consequences of inadequate funding for bridges.
If flat/uncertain funding continues, the condition of the State-maintained bridges will continue to deteriorate.	L: Likely C: Moderate V: 6	Same as above.
If the minimum condition level established by the FAST Act on NHS bridges is not met for three consecutive years, Federal funding flexibility will be reduced	L: Unlikely C: Moderate V: 2	Conduct performance-based needs analyses to estimate the minimum investment level to meet FAST Act requirements
If quality bridge condition data is not collected in a timely manner, then selection, prioritization, and programming of bridge projects may be adversely affected.	L: Unlikely C: Moderate V: 2	Monitor bridge inspections to ensure they meet the requirements of the NBIS

Source: MDOT.

5.2 Evaluating Assets Repeatedly Damaged by Emergency Events

Federal regulations require that each State conduct statewide evaluations to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events. The likelihood of these events occurring is minimal but could have a major impact. According to FHWA, evaluation is defined as "an analysis that includes identification and consideration of any alternative that will mitigate, or partially or fully resolve, the root cause of the recurring damage, the costs of achieving the solution, and the likely duration of the solution." According to the regulations "emergency event means a natural disaster or catastrophic failure resulting in an emergency declared by the Governor of the State or an emergency or disaster declared by the President of the United States" and "reasonable alternatives include options that could partially or fully achieve the following:

1. Reduce the need for Federal funds to be expended on emergency repair and reconstruction activities.

2. Better protect public safety and health and the human and natural environment.

3. Meet transportation needs as described in the relevant and applicable Federal, State, local, and tribal plans and programs."

Although this requirement was established as a standalone rule, the TAMP requires "a summary of the evaluations of facilities repeatedly damaged by emergency events."

Since January 1, 1997, 39 Major Disaster or Emergency Declarations have been issued for one or more counties within the State of Mississippi (see Table 20). Major Disaster or Emergency Declarations are requested by the governor, through the regional FEMA office, and approved by the President of the United States if it is shown that "the disaster is of such severity and magnitude that effective response is beyond the capabilities of the State and the local governments and that Federal assistance is necessary" (Federal Emergency Management Agency (FEMA)). Both declaration types authorize the President to provide Federal disaster assistance. However, the total amount of assistance offered through an Emergency Declaration is limited to $5 million. Smaller incidents that can be managed by State or local officials are not included on this list. Although there are many FEMA disaster types, including chemical/biological, industry hardship, radiation leak, and terrorism, the only declared major disasters in Mississippi in the last few decades have been natural in origin. In fact, going back to 1953, only one non-natural incident is listed as a declared Major Disaster, the Mississippi Chlorine Barge Accident of 1962 (a barge carrying over 1,000 tons of chlorine gas sunk near Natchez).

As a result of the listed emergency events, there is no record of NHS facilities having been repeatedly damaged requiring repair or reconstruction on two or more occasions. While the impact of a major weather event could have a major impact on the NHS, all feasible measures have been taken to ensure the State highways remain operational. MDOT will continue to monitor emergency events and conduct evaluations as required.

Table 20. Major Disaster Declarations in Mississippi, 1997–2019

Disaster/Emergency	Date Declared
Mississippi Severe Storms, Straight-line Winds, Tornadoes, and Flooding (DR-4429)	4/23/2019
Mississippi Severe Storms, Flooding, and Tornado (DR-4415)	2/14/2019
Mississippi Hurricane Nate (DR-4350)	11/22/2017
Mississippi Hurricane Nate (EM-3393)	10/7/2017
Mississippi Severe Storms, Tornadoes, Straight-line Winds, and Flooding (DR-4314)	5/22/2017
Mississippi Severe Storms, Tornadoes, Straight-line Winds, and Flooding (DR-4295)	1/25/2017
Mississippi Severe Storms and Flooding (DR-4268)	3/25/2016
Mississippi Severe Storms, Tornadoes, Straight-line Winds, and Flooding (DR-4248)	1/4/2016
Mississippi Severe Storms and Tornadoes (DR-4205)	1/6/2015
Mississippi Severe Storms, Tornadoes, and Flooding (DR-4175)	4/29/2014
Mississippi Severe Storms, Tornadoes, and Flooding (DR-4101)	2/12/2013
Mississippi Hurricane Isaac (DR-4081)	8/28/2012
Mississippi Tropical Storm Isaac (EM-3348)	8/27/2012
Mississippi Flooding (DR-1983)	5/10/2011
Mississippi Flooding (EM-3320)	5/3/2011
Mississippi Severe Storms, Tornadoes, Straight-line Winds, and Associated Flooding (DR-1972)	4/28/2011
Mississippi Severe Storms, Tornadoes, and Flooding (DR-1916)	5/13/2010
Mississippi Severe Storms, Tornadoes, and Flooding (DR-1906)	4/28/2010
Mississippi Severe Storms, Flooding, and Tornadoes (DR-1837)	5/11/2009
Mississippi Hurricane Gustav (DR-1794)	9/21/2008
Mississippi Hurricane Gustav (EM-3291)	8/29/2008
Mississippi Severe Storms and Tornadoes (DR-1764)	5/27/2008
Mississippi Severe Storms and Flooding (DR-1753)	5/7/2008
Mississippi Hurricane Katrina (DR-1604)	8/28/2005
Mississippi Hurricane Katrina (EM-3213)	8/27/2005
Mississippi Hurricane Dennis (DR-1594)	7/9/2005
Mississippi Hurricane Ivan (DR-1550)	9/14/2004
Mississippi Severe Storms, Tornadoes, and High Winds (DR-1470)	5/22/2003
Mississippi Severe Storms, Tornadoes and Flooding (DR-1459)	4/23/2003
Mississippi Severe Storms and Tornadoes (DR-1443)	11/13/2002
Mississippi Tropical Storm Isidore (DR-1436)	9/30/2002
Mississippi Severe Storms and Tornadoes (DR-1398)	12/6/2001
Mississippi Tropical Storm Allison (DR-1382)	6/20/2001
Mississippi Severe Storms and Flooding (DR-1365)	4/16/2001
Mississippi Tornadoes and Severe Storms (DR-1360)	2/22/2001
Mississippi Severe Winter Storms, Ice, and Freezing Rain (DR-1265)	1/24/1999
Mississippi Hurricane Georges (DR-1251)	9/30/1998
Mississippi Hurricane Georges (EM-3132)	9/27/1998
Mississippi Flooding (DR-1178)	6/12/1997

Source: MDOT and FEMA.

6.0 Performance Gap Analysis

The gap analysis compares future performance with current funding levels against four-year performance targets. The difference between the two is a performance gap. Section 2.1 and 3.1 details the current performance and historical performance trends for pavements and bridges, respectively.

6.1 Pavement Performance Gap Analysis

Mississippi will continue to prioritize Interstates and Non-Interstate NHS roads. With remaining funds, it will invest in non-NHS State-maintained two-lane roads. With planned expenditures, MDOT anticipates the following performance gaps:

Interstates

For Interstate pavements:

- The current condition is 0.5% poor and 67% good based on the Federal Measure.
- MDOT anticipates making an investment of $110 million per year over the next 10 years.
- At this investment level, the future condition will be 0.3% poor and 36% good.
- The four-year target performance (based on the Federal measure) is <5% poor and >55% good.
- Based on the HERS analysis, $110 million annual investments in the Interstate will lead to a decline in the amount of good pavement and an increase in the amount of fair pavement. In the short-term, this will not lead to an increase in poor pavement. In the long-term, this investment level will lead to an increase in poor Interstate pavement.

Performance Condition Analytics

MDOT currently is in the process of implementing AASHTOware BrM for bridge management and dTIMS for pavement management. The systems will give MDOT the analytical engines it needs to predict asset condition with any investment level.

These systems were not available during the development of this TAMP. Any results shown here are subject to change when the MDOT systems are operational.

While its own systems were under development, MDOT used the National Bridge Investment Analysis System (NBIAS) and the Highway Economic Requirements System (HERS) to assess bridge and pavement needs.

With State-specific parameters, NBIAS and HERS can help identify needs. Still, the results need caveats. This is especially true for pavements:

- HERS uses the Highway Performance Monitoring System (HPMS) dataset, converts cracking, rutting, and IRI to a calculated IRI measure, and uses this to understand pavement investment needs. HERS does not use PCR or the Federal measure.
- HERS uses sample pavement condition data while MDOT uses data for the full network.

- Based on the HERS analysis, an annual investment of $110 million appears to keep the current condition distribution intact.

Non-Interstate NHS

For Non-Interstate NHS:

- The current condition is 4% poor and 35% good, based on the Federal measure.
- MDOT anticipates making an investment of $50 million per year over the next 10 years.
- At this investment level, the future condition will be 16% poor and 26% good.
- The target performance for Non-Interstate NHS (based on the Federal measure) is <10% poor and >25% good.
- A $50 million annual investments in Non-Interstate NHS will lead to a decline in the amount of good pavement and an increase in the amount of fair and poor pavement. This matches historical trends. Based on PCR, State-maintained highways in poor condition have increased by approximately 14 percent over the last decade.
- Based on the HERS analysis, an annual investment of $275 million will be needed to reverse the decline of pavement condition.
- To close this performance gap, additional funding is needed. The performance gap can also be reduced by implementation of the dTIMS PMS, which can help lower the costs of keeping the Non-Interstate NHS pavement in a state of good repair.

Table 21 summarizes the findings of the pavement performance gap analysis. MULTIPLAN 2045 will allocate resources for all State-maintained pavements. Pavement needs for the entire state-maintained highway system were estimated in 2016 at approximately $2 billion or greater. This is due to the large amount of non-NHS mileage in a largely rural state. The $2 billion figure has likely increased with more pavement falling into Poor or Very Poor condition. 2019 estimates are currently unavailable.

Table 21. NHS Pavement Performance Gap Summary

	Interstate	Non-Interstate NHS
2017 Spend	$123 m	$33 m
Current Condition (Federal Measure)	0.5% poor 67% good	4% poor 35% good
Four-Year Target (Federal Measure)	*<5% poor* *>55% good*	*<10% poor* *>25% good*
Estimated 10-Year Annual Spend Based on Reasonable Budget	$110 m	$50 m
Condition After 10-Years Based on Reasonable Budget	0.3% poor 36% good	16% poor 26% good
Estimated 10-Year Annual Spend to Meet Target	$110 m	$275 m
Condition After 10-Years Based on Increased Budget	0.5% poor 36% good	10% poor 47% good
Performance Gap	$0 m[1]	$225 m

Source: MDOT 2017 FHWA 534 report submission, Cambridge Systematics analysis.

[1] *Interstates have a performance gap to meet the target for percentage of good pavement. This will be estimated in MULITPLAN 2045.*

State-Maintained Non-NHS 4-Lane

For State-Maintained Non-NHS 4-Lane pavement:

- The current condition is 27% poor and 73% fair or good, based on PCR.
- MDOT anticipates making an investment of $4 million per year over the next 10 years.
- At this investment level, the future condition will be 25% poor and 75% fair or good.
- The target performance for State-Maintained Non-NHS 4-lane (based on PCR) is <25% poor.
- A $4 million annual investment in State-Maintained Non-NHS 4-lane will lead to a decline in the amount of poor pavement and an increase in the amount of fair and good pavement.
- There is no performance gap for this category.

State-Maintained Non-NHS 2-Lane

For State-Maintained Non-NHS 2-Lane pavement:

- The current condition is 32% poor and 68% fair or good, based on PCR.

- MDOT anticipates making an investment of $48 million per year over the next 10 years.
- At this investment level, the future condition will be 86% poor and 14% fair or good.
- The target performance for State-Maintained Non-NHS 2-lane (based on PCR) is <25% poor.
- An $48 million annual investment in State-Maintained Non-NHS 2-lane will lead to a significant increase in the amount of poor pavement and an decrease in the amount of fair and good pavement.
- There is a large performance gap for this category. An estimate of the total gap is not yet available, and will be estimated as part of MDOT's upcoming long range transportation plan. To close this performance gap, additional funding is needed. The performance gap can also be somewhat reduced by implementation of the dTIMS PMS, which can help lower the costs of keeping the State-Maintained Non-NHS 2-lane pavement in a state of good repair.

Table 22 presents the performance summary of the non-NHS pavement.

Table 22. Non-NHS Pavement Performance Summary

	State-Maintained Non-NHS 4-Lane	State-Maintained Non-NHS 2-Lane
2017 Spend	$56 m	
Current Condition (PCR)	27% poor 73% fair+good	32% poor 68% fair+good
Four-Year Target (PCR)	*<25% poor*	*<25% poor*
Estimated 10-Year Annual Spend Based on Reasonable Budget	$4 m	$48 m
Condition After 10-Years Based on Reasonable Budget	25% poor 75% fair+good	86% poor 14% fair+good

Source: MDOT 2017 FHWA 534 report submission, Cambridge Systematics analysis.

6.2 Bridge Performance Gap Analysis

The established performance target for bridges is no more than 5 percent percent of the total deck area shall be in poor condition on NHS bridges. As of the 2018 NBI data submittal to FHWA, the total deck area of NHS bridges in Mississippi that is in good or fair condition is 2.2 percent, which indicates that there is no condition gap for this asset at this time using the established Federal targets.

For NHS bridges:

- The current condition is 2% poor and 62% good by deck area.

- MDOT anticipates making an investment of $50 million per year over the next 10 years on the NHS bridge system.
- At this investment level, the future condition will be 5% poor and 80% good.
- The target performance for NHS bridges is <5% poor and >60% good.
- A $50 million annual investment in NHS bridges will enable MDOT to meet its targets, and there is no performance gap.

For State-Maintained Non-NHS bridges:

- The current condition is 3% poor and 70% good by deck area.
- MDOT anticipates making an investment of $55 million per year on State-maintained Non-NHS bridges.
- At this investment level, the future condition will be 3% poor and 85% good.
- The target performance for Non-NHS bridges is <3% poor and >60% good.
- A $55 million annual investment in NHS bridges will enable MDOT to meet its targets, and there is no performance gap.

Table 23 summarizes the findings of the bridge performance gap analysis for NHS bridges. MULTIPLAN 2045 will allocate resources for all State-maintained bridges. The goal of the FHWA Final Rulemaking for Asset Management Plans & Processes is to achieve and sustain assets in a "state of good repair". In an effort to remain consistent with this concept, we have included all bridges on our inventory that would require either repair or replacement in order to bring them up to an NBI Condition Classification of "Good". This results in a total of 1,865 bridges as of the 2018 NBI Submittal date of March 15, 2018. In summary, the data below is calculated by using a replacement cost for all bridges categorized as poor, and 20% of replacement costs to rehab all bridges categorized as fair. These 1,865 bridges result in a needs backlog of $2 billion, which comes from:

- Replace All Poor Bridges: $613.4 million.
- Repair All Fair Bridges at 20% of Replacement Cost: $1,374.3 million.

Table 23. NHS and Non-NHS Bridge Performance Gap Summary

	NHS	Non-NHS
2017 Spend	$51 m	$113 m
Current Condition	2% poor 62% good	3% poor 70% good
Four-Year Target	<5% poor >60% good	<3% poor >60% good
Estimated 10-Year Annual Spend Based on Reasonable Budget	$50 m	$55 m
Condition After 10-Years Based on Reasonable Budget	5% poor 80% good	3% poor 85% good
Estimated 10-Year Annual Spend to Meet Target	$50 m	$55 m
Condition After 10-Years Based on Increased Budget	5% poor 80% good	3% poor 85% good
Performance Gap	$0 m	$0 m

Source: MDOT 2017 FHWA 534 report submission, Cambridge Systematics analysis.

7.0 Financial Plan

This financial plan illustrates the financial State of MDOT and identifies financial needs for the 10-year period. It explains the funding sources and available revenues to support TAM, funding needs to achieve MDOT's goals, objectives, and targets, and an estimated value of MDOT's pavements and bridges.

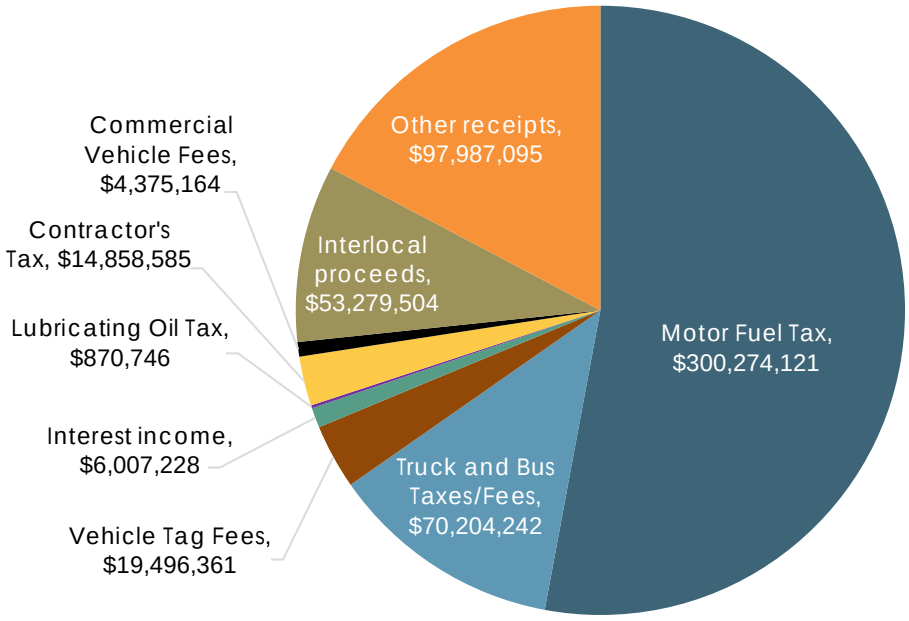
7.1 Revenue Acquisition

MDOT is funded through appropriations by the U.S. Congress and the Mississippi Legislature. In FY2018, MDOT received **$1,096.6 million** in total funding. Congress provides funding through FHWA, the Federal Transit Administration (FTA), the Federal Railroad Administration (FRA), and the Federal Aviation Administration (FAA). For FY2018, MDOT received **$529.2 million** in Federal funds.

The Mississippi Legislature provides state funding through motor fuel taxes and other fees. Figure 12 shows the average share of State revenues available to MDOT on an annual basis. Motor fuel taxes account for 53 percent, followed by truck and bus fees with 13 percent. The commercial vehicle fees are the truck fees collected under the Uniform Carrier Registration. Other receipts include transfers from other funds; receipts for other licenses, fees, and permits; reimbursements and donations; and sales of supplies and services; and others.

The size of these state funds in Fiscal Year 2018 (FY2018) revenue is illustrated in Figure 12.

Figure 12. FY2018 State Fund Revenues for MDOT (millions)



Source: MDOT Annual Report and Statement of Appropriations (2018).

Federal Funding

Federal funds mainly come from FHWA, which provides funding for various surface transportation programs, and from the FTA, which provides financial and technical assistance to support the local public transit systems. Annual disbursements to the State are defined by statutory formulas.

FHWA funding to Mississippi increased from $465 million in 2014 to $517 million in 2018, a CAGR of 2.7 percent (2.2 percent 2015 – 2018). For this analysis, the share that has historically been allocated to Metropolitan Planning and State Planning was subtracted.

FTA funds also increased in nominal dollars from $27 million in 2013 to almost $29 million in 2018, a CAGR of **0.9 percent** per year. FTA funding from 2013 has remained relatively flat, averaging $26–28 million per year.

Motor Fuel Tax

The tax on motor fuels is the State's major revenue source for MDOT. Mississippi has a fuel tax of 18.4 cents per gallon. Under the Mississippi statutes, MDOT receives about 73 percent of total fuel taxes. In FY2018, MDOT received $300.2 million in motor fuel tax, up from $286 million in 2014. Nominally, motor fuel taxes experienced a CAGR of **1.2 percent** between 2014 and 2018, and a CAGR of **2.0 percent** 2015–2018.

Table 24. Historic Motor Fuel Tax Revenues to MDOT ($ millions)

State Revenues	2014	2015	2016	2017	2018	CAGR 2014–2018	CAGR 2015–2018
Total Motor Fuel Tax Revenues	$286.2	$283.3	$315.8	$303.8	$300.3	1.2%	2.0%

Source: MDOT Annual Reports.

Fees

MDOT is also funded through receipts derived from truck and bus fees, which include the truck and privilege tax, weight and size permits, and trip permits; a contractor's tax of 3.5 percent assessed on certain highway construction contracts; a $5 per vehicle tag registration fee; a lubricating oil tax; and interest income. Between FY2014 and FY2018, nominally, these fees have increased from $83 million to $90 million, a CAGR of **2.1 percent**, and a CAGR of **1.4 percent** FY2015 - FY2018, Table 25.

Revenues from truck and bus fees are relatively flat. Revenues from vehicle tag fees also appear to be relatively flat but show a significant dip in FY2017 and a sharp increase in FY2018.

Table 25. Historical Truck/Bus Taxes/Fees and Vehicle Tag Fees Revenues to MDOT ($ millions)

State Revenues	2014	2015	2016	2017	2018	CAGR 2014-2018	CAGR 2015-2018
Truck and Bus Taxes/Fees	$67.1	$70.3	$69.0	$68.6	$70.2	1.1%	0.0%
Vehicle Tag Fees	$15.4	$15.7	$15.9	$14.2	$19.5	6.1%	7.4%
Total	**$82.5**	**$86.0**	**$84.9**	**$82.8**	**$90.4**	**2.1%**	**1.4%**

Source: MDOT Annual Reports.

Interlocal Proceeds

MDOT also funds its transportation program with interlocal proceeds, which are bonds that MDOT must repay. Between FY2014 and FY2018, interlocal proceeds declined $100 million from $153 to $53 million, a CAGR of **-23.1 percent**. Between FY2015 and FY2018, the CAGR was **-16.7 percent**, Table 26.

Table 26. Historic Interlocal Proceed Revenues to MDOT ($ millions)

State Revenues	2014	2015	2016	2017	2018	CAGR 2014–2018	CAGR 2015–2018
Total Interlocal Proceeds	$152.6	$92.1	$41.5	$70.9	$53.3	-23.1%	-16.7%

Source: MDOT Annual Reports.

Minor Sources

Minor sources of MDOT revenues include a contractor's tax of 3.5 percent assessed on certain highway construction contracts; apportioned commercial vehicle fees; a lubricating oil tax; and interest income, Table 27.

Table 27. Historic Minor Source Revenues to MDOT ($ millions)

State Revenues	2014	2015	2016	2017	2018	CAGR 2014–2018	CAGR 2015–2018
Interest income	$4.6	$5.8	$5.9	$5.9	$6.0	6.7%	1.3%
Lubricating Oil Tax	$0.9	$0.9	$0.9	$0.9	$ 0.9	-1.0%	-1.1%
Contractor's Tax	$4.0	$21.5	$19.4	$16.3	$14.9	38.7%	-11.5%
Commercial Vehicle Fees	$2.7	$7.1	$4.7	$4.6	$ 4.4	13.3%	-14.8%
Other Receipts	$80.1	$82.4	$53.2	$129.9	$98.0	5.2%	6.0%
Total	**$92.3**	**$117.7**	**$84.1**	**$157.6**	**$124.2**	**7.7%**	**1.8%**

Source: MDOT Annual Reports.

Between FY2014 and FY2018 most components show robust growth rates, but since FY2014, contractor's tax and commercial vehicle fees show a dramatic decline. Overall, FY2015-FY2018 CAGR was **1.8 percent**.

Overall Distribution of Revenue

In FY2018, MDOT's actual expenditures were **$1,119.6 million**. As presented in Table 28, **$938.1 million** was spent on State- and locally-maintained roads and bridges.[2] Expenditures not related to State-maintained roads and bridges totaled $81.5 million and included transfers for other purposes, transfers for local road and bridge system, and business support activities.

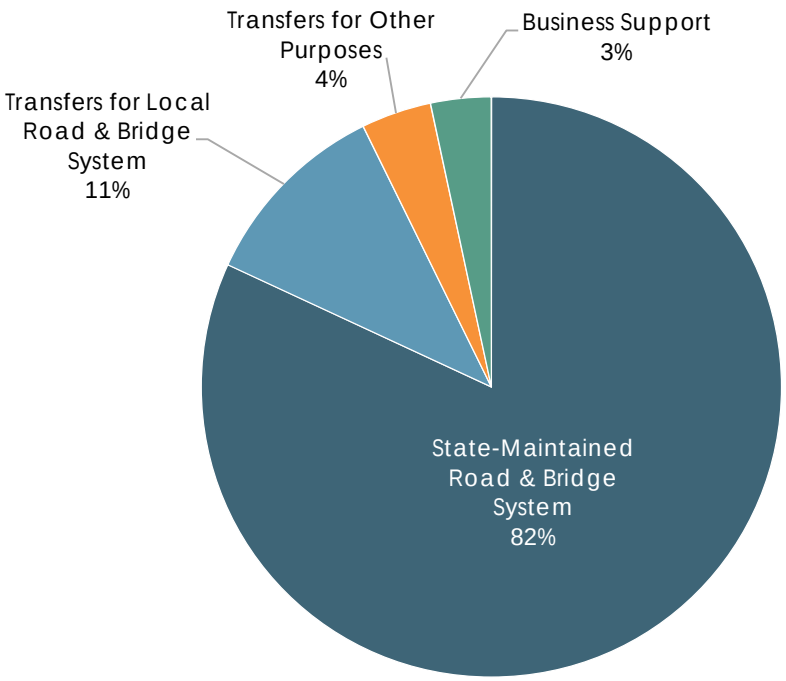
Table 28. MDOT FY2018 Disbursements ($ millions)

Expenditure	FY2018 ($ millions)
State-maintained Road & Bridge System	$817.1
Transfers for Local Road & Bridge System	$121.0
Transfers for Other Purposes	$43.7
Business Support	$37.8
Debt Service, Enforcements, Equipment/Buildings	$100.0
Total Disbursements	**$1,119.6**

Source: MDOT Annual Reports.

[2] Mississippi Department of Transportation Annual Report FY2018.

Figure 13. FY2018 MDOT Funding Allocation



Source: MDOT Annual Report and Statement of Appropriations (2018).

Of the monies spent on State- and locally-maintained roads and bridges, **$604 million** was spent on active MDOT road and bridge contracts, **$4.3 million** was spent on routine bridge repair and maintenance, and **$188.6 million** was spent on routine road maintenance projects such as overlays, restriping, patching pot-holes, controlling invasive plants, and chip sealing.

MDOT spent **$212 million** in FY17 to preserve and maintain the State-maintained pavement network, and **$165 million** to preserve and maintain the State-maintained bridge network.

The $81.5 million in expenditures not related to State-maintained roads and bridges included:

- **Transfers for other purposes** were for state-mandated transfers which include harvest permit revenues and overweight fines to counties, beaver control to the Mississippi Department of Agriculture and Commerce (MDAC), welcome center operations to the Mississippi Development Authority (MDA), antilitter to Keep MS Beautiful, GO payments to the Treasurer, and Multimodal Fund transfers.
- **Federal grant pass-throughs** included Federal Transit grants to public transit providers and Federal Aviation Authority payments.
- **Transfers for local road and bridge system** included Federal Highway pass-throughs to State Aid and local governments for local road and bridge systems.

- **Business support** included support and oversight functions including executive management, financial management, budget, procurement, asset management, audit, human resources, public affairs, and information systems.

On the NHS, based on the 534 reports, in 2017 MDOT spent **$123 million** on Interstate pavements, **$33 million** on Non-Interstate NHS pavement, and **$51 million** on NHS bridges, in addition to spending on engineering, right-of-way, and additional maintenance. This is detailed in Table 29.

Table 29. MDOT FY2017 Spending

Expenditure	NHS Interstate	NHS Non-Interstate	State-Maintained Non-NHS	Total
Right-of-Way and Engineering Costs	$7.8 m	$12.1 m	$46.1 m	$66.0 m
Bridges	$12.1 m	$39.1 m	$113.1 m	$164.3 m
Pavement	$122.9 m	$33.4 m	$56.1 m	$212.4 m
Maintenance	$0 m	$13.6 m	$42.2 m	$55.8 m
Total, All Maintenance and Preservation				**$498.5 m**

Source: MDOT 2017 FHWA 534 report submission.

7.2 Future Funding Levels

This section provides a detailed summary of the data sources and assumptions used to generate the financial revenue forecasts for transportation investments in Mississippi. Revenue forecasts are presented for the programming tier: 2020-2029.

The forecasts are based on current state and Federal funding programs projected into the future. Emphasis was placed on two primary Federal funding sources: the FHWA and FTA programs as administered through the Fixing America's Surface Transportation (FAST) Act (Pub. L. No. 114-94) and two major State revenue sources: motor fuel excise tax (MFT) revenues and truck/bus tax revenues.

The revenue projection consists of conservative assumptions. The forecast reflects the current funding policy and revenue that is reasonably expected to be available.

Federal Funding

Federal funds mainly come from the FHWA, which provides funding for various surface transportation programs, and from the FTA, which provides financial and technical assistance to support the local public transit systems. Annual disbursements to the state are defined by statutory formulas.

For the baseline forecast, apportionments are assumed to grow at an average annual rate of **1.0 percent** which is a conservative assumption based on the historical growth rate. Cambridge Systematics subtracted the share that has historically been allocated to the Metropolitan

Planning, State Planning, and Research programs since these funds cannot be used for highway investments. In addition, the apportionments forecast were reduced by 8 percent, which is the average obligation authority of the state.[3] Total FHWA revenues are estimated at **$5,104 million** for the 2020-2029 period or **$4,574 million** in 2018 dollars.

The majority of FTA funds are apportioned to states on the basis of legislative formulas. These formulas incorporate one or a combination of factors, including population, population density, low-income population, bus revenue vehicle miles, bus passenger miles, fixed guideway revenue vehicle miles, and fixed guideway route miles. The parameters for each of the factors are determined on an annual basis and take into consideration the operating characteristics of all the transit agencies in the nation and the total amount appropriated by Congress every year.

Historically, there has been consistency among most of the factors; however, forecasting revenues applying the formulas implies forecasting the demographical and operational characteristics of all the transit agencies. Therefore, Cambridge Systematics used the historical trend to estimate how much is reasonable to expect from 2020-2029. The main assumption is that funding allocation shares will remain relatively constant.

FTA funds increased in nominal dollars from $26 million in 2014 to almost $29 million in 2018, a CAGR of **0.9 percent** per year (**2.1 percent** 2015 – 2018). FTA funding since 2013, though, has remained relatively flat, averaging $26-28 million per year. For the forecast, annual percent growth in FTA funding, depending on the funding section, ranges between **0.0 and 1.0 percent**. Total FTA revenues are estimated at **$302 million** for the 2020-2029 period or **$271 million** in 2018 dollars. Table 30 presents the projected FHWA and FTA funding for MDOT.

Table 30. Projected Federal 2019–2029 Obligations to Mississippi Gross Revenues ($ millions)

Source	Gross Revenue Nominal Dollars	Gross Revenue 2018 Dollars
FHWA	$5,104	$4,574
FTA	$302	$271
Total	**$5,406**	**$4,845**

Source: Cambridge Systematics.

Traditional State Revenue Sources

MDOT revenues from State sources decreased in nominal dollars from $614 million in 2014 to $568 million in 2018, an average decrease of **1.9 percent** per year (Table 31). However, MDOT revenues from state sources only decreased in nominal dollars from $579 million in 2015 to

[3] Historical apportionments and obligations obtained from the FHWA Highway Statistics database and MAP-21 and FAST Act websites.

$568 million in 2018, an average decrease of **0.7 percent** per year. The components of state revenue are described in the following.

Table 31. Historic Compound Annual Growth Rates (CAGR) for State Revenues to MDOT ($ millions)

State Revenues	2014	2015	2016	2017	2018	CAGR 2014-2018	CAGR 2015-2018
Total Motor Fuel Tax Revenues	$286.2	$283.3	$315.8	$303.8	$300.3	1.2%	2.0%
Truck and Bus Taxes/Fees	$67.1	$70.3	$69.0	$68.6	$70.2	1.1%	0.0%
Vehicle Tag Fees	$15.4	$15.7	$15.9	$14.2	$19.5	6.1%	7.4%
Total Interlocal Proceeds	$152.6	$92.1	$41.5	$70.9	$53.3	-23.1%	-16.7%
Interest income	$4.6	$5.8	$5.9	$5.9	$6.0	6.7%	1.3%
Lubricating Oil Tax	$0.9	$0.9	$0.9	$0.9	$ 0.9	-1.0%	-1.1%
Contractor's Tax	$4.0	$21.5	$19.4	$16.3	$14.9	38.7%	-11.5%
Commercial Vehicle Fees	$2.7	$7.1	$4.7	$4.6	$ 4.4	13.3%	-14.8%
Other Receipts	$80.1	$82.4	$53.2	$129.9	$98.0	5.2%	6.0%
New Sources (HEVT, Lottery)	–	–	–	–	$4.0	NA	NA
Total	**$613.60**	**$579.10**	**$526.30**	**$615.10**	**$571.50**	**-1.9%**	**-0.7%**

Source: MDOT Annual Reports, Cambridge Systematics analysis.

Motor Fuel Tax (MFT) Revenues

MFT revenues represent approximately 27 percent of all MDOT funding in 2018 and 53 percent of all State revenue sources. The state's MFT is 18.4 cents per gallon and is not indexed by inflation. MFT revenue projections were developed using a methodology that recognizes the following:

- **The fuel efficiency of the Mississippi vehicle fleet over time.** Perrin, Thorau & Associates (PTA) provided Cambridge Systematics the annual percent changes in fuel economy of the Mississippi light vehicle fleet over time, as older vehicles are scrapped and are replaced with new vehicles. Fuel efficiency estimates (i.e., miles per gallon) were determined based on a regression model consisting of different independent variables: population age and gender mixes, Gross Domestic Product (GDP), employment, household wealth and incomes, retail fuel prices, and vehicle miles traveled (VMT).

  For truck efficiency, the U.S. Energy Information Administration (EIA) provides projections for fuel economy for freight trucks through the year 2040. The fuel efficiency of the freight fleet in Mississippi is assumed to change at the same rate as the national average.

- **The future growth of vehicle miles traveled (VMT) projections.** Based on data collected from the FHWA Highway Statistics Series, VMTs have grown at an average annual rate of 0.6 percent since 2001, and trucks account for about 11 percent of VMTs. Cambridge

Systematics assumed VMTs would grow at 0.2 percent per year through 2016 to reflect the flat trend over the past five years. After 2016, a rate of 0.7 percent was assumed consistent with the annual growth in the travel demand model.

These two elements were combined to estimate fuel consumption and revenues. Given that MFT collections depend on transfers and other credits, Cambridge Systematics applied the annual percent change in revenue from the model output to MDOT actual revenues. Based on the forecast, MFT revenues are projected to decline at an average annual rate of **0.3 percent** between 2020-2029.

MFT revenues (2020-2029) are estimated at **$3,008 million** or **$2,700 million** in 2018 dollars.

Truck and Bus Fees

Truck and bus fees account for about 6 percent of MDOT annual revenues. These revenues have remained relatively stable between 2014 and 2018. Cambridge Systematics evaluated the historical growth and developed an ordinary least-squares fit of truck and bus fees for the 10 most recent years (2009-2018). Based on this analysis, the projected growth in truck and bus fees and taxes is 0.2 percent per year.

The revenue (2020-2029) from Truck and bus fees is estimated at **$711 million** or **$638 million** in 2018 dollars.

Vehicle Tag Fees

Vehicle tag fees account for 2 percent of MDOT annual revenues. Cambridge Systematics evaluated the historical growth and conducted a regression analysis between revenues and driving population (i.e., 16-85 years). A total of 16 observations were used. The revenue (2020-2029) from Vehicle tag fees is estimated at **$189 million** or **$169 million** in 2018 dollars.

Minor Revenue Sources

Cambridge Systematics used the historical trend of the sources that do not represent a substantive component of the state revenues to estimate future revenues. These other revenue sources and their forecasted values are presented in Table 32. In total, the revenue (2020-2029) from Other revenue sources is estimated at **$573 million** or at **$513 million** in 2018 dollars. For forecasting purposes, interlocal proceeds are not included.

Table 32. Gross Revenue Projections of Minor Revenue Sources ($ millions), Nominal Dollars

Revenue Source	Growth Assumption	Total 2020–2029 Nominal Cost	Total 2019–2029 Cost $2018
Interest Income	$6,007,228 per year through 2029.	$60,072,279	$53,901,004
Lubricating Oil Tax	$870,746 per year through 2029.	$8,707,463	$7,812,938
Contractor's Tax	$18,005,936 per year through 2029 adjusted for inflation.	$196,145,812	$175,619,611
Commercial Vehicle Fees	$4,375,164 per year through 2029.	$43,751,639	$39,256,997
Other Receipts	$25,000,000 (2018). Plus 1% annual growth rate.	$264,170,867	$236,704,670
Total		**$572,848,059**	**$513,295,220**

Source: Cambridge Systematics.

New State Revenue Sources

Recent legislation to help MDOT meet its increasing needs and to address the decline in some of its traditional sources of revenue, new funding sources have been approved. These include a tax of hybrid and electric vehicles (primarily to help offset decreasing fuel tax revenues) and from a state lottery.

Electric Car and Hybrid Tax

The new annual taxes on electric and hybrid vehicles, effective October 1, 2018, is $150 for electric cars and $75 for hybrid cars. Mississippi imposes the new taxes in addition to other taxes on these vehicles. Beginning July 1, 2021, and each following July 1, the Electric Car and Hybrid Taxes (ECHT) will increase by a percentage equal to the U.S. inflation rate for the prior calendar year.

Current ECHT revenues are approximately **$1 million** based on 13,300 hybrid and 300 electric cars registered in Mississippi.

The EIA predicts that battery electric vehicles (BEV) sales increase from less than 1 to 6 percent of total light-duty vehicles sold in the United States over 2016–2040, and plug-in hybrid electric vehicle (PHEV) sales increase from less than 1 to 4 percent over the same period.[4] On the basis of these conservative growth estimates, revenues from the ECHT are assumed to grow 0.2 percent per year.

The revenue (2020-2029) from ECHT is estimated at **$11 million** or at **$9 million** in 2018 dollars.

[4] https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf. Last accessed 3/27/2019.

Lottery and Sports Betting Sales Proceeds

Senate Bill 2001 establishes a State lottery with proceeds dedicated to infrastructure through June 2028. Under this legislation, at least 50 percent of gross revenue from the sale of lottery tickets must be awarded in prize money, while no more than 15 percent can be used to cover the overhead costs of administering the lottery. The remaining proceeds, around 35 percent of gross revenue from the sale of lottery tickets, will be transferred to the State Highway Fund. Currently, MDOT funding from the lottery beginning FY2021, when the lottery will be fully implemented will be **$65 million** annually. The forecast assumes that lottery proceeds will increase annually by 1 percent from FY2021 through FY2029.

Revenues from the tax on sports betting, which was recently legalized in the state, go to the State Highway Fund through June 2028, and then to the General Fund. It is estimated that the revenues are **$3 million** annually. The forecast assumes that sports betting tax revenues will increase annually by 1 percent through FY 2028.

The revenue (2020-2029) from Lottery and Sports Betting proceeds is estimated at **$634 million** or **$564 million** in 2018 dollars.

Gross Revenue Projections

The revenues sources described in the previous sections taken together represent the gross revenue available to MDOT. These are summarized in Table 33.

Table 33. Projected MDOT Revenues (2020-2029) ($ millions)

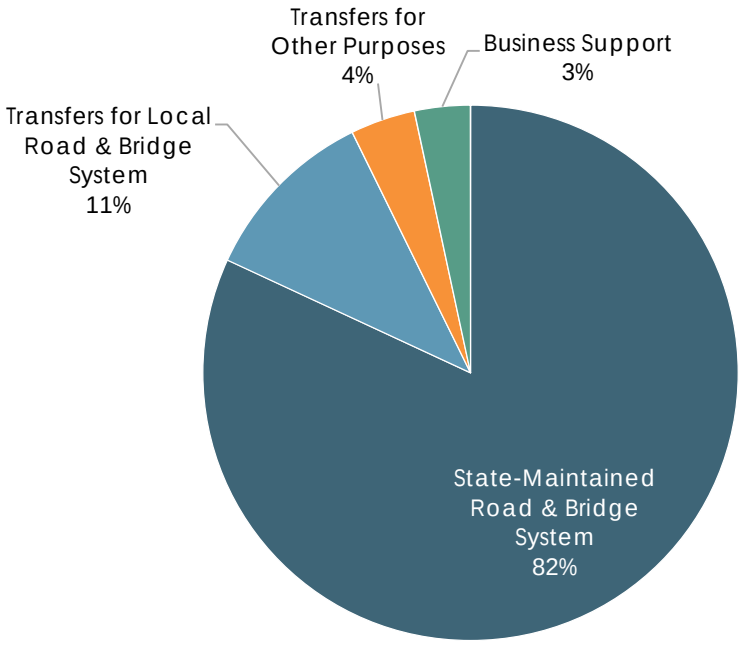
MDOT Revenues (2020-2029)	$ Year of Expenditure	$ 2018
FHWA	$5,104	$4,574
FTA	$302	$271
Total Motor Fuel Tax Revenues	$3,008	$2,700
Truck and Bus Taxes/Fees	$711	$638
Vehicle Tag Fees	$189	$169
Minor Sources	$573	$513
New Sources (HEVT, Lottery)	$645	$573
Totals	**$10,532**	**$9,438**

Source: Cambridge Systematics.

Transportation Expenditures

A large majority of MDOT's annual revenues are used to support the construction program (Figure 14). In FY2018, about 82 percent of the annual revenues are spent directly on the State-maintained system (i.e., construction and maintenance), 11 percent went to Transfers for Local Road & Bridge System, Transfers for Other Purposes was 4 percent and 3 percent went to Business Support.

Figure 14. FY2018 MDOT Expenditures



Source: MDOT Annual Report and Statement of Appropriations (2018).

Debt Service

In addition to Federal funds and state MFT revenues, MDOT uses bond proceeds to finance its transportation program. Outstanding debt service estimates were provided by MDOT. Current debt service payments extend through FY 2040, and it is assumed that no additional bonds are issued during the timeframe of the plan. Outstanding MDOT debt service has been calculated to refine future projected Federal and state revenues.

Bonds issued by MDOT are being paid from MFT revenues and from FHWA revenues. MFT revenues are used to make approximately 20 percent of the bonds debt service payments. The remaining 80 percent of the bonds are paid with the state obligation of future Federal-aid apportionments.

The outstanding debt service over the period 2020-2029 is estimated at **$775 million** or **$695 million** in 2018 dollars.

Non-Construction Program Expenditures

MDOT also has other, non-construction program expenditures including routine maintenance, administration, facilities and equipment, enforcement, pass thru funds to aeronautics, rail and transit and others. Routine maintenance for the State-maintained highway system, which consists of clearing roads, doing minor repairs, mowing, etc., comprises the largest non-construction program expenditure at over $200 million annually. Table 34 displays the historical spending for the other major non-construction program expenditure categories. With the

exception of enforcement and the pass-through monies, there has been a steady decline in non-construction program expenditures over the past few years.

Table 34. Non-Construction Program Expenses

Year	Admin	Routine Maintenance	Enforcement	Aeronatics, Rails, & Other	Non-Project Expenditures	Total
2014	$47,572,456	$193,749,810	$14,125,903	$33,199,588	$49,381,055	**$338,028,812**
2015	$50,471,858	$208,693,601	$13,825,678	$27,785,221	$28,563,000	**$329,339,358**
2016	$52,880,552	$210,013,450	$13,582,737	$32,788,176	$29,882,501	**$339,147,416**
2017	$47,753,278	$205,915,833	$15,171,957	$34,409,181	$27,730,804	**$330,981,053**
2018	$47,591,615	$189,019,040	$14,535,119	$35,025,067	$25,282,008	**$311,452,849**
Mean	**$49,253,952**	**$201,478,347**	**$14,248,279**	**$32,641,446**	**$32,167,874**	**$329,789,898**

Source: MDOT Annual Reports.

During the plan's horizon, non-capital expenditures are estimated to be **$3.1 billion** or **$2.8 billion in 2018 dollars**. This averages about **$313 million** annually in nominal dollars or **$281 million** annually in 2018 dollars, or about 32 percent of the total state transportation budget annually.

Net Revenue Estimates

The net revenue estimates are total MDOT revenues (**$10,531 million**) minus debt service (**$775 million**) and non-construction expenses (**$3,134 million**) and represent that portion of revenues available for construction projects or net revenue (**$6,622 million**). In 2018 dollars, net revenue is estimated at **$5,931 million**.

Table 35 presents the estimated MDOT total revenues, debt service and non-construction expenses, and net revenues for the 2020-2029 forecast horizon.

Debt service obligations are subtracted from gross revenue projections for the final (net) financially constrained forecast to reflect debt repayment needs as a priority before additional transportation investments are considered.

Table 35. Total and Net MDOT Revenues

Year	Total MDOT Revenues	Debt Service	Non-Construction Expenses	Net Revenues (Current Year Dollars)	Net Revenues (2018 Dollars)
2020	$968,235,033	$75,444,858	$312,064,198	$580,725,977	$561,473,609
2021	$1,038,778,256	$75,897,527	$312,370,663	$650,510,066	$618,430,873
2022	$1,044,923,127	$76,352,912	$312,677,659	$655,892,556	$613,124,811
2023	$1,051,044,750	$76,811,029	$312,985,184	$661,248,537	$607,798,969
2024	$1,057,154,844	$77,271,896	$313,293,242	$666,589,706	$602,466,476
2025	$1,063,271,188	$77,735,527	$313,601,832	$671,933,829	$597,145,049
2026	$1,069,400,048	$78,201,940	$313,910,957	$677,287,151	$591,841,226
2027	$1,075,546,208	$78,671,152	$314,220,616	$682,654,440	$586,559,864
2028	$1,081,760,005	$79,143,179	$314,530,813	$688,086,013	$581,344,008
2029	$1,081,430,433	$79,618,038	$314,841,547	$686,970,848	$570,699,938
Total	**$10,531,543,893**	**$775,148,058**	**$3,134,496,711**	**$6,621,899,124**	**$5,930,884,824**

Source: Cambridge Systematics.

Non-Construction Program Expenditures

MDOT also has other, non-construction program expenditures including routine maintenance, administration, facilities and equipment, enforcement, pass thru funds to aeronautics, rail and transit and others. Routine maintenance for the state-owned highway system, which consists of clearing roads, doing minor repairs, mowing, etc., comprises the largest non-construction program expenditure at over $100 million annually. With the exception of enforcement and the pass-through monies, there has been a steady decline in non-construction program expenditures over the past few years.

7.3 Valuation of Assets

MDOT uses the replacement cost method to estimate the value of its assets. This method measures the cost to replace the existing asset with a new one. MDOT estimates the value of the TAMP assets at $80.9 billion in 2016 dollars (Table 36). This value covers all existing pavements, bridges on the NHS, and bridges on the Non-NHS and maintained by the Department.

Table 36. Value of Transportation Assets

TAMP Asset	Value (2016 dollars)[1]
Pavements	$61.6 billion
Bridges	$19.3 billion
Total	**$80.9 billion**

[1] *Estimate excludes Preliminary Engineering (PE), Construction Engineering and Inspection (CE&I) services, and right-of-way (ROW). Source: MDOT.*

8.0 TAMP Investment Strategies

This section describes MDOT's decision process for making investments in its assets. To invest in its assets, MDOT:

- **Makes the annual case for revenue to the legislature.** State funds available to MDOT are appropriated by the Mississippi State legislature. Over the past several years, MDOT has made an effort to educate and inform the legislative process through the submission of annual budget requests and meetings to explain the agency's needs. The budget request is typically a level-request, with the total funding request in line with the anticipated Federal appropriations and State tax revenue receipts.

  There also have been recent bond issues authorized by the Legislature, including $162 million to replace bridges in 2015, and the Emergency Road & Bridge Repair Funds, which are tax-exempt bonds issued in 2018 and awarded through a competitive grant process to repair bridges. This program awarded approximately $37 million to MDOT and $213 million to replace local bridges. There was a great deal of interest in this program, with 690 applications received totaling $970 million.

- **Allocates revenue to pavements, bridges, and other programs.** MDOT conducts performance and tradeoff analyses among competing needs to develop performance-based funding allocations. For constrained funding scenarios, MDOT selects the asset management investment strategy that best aligns with State and Federal performance targets; public and stakeholders' desire for asset condition; and MDOT's priority to maximize overall system performance and achieve the highest return on investments. There are some general rules that govern resource allocation among asset classes:

  – **MDOT is risk-aware.** Section 5 presents MDOTs comprehensive risk register. The register identifies risks that could impede the department to achieve its asset management objectives. MDOT has assigned responsibility for oversight of the risk registers to each of the asset types' leads. They will be responsible for the integration of the risk registers into ongoing decision-making.

    MDOT is using the funds identified in the Gap Analysis in Section 6 to mitigate and address these risks. The investment plan incorporates expected funding levels, and allocates funding between asset types to best meet the performance targets for each. The investment plan ensures MDOT will meet minimum condition levels established by the FAST Act on NHS bridges and pavements, which will maximize Federal funding flexibility. In addition, MDOT works to make sure its estimates are as accurate as possible, and frequently communicates rising construction costs with the legislature. MDOT also considers workload of contractors and the timing of lettings to better manage project cost risks.

Several of the risks identified in the Risk Register relate to data on pavement and bridge condition being collected, managed, and of high quality. Implementation of the BMS in December 2022 and the PMS in late 2020 will help mitigate several of the risks identified in the Risk Register in Section 5, including risks related to data limitations, confidence in data quality, and decision making. Both management systems will help MDOT choose the lowest lifecycle cost strategies. This will help keep bridges and pavement in a state of good repair, which will reduce the impact of unforeseen funding drops or increases to project costs. By choosing the lowest lifecycle cost strategies, MDOT can reinvest saved money into improving the condition of rest of system while meeting its performance targets.

- **MDOT uses FHWA funds and the State match to make safety investments.**

- **MDOT minimizes closed bridges.** Bridge funding decisions are driven by the condition of the bridge, and the desire to minimize the closure of bridges. There are currently over 500 closed bridges in the State; about five of the closed bridges are State-maintained. Each of the closed State-maintained bridges is due to an active replacement or was caused by damage (e.g., from a barge collision). Following the bond issues in 2015 and 2018, bridge conditions improved and have allowed MDOT to shift focus to toward preservation work.

- **MDOT replaces all timber bridges and those that are – under current guidelines – posted for load limits.** Currently, MDOT has 125 posted bridges and 165 timber structures. Posted bridges impact the State's economy by limiting the efficient movement of goods. Timber structures require more maintenance to ensure their structural integrity.

- **MDOT makes bridges the first priority for state of good repair work.** MDOT recognizes that a bridge failure is more critical than a pavement failure, so it prioritizes bridges while making sure pavement condition remains acceptable.

- **MDOT makes Interstates the second priority for state of good repair, followed by four-lane roads, and then two-lane roads**. Because Interstates provide the mobility infrastructure in the State, MDOT prioritizes them over four- and two-lane roads. MDOT invests in Interstates to keep them in good condition, then invests in four-lane roads (most of which are on the NHS), and finally invests in two-lane roads.

- **MDOT makes other investments during project work.** MDOT makes investments in safety, bicycle, pedestrian infrastructure during the course of its bridge and pavement reconstruction work.

- **MDOT does not typically make investments in capacity expansion projects** unless the project is written into the funding bill by the Legislature.

- **Allocates revenue to replacement, preservation, and maintenance.** Chapter 4 provides a detailed description of how the Research, Maintenance, and Bridge Divisions work with the Districts to make decisions about project work. There are some general rules that MDOT and its Districts follow when allocating resources among work types:
  - **The State selects one or two Interstate bridges every year for widening and preservation work.**
  - **Each District must spend at least 10 percent of its two-lane and four-lane budget for pavements on preventive maintenance treatments.** This 10 percent mandate is specifically for pavement preservation and maintenance treatments, however, due to issues of deterioration, Districts at times, often incorporate more than the required 10 percent in order to stretch their sub-allocated money further. It is important to note that there is no preservation requirement for the remaining 90 percent.
  - **Each District is given an equal portion of bridge preservation funds.** Preservation funding is set aside and split evenly among the Districts. Bridge preservation activities include cyclical maintenance (e.g., bridge washing) and corrective maintenance (e.g., Bearing area restoration or replacement).

MULTIPLAN 2045 will set the vision of Mississippi's future transportation network and describes how MDOT will strategically allocate resources to address the challenges and strive to meet its transportation goals. Based on extensive feedback received from participants and stakeholders of MULTIPLAN, MDOT will select investment strategies to achieve the desired level of asset condition and system performance.

The 10-year financial plan is tied to these investment strategies. The focus of the investment plan is in the maintenance, preservation, rehabilitation, and reconstruction of the pavement and bridges in the State, with little to no new construction planned. MDOT's approach to selecting projects, which will be further enhanced by the implementation of its BMS and PMS systems, focuses on strategies to find the lowest lifecycle cost investments.

MDOT anticipates that NHS bridges and pavements will remain a priority and that the remainder of the State-maintained system will continue to deteriorate.

9.0 Future TAMP Enhancements

This TAMP is the product of an ongoing commitment to asset management for MDOT. MDOT's TAM Task Force has been meeting regularly for several years to coordinate on TAM issues and lay the foundation for the TAM processes, strategies, and goals documented within this TAMP. MDOT will use the TAM Task Force as the foundation for implementation of the TAMP. The group will continue to meet regularly, as will the TAM Steering Committee, who will provide oversight on TAMP implementation.

MDOT's major TAM enhancements include:

- **Pavement Management System Development.** As noted in Section 4.0, MDOT is implementing dTIMS as its PMS. The development of a PMS will greatly strengthen MDOT's ability to develop treatments and strategies that account for the whole life-cycle of State-maintained pavement assets. MDOT will use TAM to guide the development of its workflows as it implements the PMS.

- **Bridge Management System Development.** As noted in Section 4.0, MDOT is implementing AASHTOWare BrM as its BMS. The BMS will enable MDOT to assess bridge deterioration at the element level and make optimal recommendations for maintenance, preservation, and replacement work.

- **Strengthening Processes to Monitor Non-State-maintained NHS Assets.** MDOT identified non-State-maintained assets on the NHS as a potential risk. MDOT has limited oversight and management responsibilities on these assets and, therefore, has limited ability to ensure data are reliable and that performance issues are addressed effectively. MDOT will be required to report performance on these assets and will, as part of this process, look for opportunities to improve monitoring.

- **Local NHS Owner Coordination.** MDOT has developed written agreements with the MPOs that outline the responsibilities for collecting, sharing, and reporting data. Further assessment of opportunities to coordinate with counties and cities outside of the urbanized areas will be an ongoing process as performance issues are identified.

- **Create New Tools to Support Asset Data Integration and Develop an Information Portal.** MDOT has been looking for opportunities to strengthen data and information across asset groups. Improvements to data management systems are continuously evaluated to improve asset management practices in the areas of data collection and management,

life-cycle cost analysis, improved project and maintenance cost estimating, as well as other benefits.

- **Optimize Linkages between the LRTP, the TAMP, and the STIP.** This TAMP has evolved from an LRTP effort. The investment strategies found in MULTIPLAN 2040 served as a starting point for MDOT's TAM efforts including this plan. Due to the deadlines for the fully compliant TAMP, the analysis and strategies found in this plan will serve as the foundation for MULTIPLAN 2045 which is currently underway. The recommended investment strategies found in the TAMP and LRTP that best meet national and state goals and targets will determine the amount of funding for specific work types which will dictate the investment and the types of projects found in the STIP. MDOT will ensure the connection between the TAMP, LRTP, and STIP remains strong. MDOT will work to ensure the LRTP and TAMP plays a role in shaping the STIP and, over time, develop a planning cycle that ensures these three major planning efforts are consistent and effective in supporting Mississippi's goals.

- **Continue Use of Asset Information Portal.** MDOT has developed a Public Accountability Transportation Hub (PATH) site to provide an interactive visual analysis of historical and current conditions of roads and bridges throughout the state of Mississippi. It is available online at https://path.mdot.ms.gov/. MDOT will work to keep this portal updated in order to keep the public and interested stakeholders informed on the inventory and condition of MDOT's infrastructure.