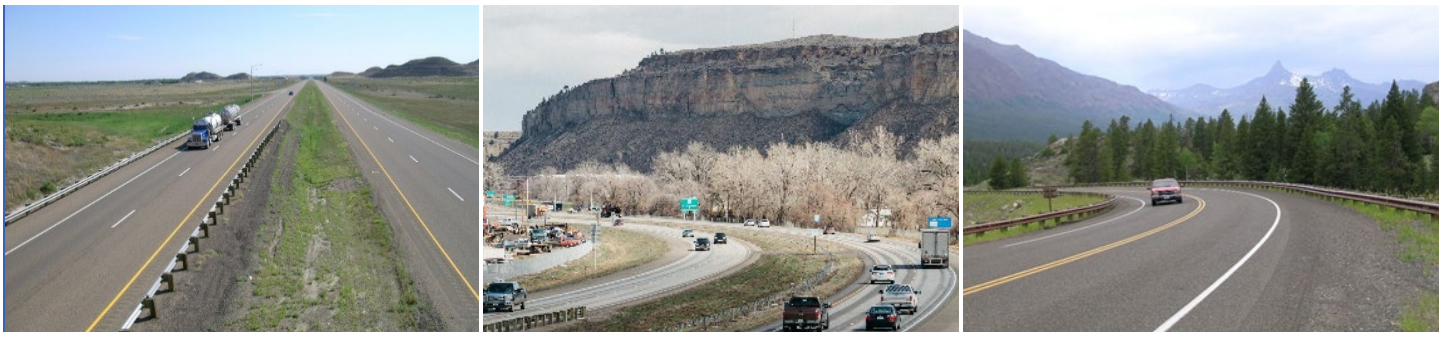


2024 PAVEMENT PERFORMANCE AND CONDITION REPORT

Montana Department of Transportation

Pavement Analysis Section

This document Includes a summary and discussion of 2024 Pavement Condition Data and a discussion of 2025 and 2027 Recommended Treatments

Prepared by Mott MacDonald

MONTANA
Department of Transportation

Christopher Dorrington, Director

2701 Prospect ▪ PO Box 201001
Helena MT 59620-1001

Memorandum

To: Distribution

From: DJ Berg, Pavement Analysis Engineer DJB
Chad DeAustin, Pavement Management Supervisor CD

Review: Jeff Jackson, Geotech and Pavement Bureau Chief Jeff Jackson

Prepared by: Mott MacDonald, Pavement Management Consultant

Date: May 20, 2025

Subject: 2024 Pavement Performance and Condition Report

The Pavement Analysis Section has completed its 2024 Pavement Condition and Treatment Report. The report concentrates on the current pavement condition, recommended treatments, and estimated cost of performing the recommended treatment for each management section on the Interstate, NHS, Primary, and Secondary systems.

Recommended treatments are available electronically. Print copies are available on request.

Distribution:

Christopher Dorrington, Director
Lawrence J. Flynn, Deputy Director
Rob Stapley, Policy Office Manager
Dustin Rouse, Project Development & Delivery Ops
Doug McBroom, Statewide Planning & Modal Ops
Jon Swartz, Asset Strategy, Maintenance and Ops
Sharon Duncan, General Operations Manager
Nicole Pallister, Administration Admin
Bob Vosen, Missoula District Admin
Geno Liva, Butte District Admin
Jim Wingerter, Great Falls District Admin
Shane Mintz, Glendive District Admin
Mike Taylor, Billings District Admin
Ryan Dahlke, Preconstruction Engineer
David Gates, Construction Engineer
Dave Holien, Highways Engineer
Megan Cail, Highways Design Engineer
Joel Boucher, Missoula Preconstruction Engineer
Steve Felix, Missoula Maintenance Chief
Justin Juelfs, Kalispell Maintenance Chief
Brandon Jones, Butte Preconstruction Engineer
Jim Pesanti, Butte Maintenance Chief
Ted Jones, Bozeman Maintenance Chief
James Combs, Great Falls Preconstruction Engineer
Harry Barnett, Great Falls Maintenance Chief
Jody Bachini, Havre Maintenance Chief
James Frank, Glendive Preconstruction Engineer
Mike Skillestad, Miles City Maintenance Chief
Mark Kurokawa, Wolf Point Maintenance Chief
Kurtis Schnieber, Billings Preconstruction Engineer
Walt Houghton, Billings Maintenance Chief
Ken Hamblen, Lewistown Maintenance Chief
Paul Johnson, Project Analysis Manager
Matt Strizich, FHWA

Table of Contents

Figures

Tables

1 Executive Summary

This report discusses statewide pavement conditions and performance based on data collected in 2024. The analysis addresses performance highlights, potential treatments, and financial needs to keep Montana's Interstate, Non-Interstate NHS, STP-Primary and Secondary highway networks in a state of good performance.

1.1 Pavement Performance and Condition

Based on statewide data, Montana's highway network pavement is primarily in good to fair condition. Pavements in good to fair condition may have visible traffic wear, with low to moderate severity cracking and minimal to slight rutting. Poor pavements have prevalent cracking and heavy rutting and patching. MDT's Overall Performance Index (OPI) combines ride quality, rutting and cracking as a single measure to assess the overall health of individual pavement sections and of the overall pavement network. OPI can take values within the range of 0-100 and is classified as good condition for values 63 and above and poor condition for values below 45.

Figure 1 depicts the pavement health for each district. With the exception of Glendive, most of the mileage of the remaining districts is categorized as good. Both Missoula and Glendive have more than six percent of their pavement mileage in poor condition. Statewide, the poor percentage increased by ~0.3% from 2023 to 2024. The average statewide OPI category for NHS, Primary, and Secondary routes is classified under the fair category while Interstate routes remained in the good category.

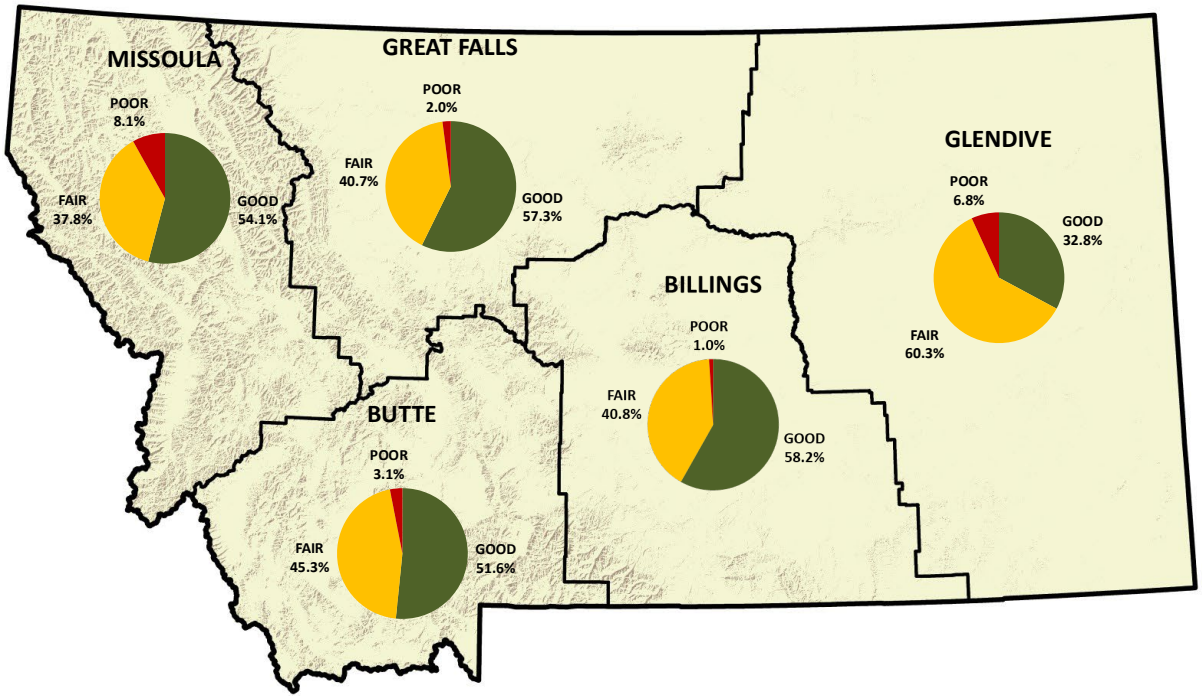


Figure 1 - 2025 OPI Category By District

Ride Quality is a functional performance metric and is the term for pavement smoothness. It is measured as International Roughness Index (IRI) and converted to a Ride Index value between 0

and 100. Roughness values of 170 inches/mile or more are classified as poor condition, (<60 IRI Index), while roughness of less than 95 inches/mile are classified as good condition (>80 IRI Index). Figure 2 presents the percentages of good, fair, and poor for each system. The Interstate system has the highest percentage of roadway miles with Ride Index in the good category, while the majority of Non-Interstate NHS, Primary, and Secondary system's roadway miles are in the fair category. The blue dot depicts the average System Ride Index for each system (Higher is better). The Ride trend is shown in more detail in Figure 12 (Section 2) of this report. Overall, all systems experienced a decrease in average ride quality from 2023 to 2024.

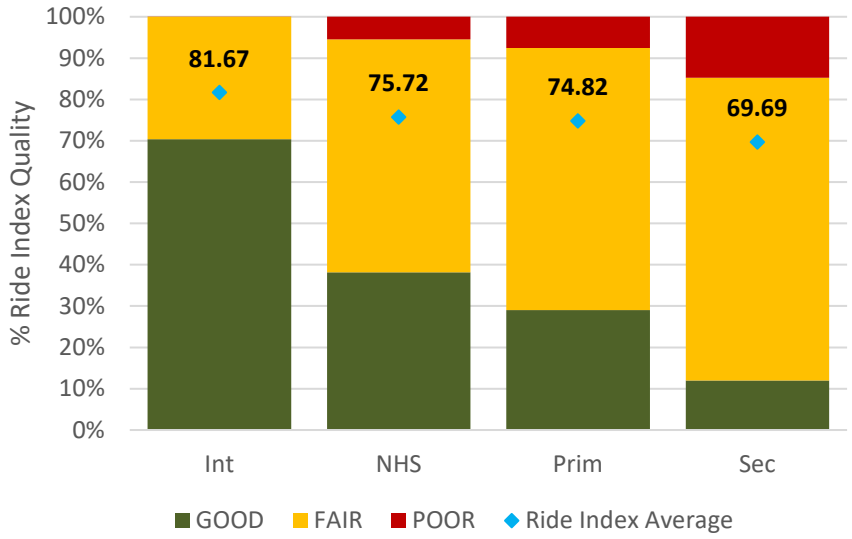


Figure 2 - 2024 Ride Quality Index by System

Rutting is evaluated by measuring the rutting depth of the wheel paths in inches and converting that value to a 0-100 index. Rut depths of 0.5 inches or more are classified as poor condition, (<40 Rut Index), while rut depths of less than 0.22 inches are classified as good condition (>60 Rut Index). Overall, in terms of rutting, the Montana highway network is in good condition. Of the four systems, the Non-Interstate NHS demonstrates the most rutting with the lowest average rut index (61.9). The NHS Rut Index trend line depicts a decreasing (worsening) trend since 2015. The steeper decline from 2021 to 2022 is present in all systems and corresponds to the replacement of data collection vans with higher resolution sensors; that trend stabilized in 2023.

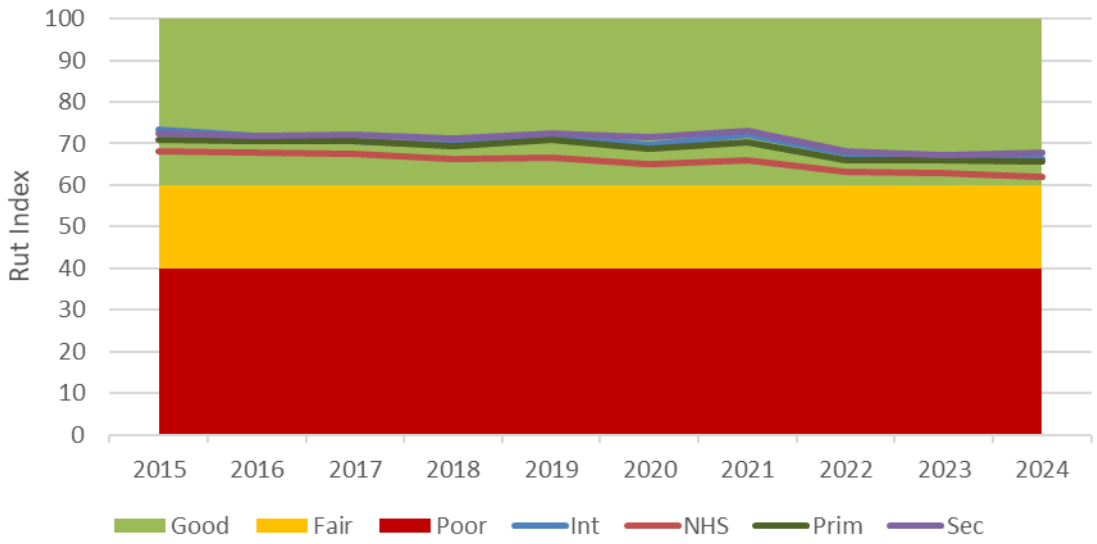


Figure 3 - Average Rut Index by System

Financial districts Billings, Glendive, and Great Falls have less than one percent of roadway miles in poor rutting condition. In contrast, Missoula has a significantly higher percentage at 7.13%, while Butte has 1.78% of roadway miles in poor rutting condition. While over half of the poor rutting miles in Missoula are in the NHS system, it is the only district with any poor rutting miles in the Primary system. Additionally, Missoula and Butte are the only districts with poor rutting miles in the Secondary system. Over the year, pavement rutting increased in these two districts, while others maintained or reduced their backlog of highly rutted roads.

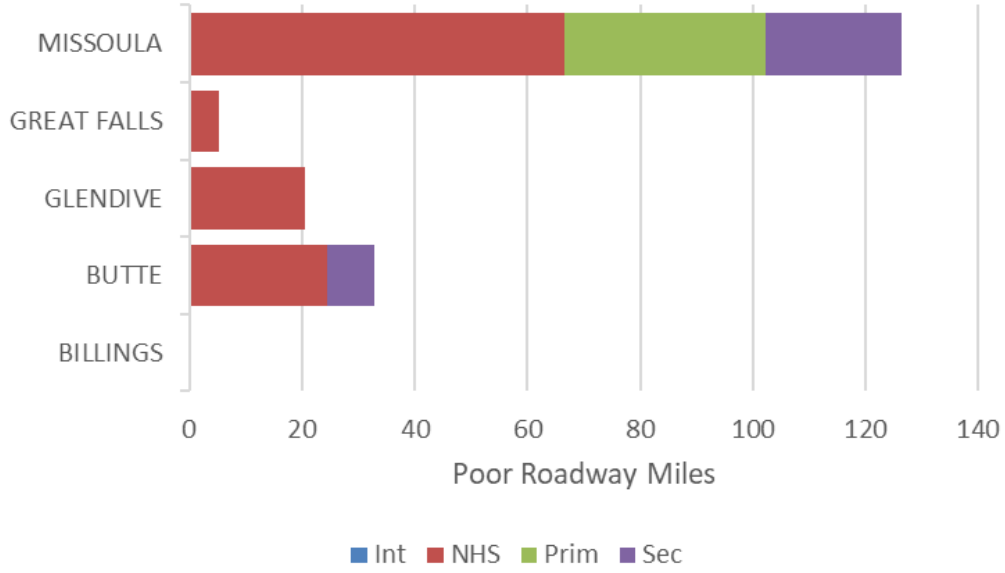


Figure 4 - 2024 Poor Rut by District and System

Cracking is evaluated using two metrics: Miscellaneous Cracking Index (MCI) and Alligator Cracking Index (ACI). Both ACI and MCI can take values withing the range of 0-100 and are classified as good condition for indices 80 and above and poor condition for indices below 60. Figure 5 shows the percentage of the roadway network with cracking indices above 80, which indicates a good cracking condition. Nearly 100% of roadway miles have an ACI over 80, while just over 86% of roadway miles have an MCI over 80. These high values reflect excellent maintenance efforts to maintain crack seals and the good results obtained by the MDT seal and cover program.

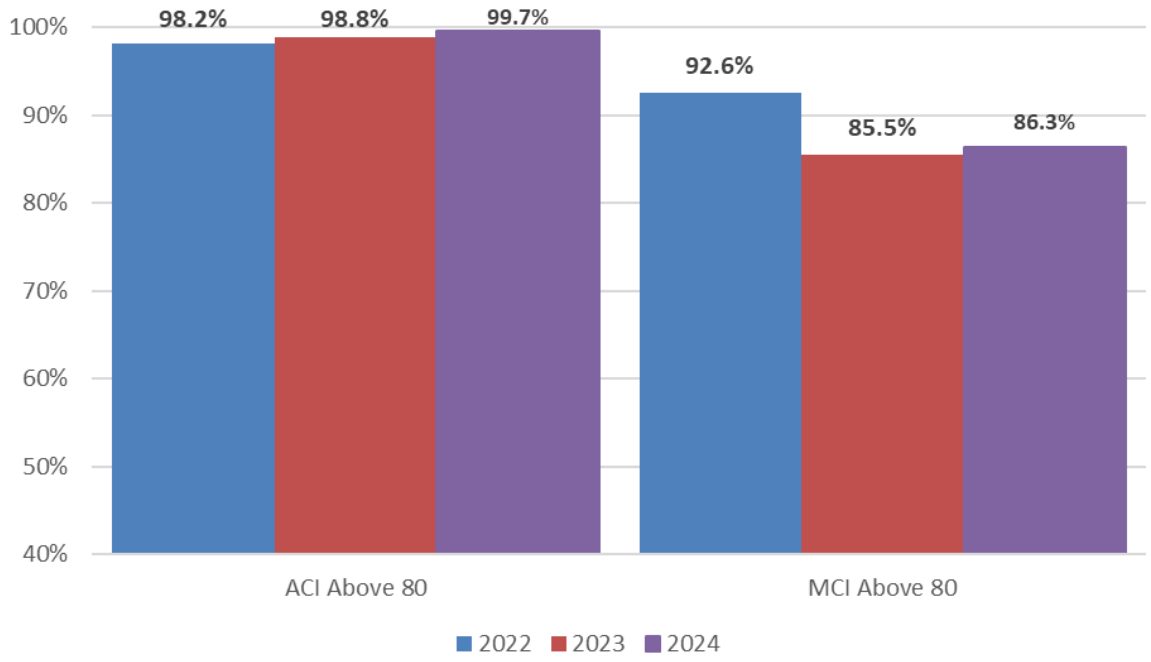


Figure 5 - Portion of the Combined System with Cracking Indices Above 80

1.2 Fiscal Needs

Fiscal need is represented by the total estimated present value cost required to complete all treatments recommended in the unlimited funding analysis. The 2025 total network fiscal need for the four systems is $2.53 billion. This is a $105 million increase over the 2024 projection. Inflation affected material costs in 2024, contributing to a significant portion of the fiscal growth. Additionally, MDT updated the calculation method for unit costs for PMS this year to include more bid items. This change was made to align needs analysis with overall construction project costs. There was also an increase in roadway mileage requiring treatment other than light preservation in 2024. A more detailed discussion of the recommended treatments and the associated need can be found in Section 2. Strategic use of capital improvement funds can significantly reduce the backlog of roads in poor condition. Roads in such poor condition often require more extensive treatments beyond seal and cover or other preservation approaches.

Figure 6 highlights the fiscal need by treatment category. The preservation category combines the crack seal, chip seal, and thin overlay treatment needs and is approximately 64% of the total needs on MDT's network. Preservation is a key component of maintaining the roadway network and

keeping good roads good. It is significantly less expensive to maintain roads in fair to good condition than conducting heavy rehabilitation or reconstruction activities. However, current budgets are insufficient to address the increasing needs each year, with allocations of $100.8 million for preservation and $166.8 million for rehabilitation and reconstruction.

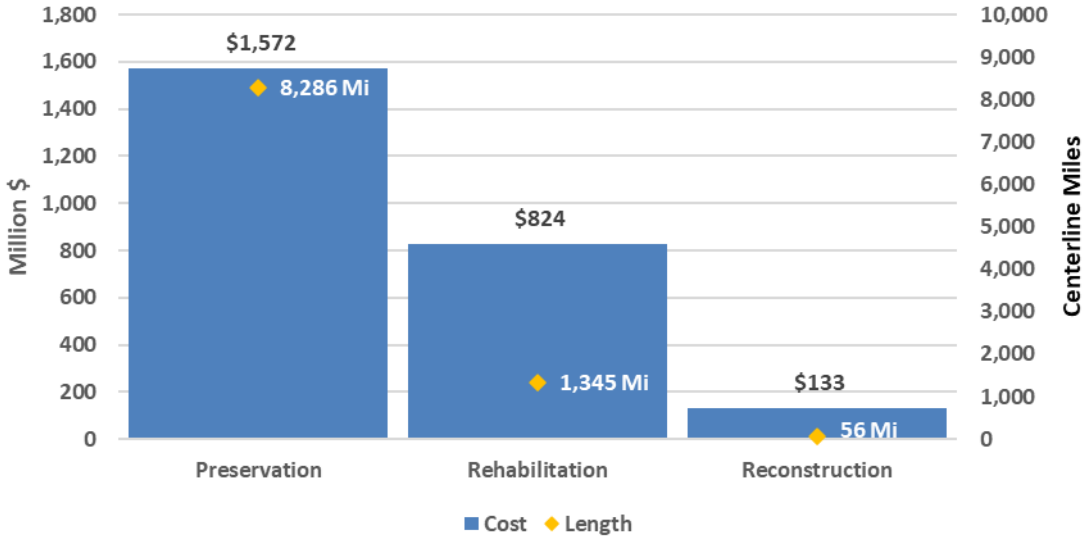


Figure 6 - 2025 Fiscal Needs by Treatment Category

Figure 7 categorizes the fiscal need by system. The Non-Interstate NHS and Secondary systems both have over $800 million in needs. The NHS is funded through Px3 distribution for MDT's pavement assets. The Secondary system funding is determined based on state laws, policy, and other considerations. Current funding is inadequate to curtail the current growth in needs year-over-year. Additional funding in conjunction with a pavement preservation management plan addressing the levels of treatment needs may inhibit the growth in needs on the Secondary system. For reference, current funding numbers by system are $59M for Interstates, $125M for the NHS System, $57M for the Primary System, and $27M for the Secondary System. It's important to note that these funding levels are the 5-year average of an annual budget, while the funding needs are an instantaneous total backlog, which would be treated over a multi-year period.

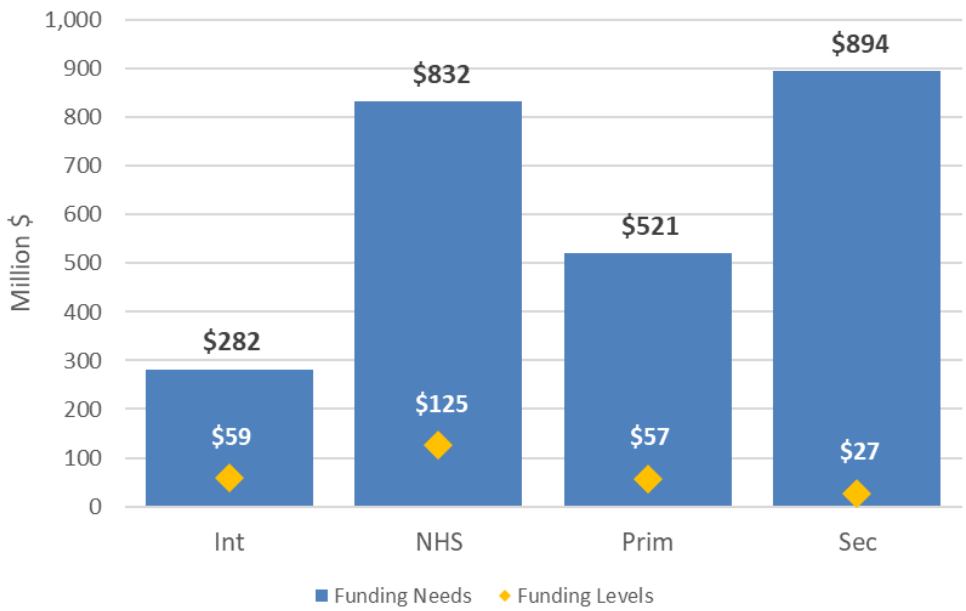


Figure 7 - Funding Needs by System

1.3 Conclusion and Recommendations

Currently, Montana's highway systems are performing well given current budget constraints, with the systems in fair to good condition. The data does demonstrate several areas of concern. Approximately 46 percent of the pavement mileage in the Glendive District needs an overlay or higher-level treatment. Continued emphasis on preservation treatments in this district will provide a firewall to further degradation by keeping roads in good condition and slowing rates of deterioration. Selective use of treatments like microsurfacing can be used to address rutting conditions. Chip seals should continue to be the primary method to rejuvenate the surface and provide protection to the subsurface. The Montana highway network is generally in good condition regarding rutting, with the Non-Interstate NHS showing the most rutting and the lowest average rut index (61.9). Although the rutting stabilized in 2023, the overall decreasing trend suggests that preservation treatments addressing rutting should be considered. With the highest percentage of poor rutting miles in Missoula District, the rutting issue is becoming increasingly problematic for the district's ability to maintain its roads in a state of good repair.

The distress data, primarily cracking and rutting, indicates an imbalanced asphalt mix design issue within the district. Figure 8 and Figure 9 show the Rutting Index trend and the MCI and ACI trends, respectively, for Missoula. It is recommended that MDT initiate a forensic investigation, either internally or through a research project, to further verify this observation. Ultimately, MDT should explore the adoption of a more balanced mix design to enhance rut performance in the district. The current asphalt mix is not performing adequately under the prevailing traffic and environmental conditions.

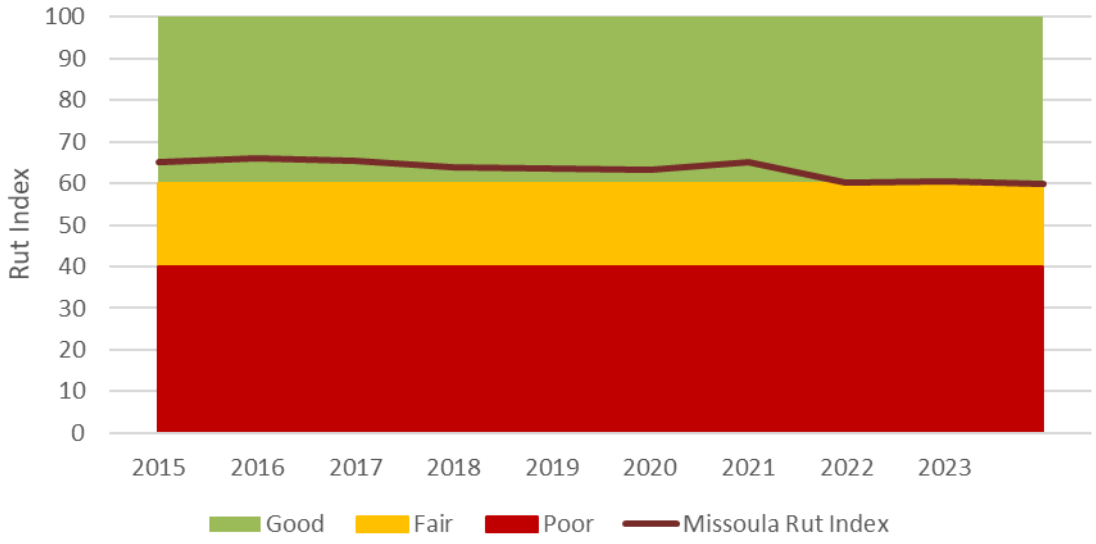


Figure 8 – Rut Index for Missoula

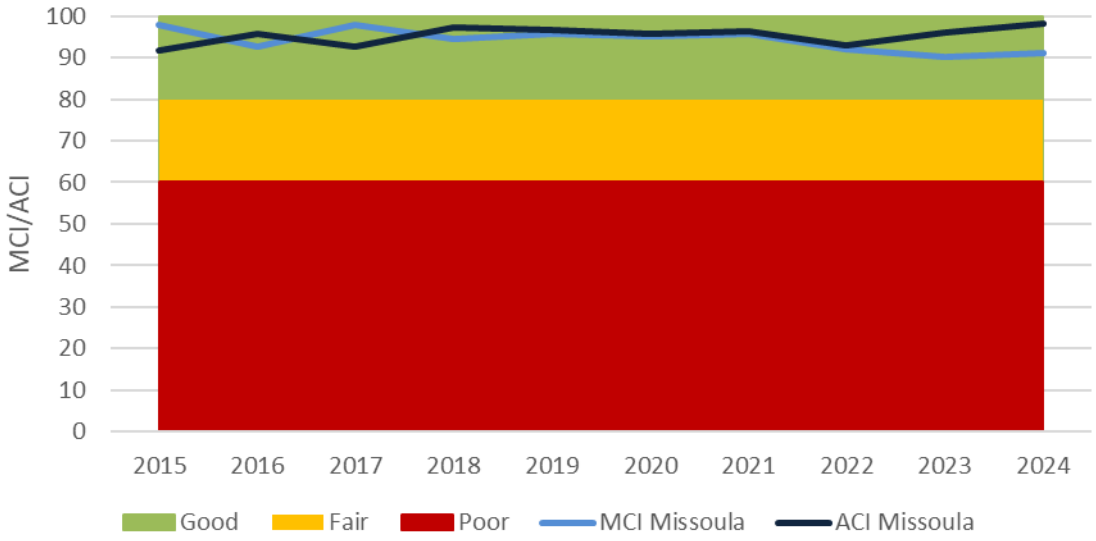


Figure 9 – MCI & ACI for Missoula

The Secondary system Ride Quality performance indicates 12 percent of centerline miles in good quality, which is very low compared to the other systems. The system has approximately 1,085 miles of Thin Overlay recommendations, totaling $515 million. The secondary road system is degrading and may not be serving the needs of the traveling public. MDT must take a leadership role in securing additional funding for the Secondary Road system and initiate discussions with the state legislature to address the overall funding and status of state secondary roads. Further delays will result in significant public pressure as these roads become unserviceable. Additionally, MDT needs to engage stakeholders to reevaluate its pavement asset management strategy, redefine pavement management decision trees, and build a program with the right mix of fixes. MDT is

currently conducting a top-to-bottom assessment and improvement program for the PvMS system to address these needs. Figure 10 below shows the Secondary system's declining OPI trend.

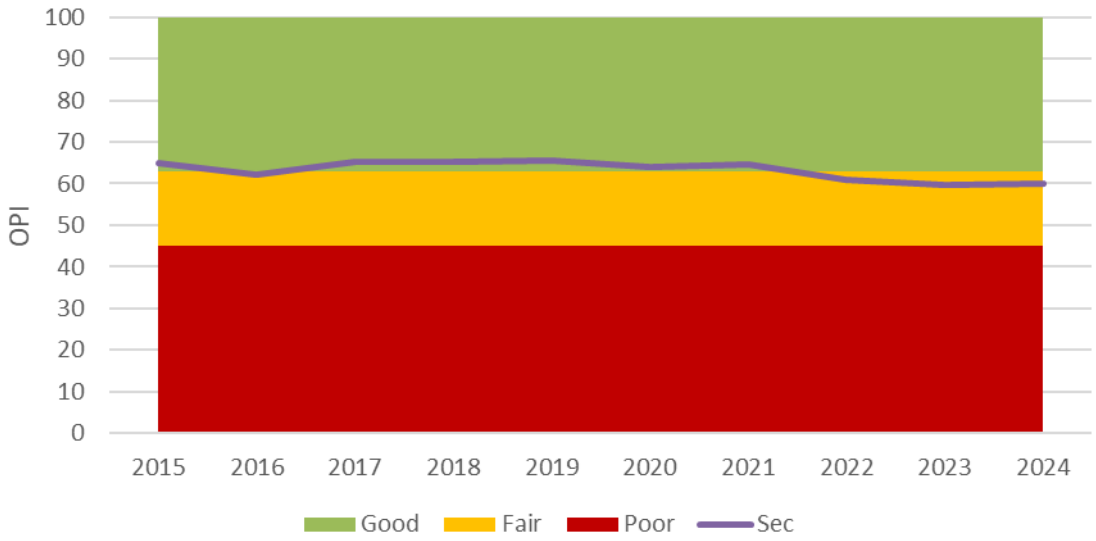


Figure 10 – OPI for Secondary system

To conclude, three key action items need to be addressed by MDT.

1. The continued degradation of the Secondary Roads System needs to be addressed. Performance goals need to be identified, and a project strategy evaluated to establish an accompanying funding plan. Significant engagement should be anticipated with local, legislative, and MDT stakeholders.
2. The asphalt pavement rutting issue in Missoula district needs to be researched for cause and recommendations for improvement identified. The rutting conditions in this district are comparatively worse than other distresses. The initial recommendation is a Materials Bureau-led investigation or MDT Research project to identify a higher performing mix design.
3. Districts continue to work with Pavement Analysis team to address district specific issues and distresses to improve pavement asset performance based on each district's challenges.

2 Montana Pavement Performance and Condition

The following sections provide more detailed discussion of the pavement current condition and trends of Montana's highway systems, including the latest 2024 data. The discussion includes the recommended treatments and funding implications of the treatments to maintain the highway systems in a state of good performance.

Prior to 2010, MDT manually evaluated pavement condition through visual inspection. This was done by random sampling of a percentage of each system. Beginning in 2010, MDT procured the first set of data collection vans for automated collection. This allowed MDT to collect data on the

entirety of the state network. These vans operated through 2021, were replaced by data collection vans from the same vendor that are equipped with higher resolution sensors and updated software. As a result, there are some changes between condition data prior to and after 2022, including a change in rutting values. These upgrades resulted in an overall decrease in pavement index values due to increased resolution.

With multiple years of evaluation with the new data collection vehicles, indexes have stabilized. OPI remained steady between 2023 and 2024, while declines in Ride Index and Rut Index occurred. This is summarized in Table 1. The following metrics will be discussed further below: ride, rut, alligator cracking and miscellaneous cracking.

Table 1 - Average Condition Metrics by Year

	OPI	Ride Index	Rut Index	ACI	MCI
2022	63.3	75.9	66.1	95.5	91.0
2023	62.5	75.9	65.7	97.2	88.3
2024	62.5	75.1	65.3	98.9	88.6

Ride Index

The functional performance metric for pavement smoothness is Ride Quality, measured as International Roughness Index (IRI) and converted to a Ride Index value between 0 and 100**.** Roughness values of 170 inches/mile or more are classified as poor condition, (<60 IRI Index), while roughness of less than 95 inches/mile are classified as good condition (>80 IRI Index). In Figure 11 below, the distribution of good, fair, and poor mileage is depicted for each system. The blue dot represents the average 2024 Ride Index for each system. This value becomes the last point on the trend line chart in Figure 12. The Interstate system continues to have the highest performance level in 2024 with an average Ride Index of 81.6. All systems experienced a slight decrease in the average Ride Index from 2023. The general trend for Ride Index from 2015 to 2024 is flat over time, indicating a consistent level of ride quality.

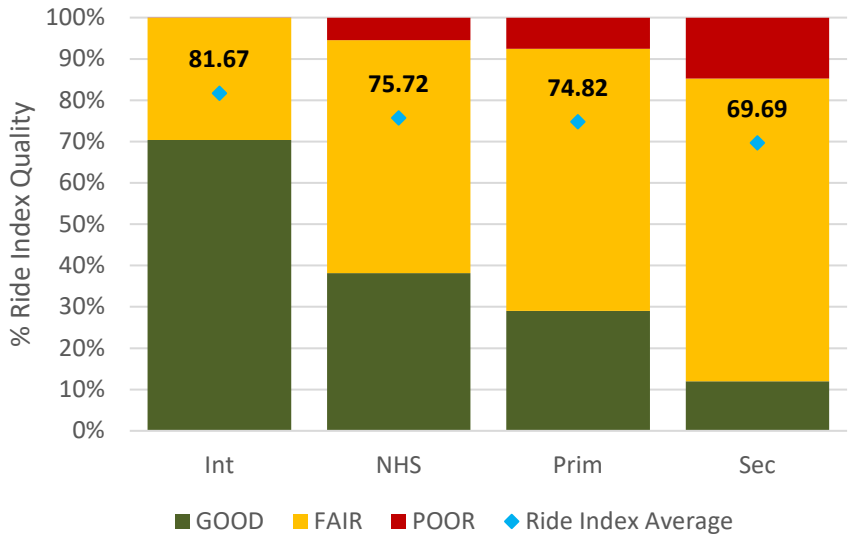


Figure 11 – 2024 Ride Index by System

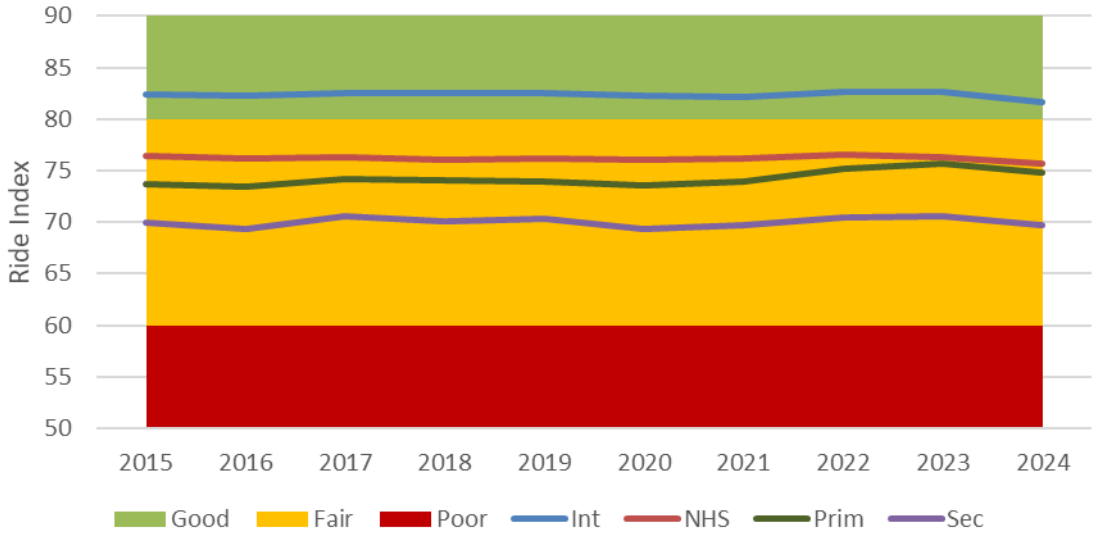


Figure 12 – Average Ride Index by System

In Figure 13 and Figure 14, the IRI cumulative distributions for the districts indicate that Glendive has higher IRI values throughout its network compared to other districts. This high IRI results in most lanes in Glendive being classified as in fair condition. In the cumulative distribution graph, the area under the curve is positive benefit. The steeper the curve and the further to the left, the better the condition of the network in the district.

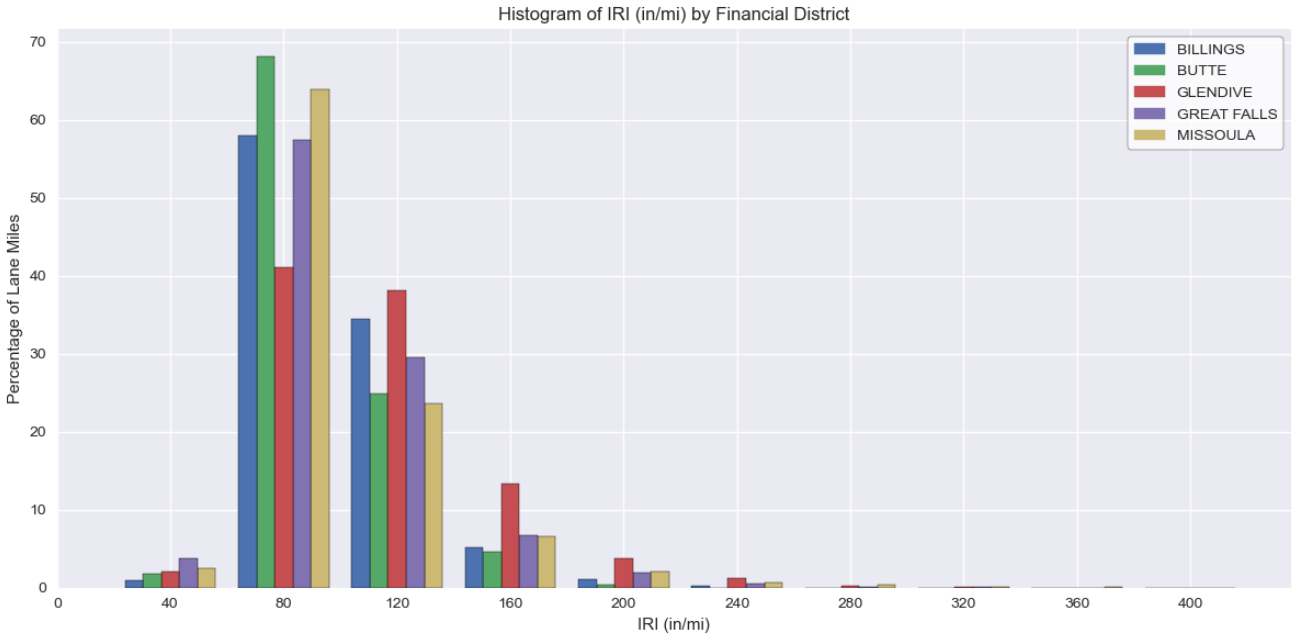


Figure 13 - Distribution of IRI by District

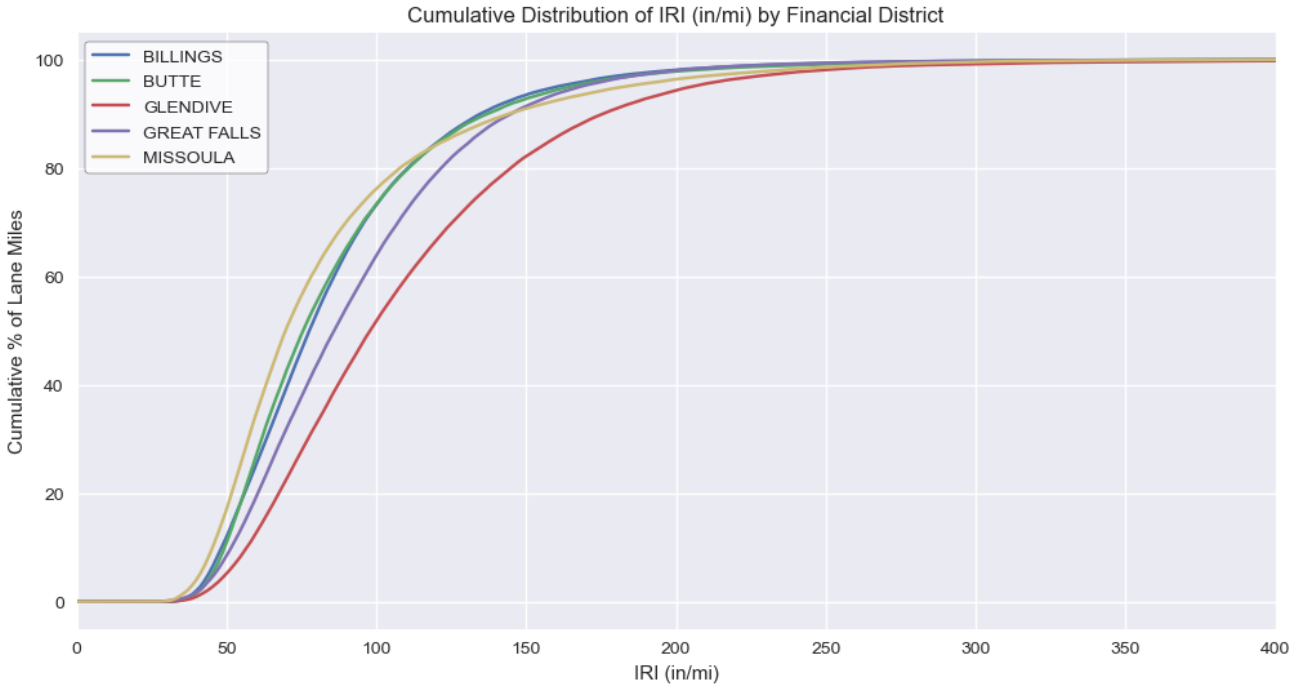


Figure 14 - Cumulative Distribution of IRI by District

Cracking

As noted above, OPI includes two types of cracking. The two cracking measures used by MDT represent environmental and structural (load related) cracking. The metric for environmental cracking is known as the Miscellaneous Cracking Index (MCI). MCI is typically impacted most by transverse cracks that occur across the roadway but can include other types of non-load related cracking. MCI can take values withing the range of 0-100 and is classified as good condition for indices 80 and above and poor condition for indices below 60. MCI is in good condition for all the systems with an average index of 88.5.

The Alligator Cracking Index (ACI) represents a combination of structural cracking elements and is primarily impacted by traffic loading and occurs in the wheel paths of the road. ACI can take values withing the range of 0-100 and is classified as good condition for indices 80 and above and poor condition for indices below 60. In 2024, ACI is in good condition for all systems at an average index of 98.9. Figure 15 highlights the percentage of the roadway network with cracking indices above 80, a good cracking condition. Over 99% of roadway miles have an ACI over 80, an improvement of almost 1% from 2023. Just over 86.3% of roadway miles have an MCI over 80, which is a 0.8% increase from 2023. These high values reflect a combination of good paving practices at MDT, including excellent maintenance efforts to maintain crack seals and the robust seal and cover program.

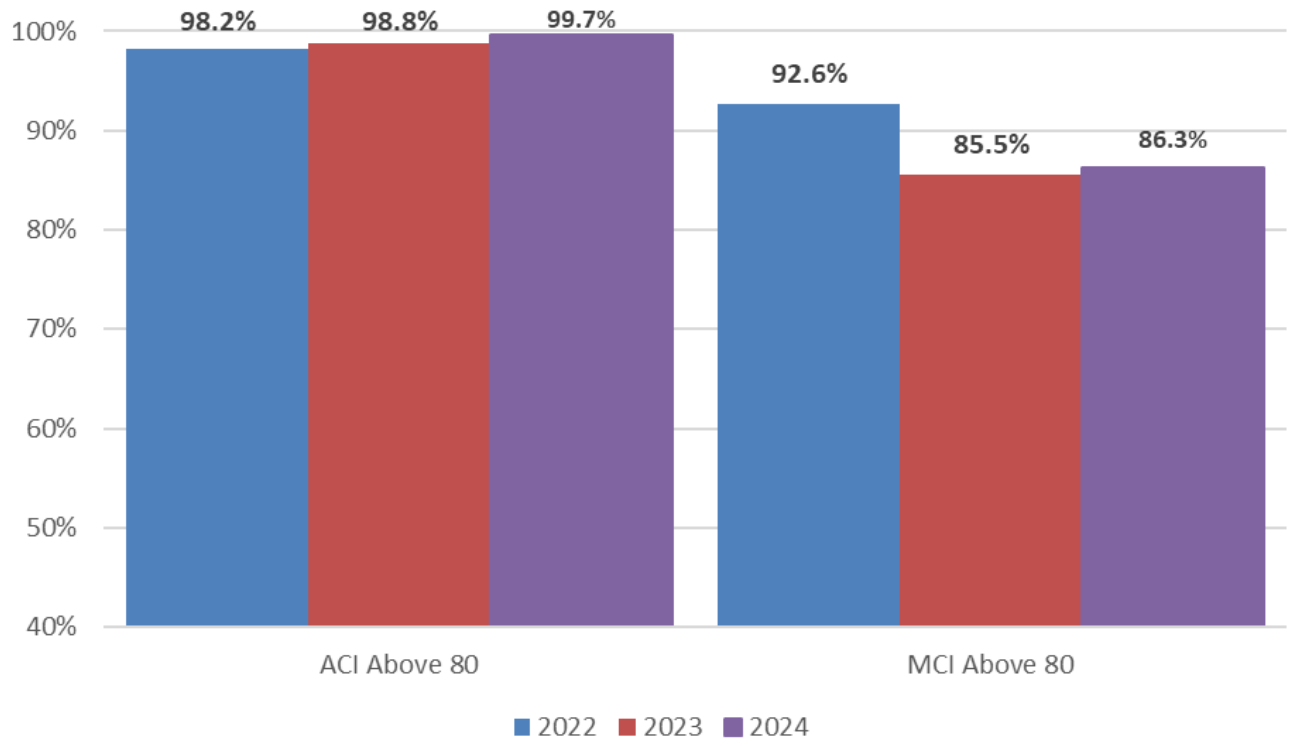


Figure 15 - Portion of the Combined System with Cracking Indices Above 80

When looking at MCI for flexible pavements, Butte and Glendive have wider distributions than the other districts as shown in Figure 16 and Figure 17. On the other hand, Missoula was observed to have relatively higher MCI values, suggesting an imbalance in the mix design.

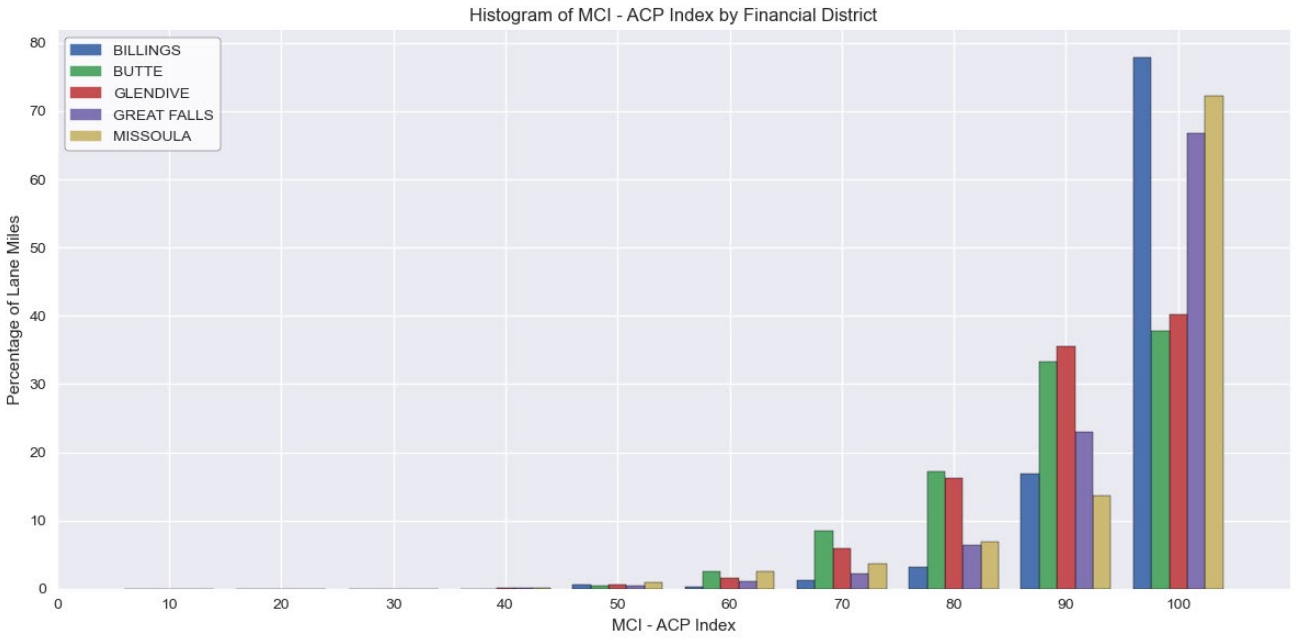


Figure 16 - Distribution of MCI - ACP by District

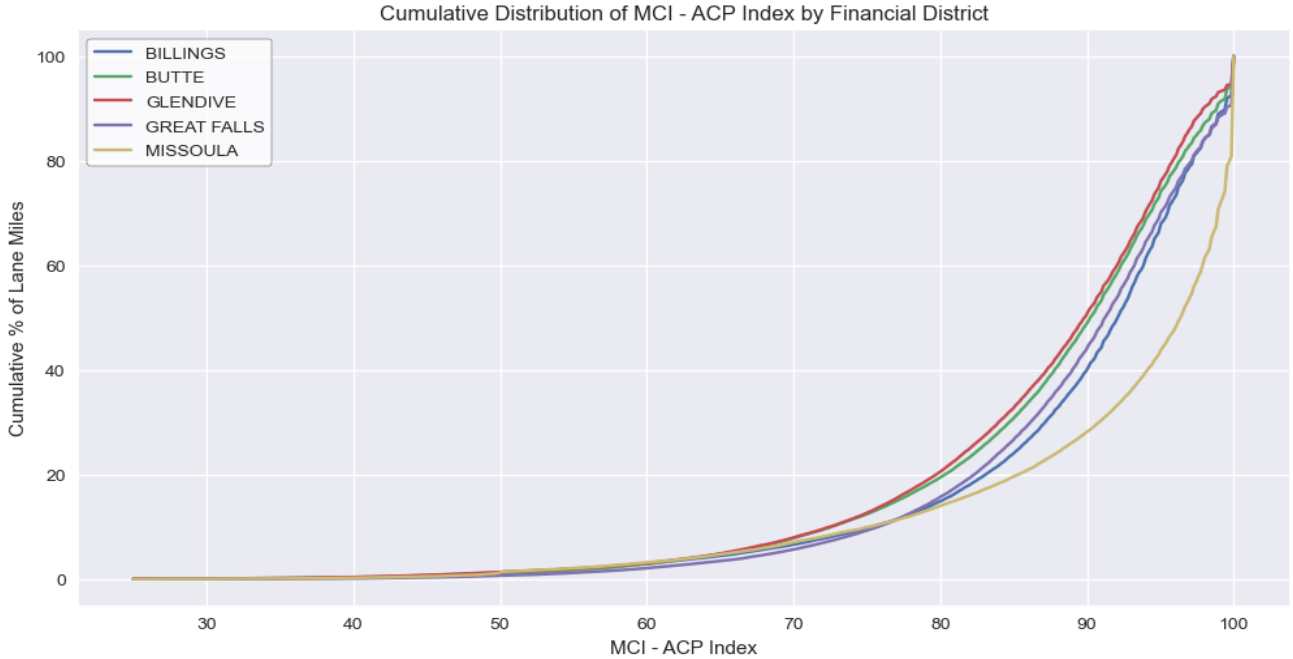


Figure 17 - Cumulative Distribution of MCI - ACP by District

ACI was reported to be above 90 on average for all districts as shown by the distributions in Figure 18 and Figure 19. Although minimal, we can see that Missoula has slightly lower values than ACI in comparison to the other districts. Both graphs clearly illustrate high ACI values which suggest that the pavement designs across the state are generally adequate to prevent structural failure of the pavement section, indicating an absence of structural fatigue cracking.

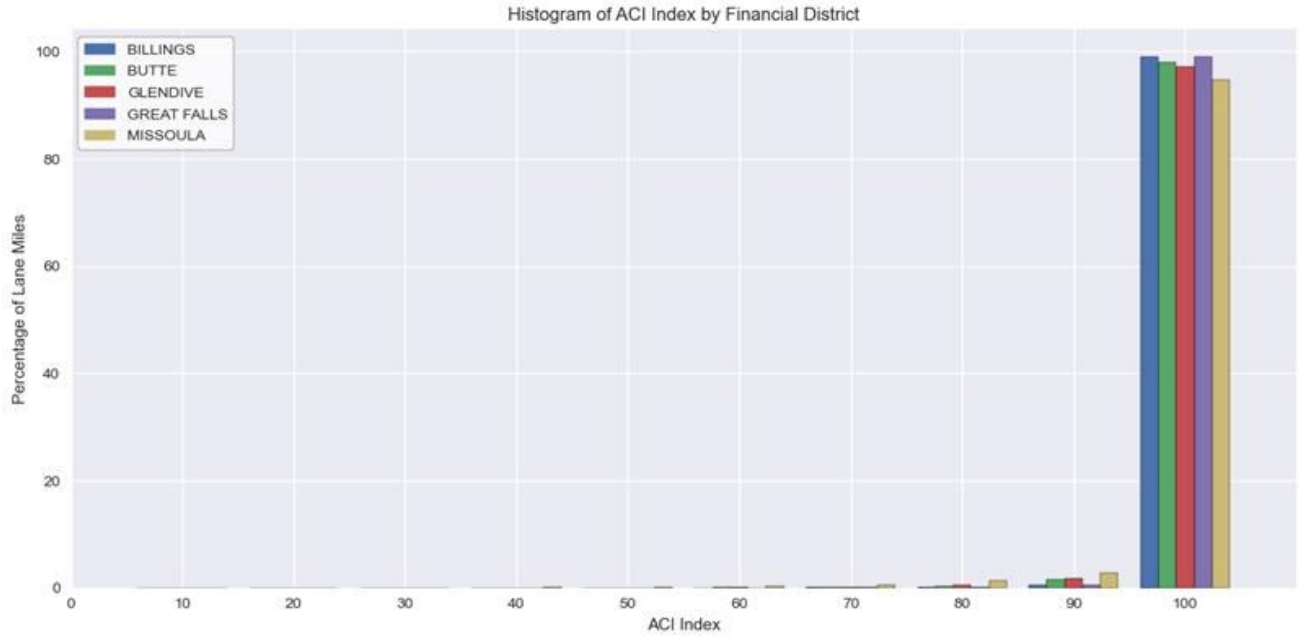


Figure 18 - Distribution of ACI by District

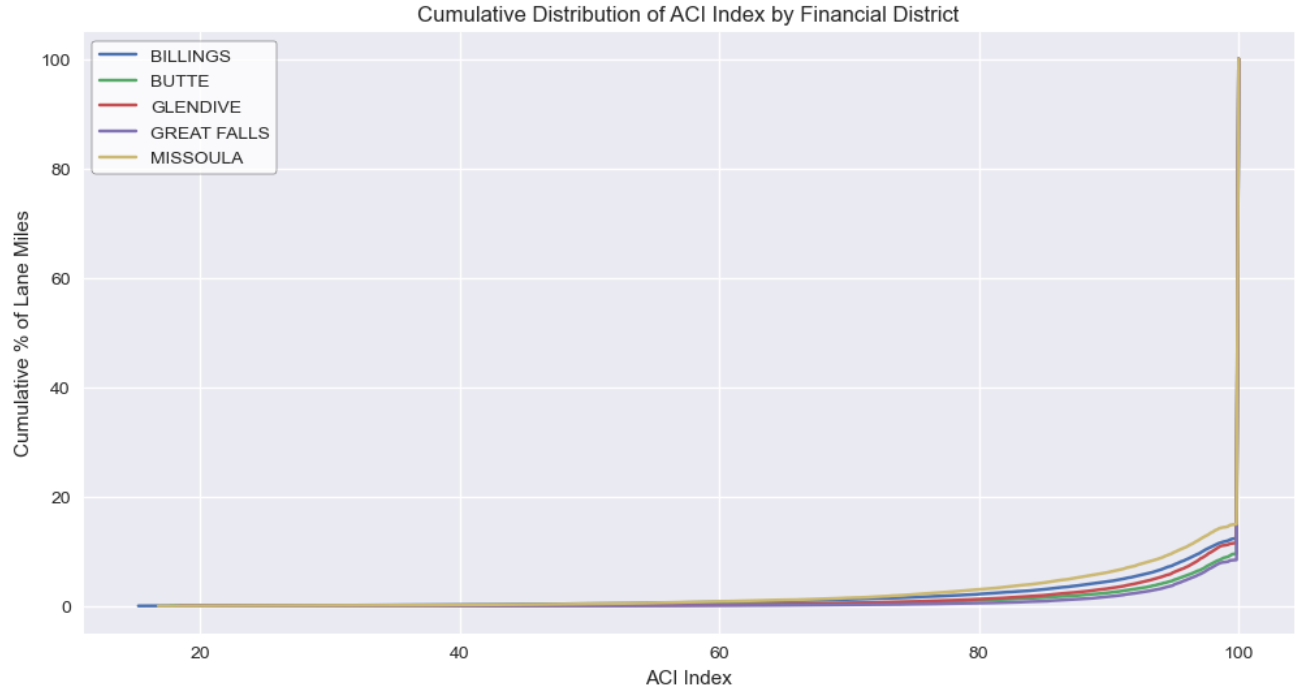


Figure 19 - Cumulative Distribution of ACI by District

Rutting

Rutting is assessed by measuring the depth of wheel path ruts in inches and converting this measurement into a 0-100 index. Rut depths of 0.5 inches or more are classified as poor condition, (<40 Rut Index), while rut depths of less than 0.22 inches are classified as good

condition (>60 Rut Index). In regard to rutting, Non-Interstate NHS is the lowest performing system in 2024 but still exhibits 62.9% of pavements in good condition. Figure 20 depicts the good-fair-poor distribution by system. The total poor rutting for all four systems is 185 miles, of which 117 miles are on the Non-Interstate NHS system.

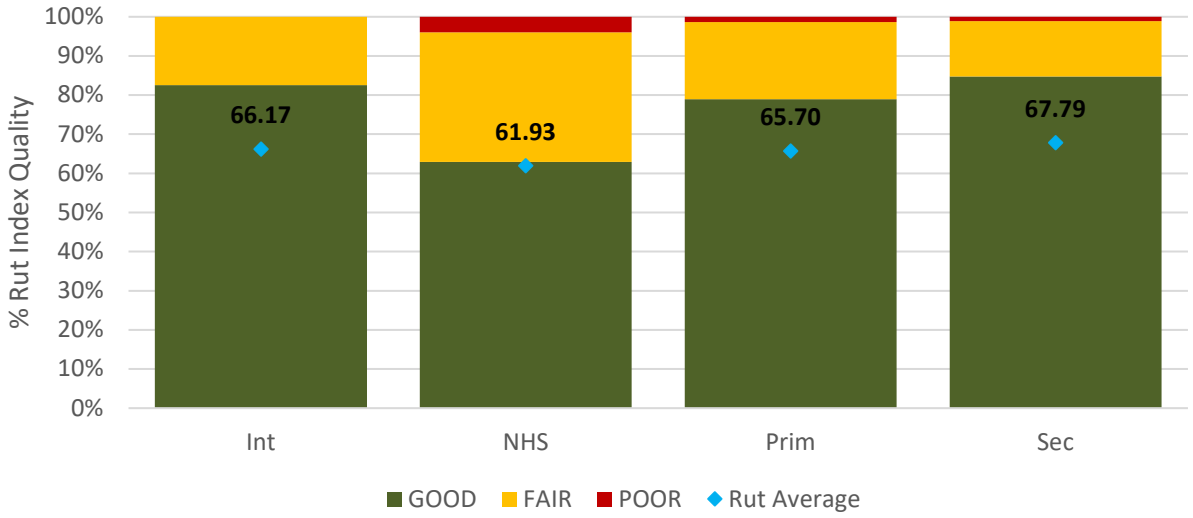


Figure 20 – 2024 Rut Condition by System

Figure 21 shows poor rutting miles by system and district. The Missoula district has 126 miles in poor rut condition, of which 66 miles are on the NHS system. Other districts have a lower level of rutting, primarily on NHS routes.

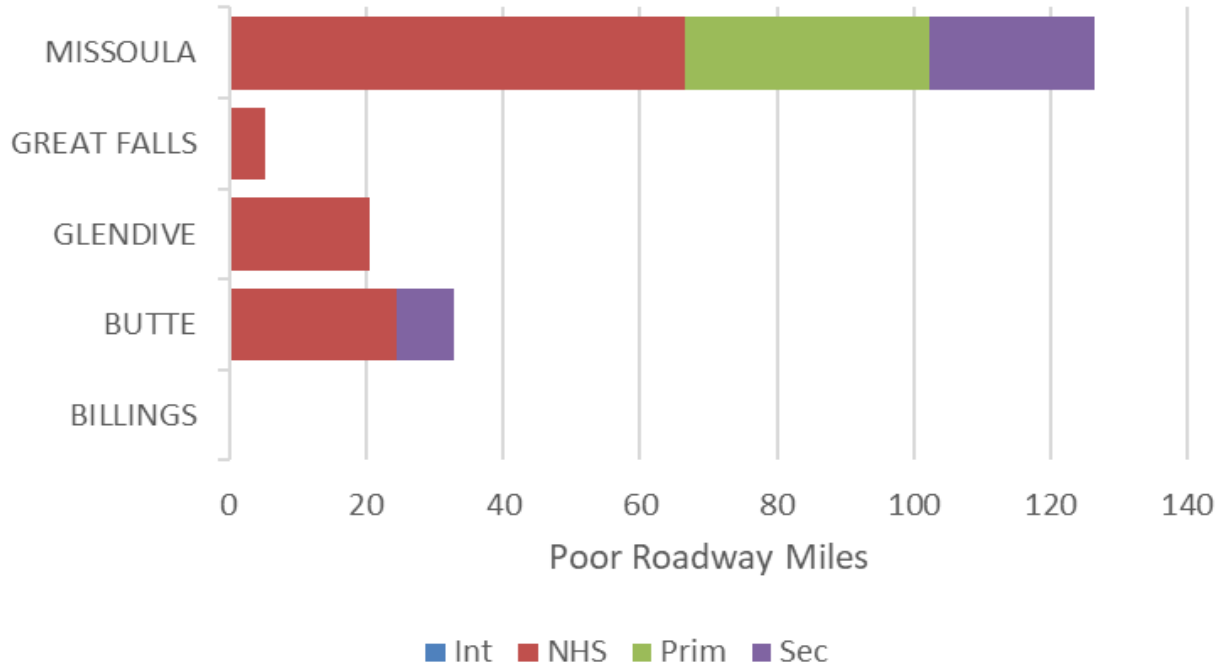


Figure 21 - 2024 Poor Rut by District and System

Figure 22 below depicts the rutting trends for the four systems. Lower values of the rut index indicate increasing amounts of rutting distress. The rutting index on the NHS system has trended downward (worsening) over the last 10 years. The average Rut index decreased by 7.8% statewide over 10 years. The Non-Interstate NHS, Primary, and Secondary systems all experience a Rutting Index decline of greater than 6.3%.

Overall, rutting has worsened gradually over the past decade, suggesting the need for additional preservation projects. Additional investigation into the root causes of rutting including construction practices, mix designs, materials and subgrade impacts should also be considered.

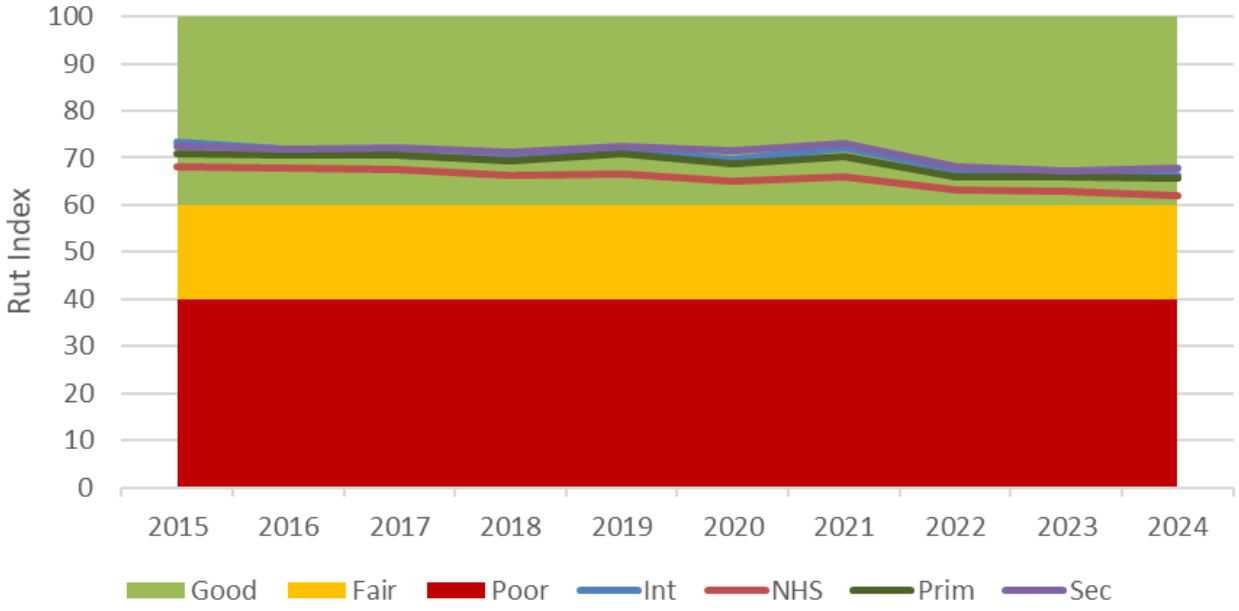


Figure 22 - Average Rut Index by System

Figure 23 and Figure 24 show that Missoula has the highest raw rutting values, which is the primary reason for this district having the largest percentage of poor lane miles. The poor performance in this district may result from the imbalance in the mix design. This suggests that further study of rutting is necessary to better understand its impact and develop effective mitigation strategies.

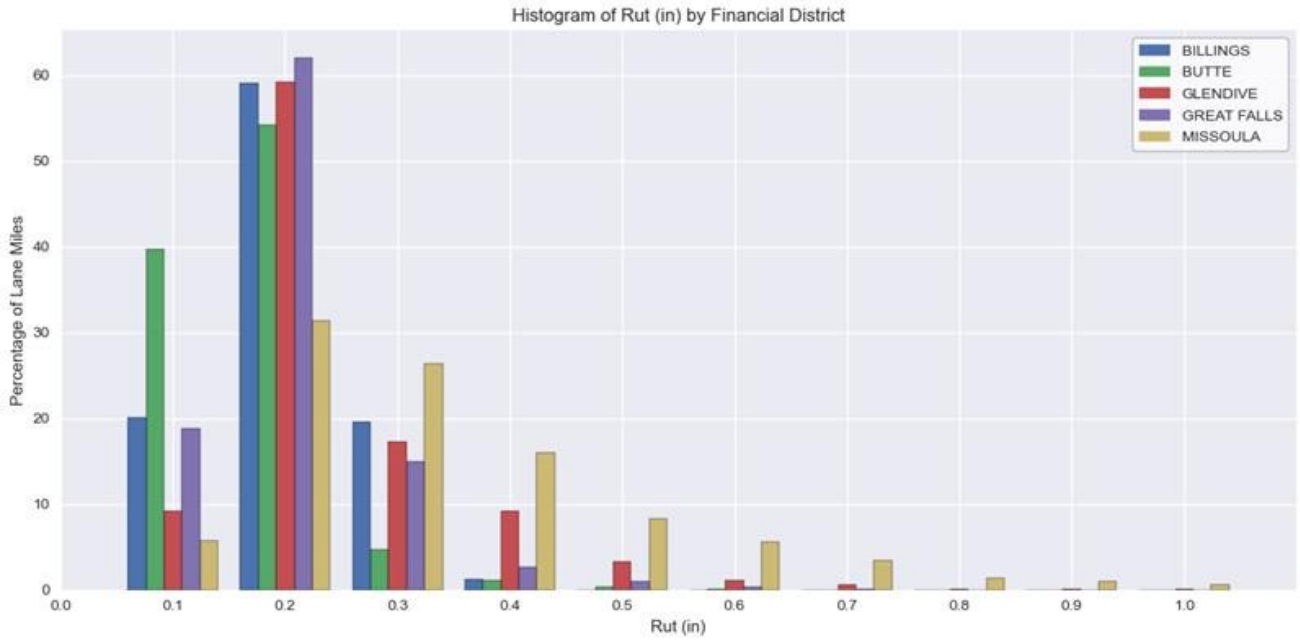


Figure 23 - Distribution of Rutting by District

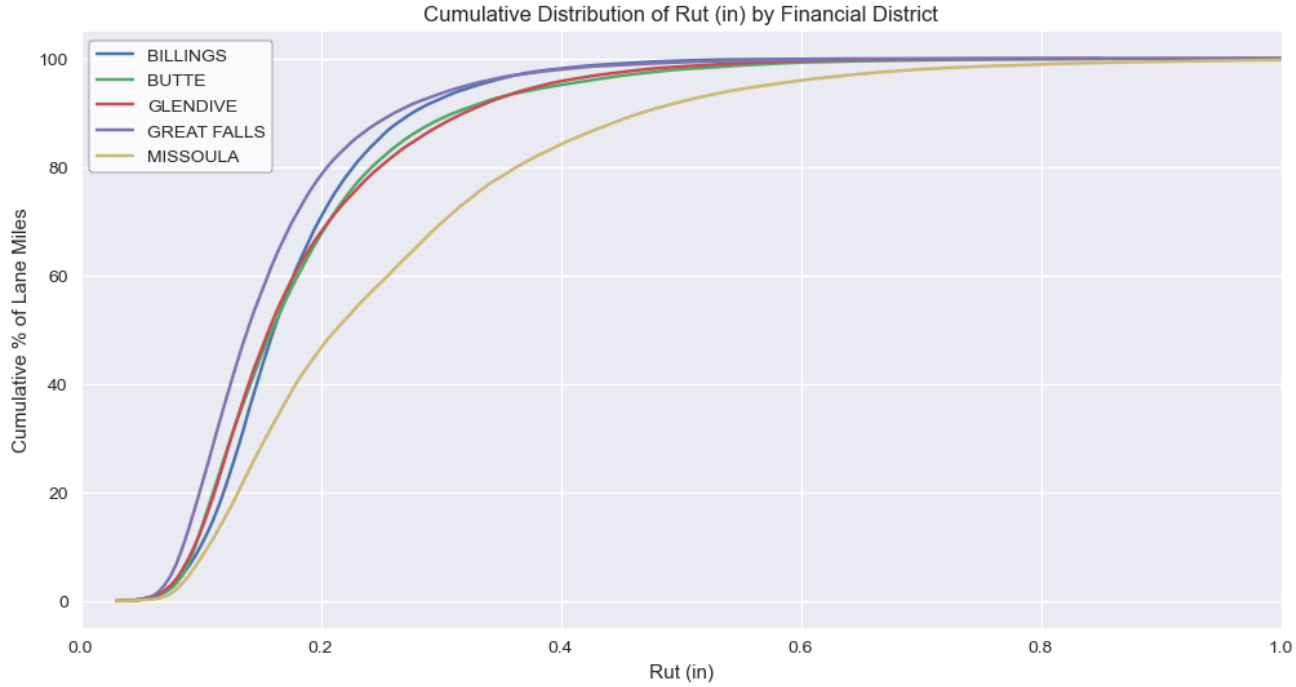


Figure 24 – Cumulative Distribution of Rut by District

Overall Performance Index

MDT combines pavement condition data into an Overall Performance Index (OPI). OPI is a comprehensive health index with a weighted combination of ride, rut, and cracking. OPI can take

values within the range of 0-100 and is classified as Good for indices 63 and above and Poor for indices below 45. The condition data for all four highway systems are shown in Figure 25 for the trend-over-time comparison. MDT's project selection and maintenance efforts continue to keep the majority of MDT's network in fair to good condition, with only 4.0% of the network in poor condition. The segments with poor OPI total 470 miles and have an average age of 33 years. A shift of centerline miles from good to fair in the years prior to and after 2022 is observed, where the average percentage of good pavements in 2020-2022 is 67%, and 51% for years 2023 and 2024. With the adjustment to Raveling Index for the 2023 data, the two distress indices with the greatest statewide change between 2022 and 2023 were Rutting Index and MCI. However, there were minimal to no changes observed in all the OPI component indices from 2023 to 2024.

The statewide average OPI stayed unchanged from 2023 to 2024 as seen in Table 1. With negligible shifts observed in the Good, Fair, and Poor percentages (Figure 25), the differences in OPI distribution by centerline miles are better understood through the more detailed distribution shown in Figure 26, which uses 5-point increments.

It can be noted from Figure 15 that the percentage of centerline miles with an OPI between 50 and 100 is 92.3% in 2023 and only increased to 92.4% in 2024. Overall, this is indicative of the good quality of MDT's system, while also signifying that the system performance needs to be maintained at current levels.

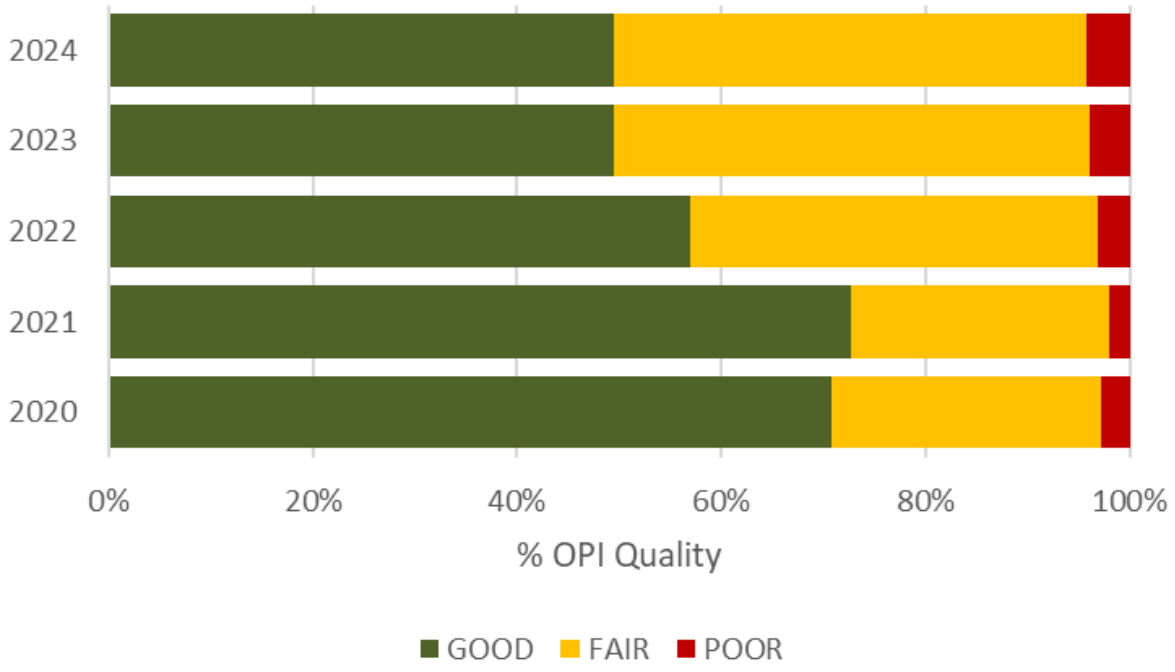


Figure 25 - Network* Condition – OPI Trend

* Combined Interstate, Non-Interstate NHS, Primary and Secondary – Overall Performance Index (OPI) is a mathematical calculation combining Ride, Rut, and Cracking indices into one index.

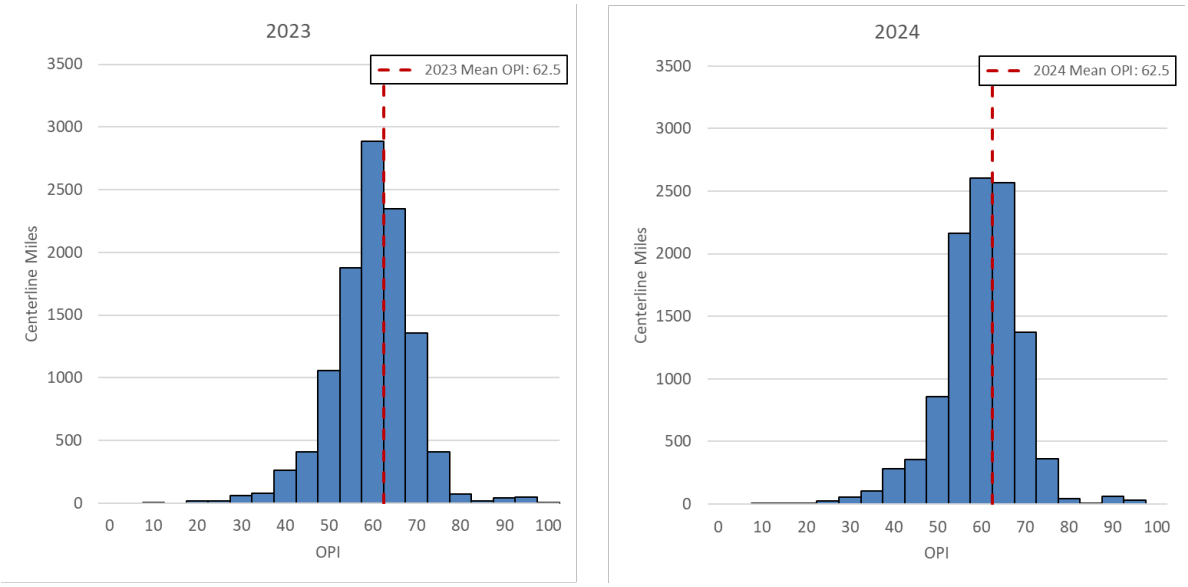


Figure 26 - Distribution of OPI between 2023 and 2024

In Figure 27, the district OPI distributions demonstrate that each district outside of Glendive has more than 50 percent of its highway systems categorized as good. The Missoula District has the largest percentage of OPI categorized as poor with a total of 145 miles falling into the poor category. Of these 145 miles, the Primary system has the most in poor condition with 51 miles, followed by the non-interstate NHS system with 49 miles and the Secondary system with 45 miles. The Interstate system has no miles in poor condition.

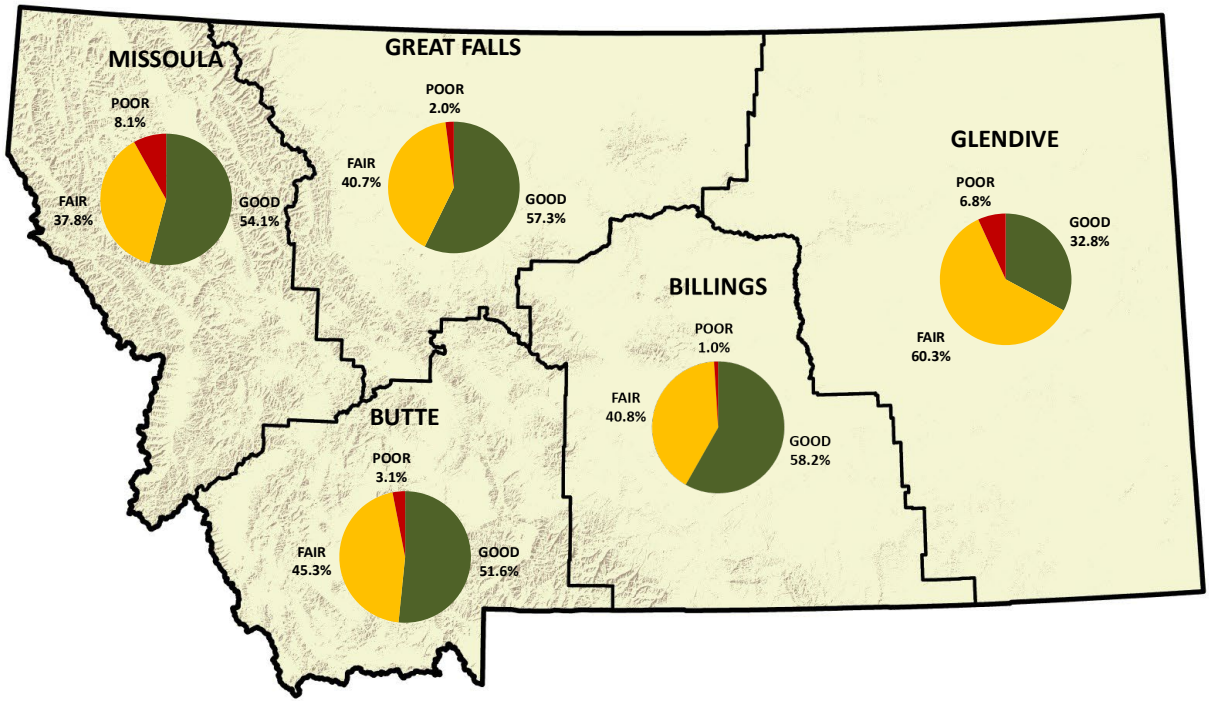


Figure 27 - Percent OPI Quality by District

The histograms and the cumulative distributions in this section are plotted using the tenth mile sections.

Figure 28 illustrates that most of the OPI values are concentrated in the 50-80 range across all districts. It can be seen in Figure 29 that Missoula has the largest cumulative percentage of lane miles with an OPI below 45 (indicating poor condition), while Glendive has the highest cumulative percentage of lane miles with an OPI between 45 and 60 (indicating fair condition). Conceptually, the area under the distribution curve is representative of cumulative damage.

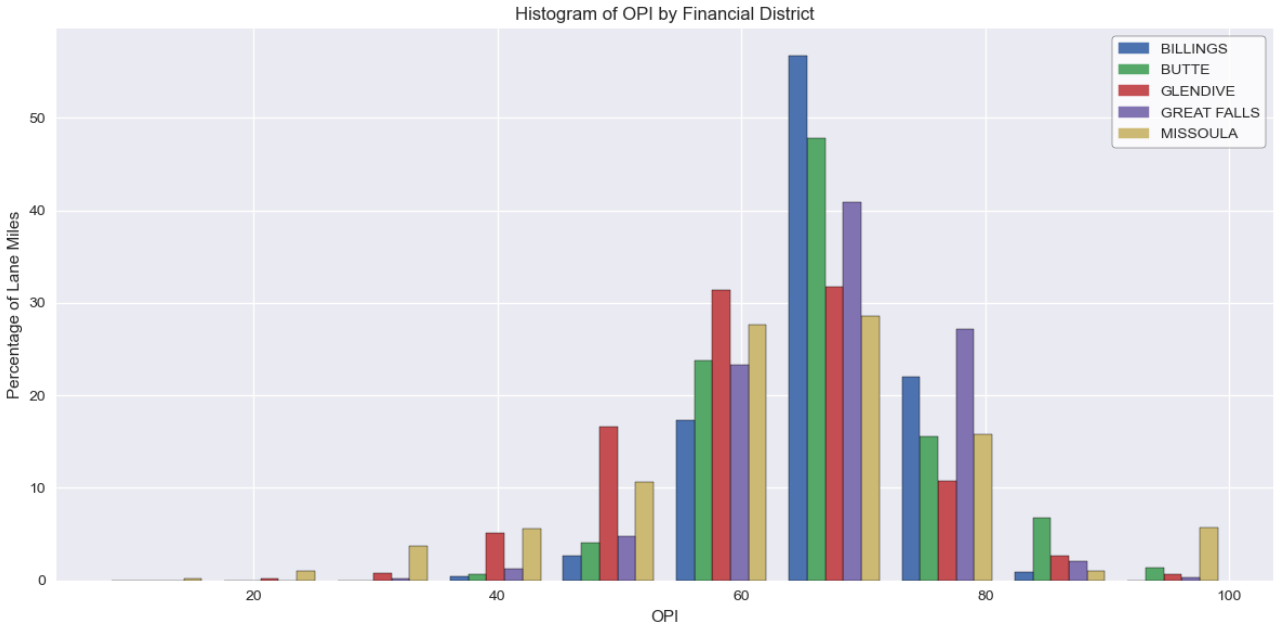


Figure 28 - Distribution of OPI by District

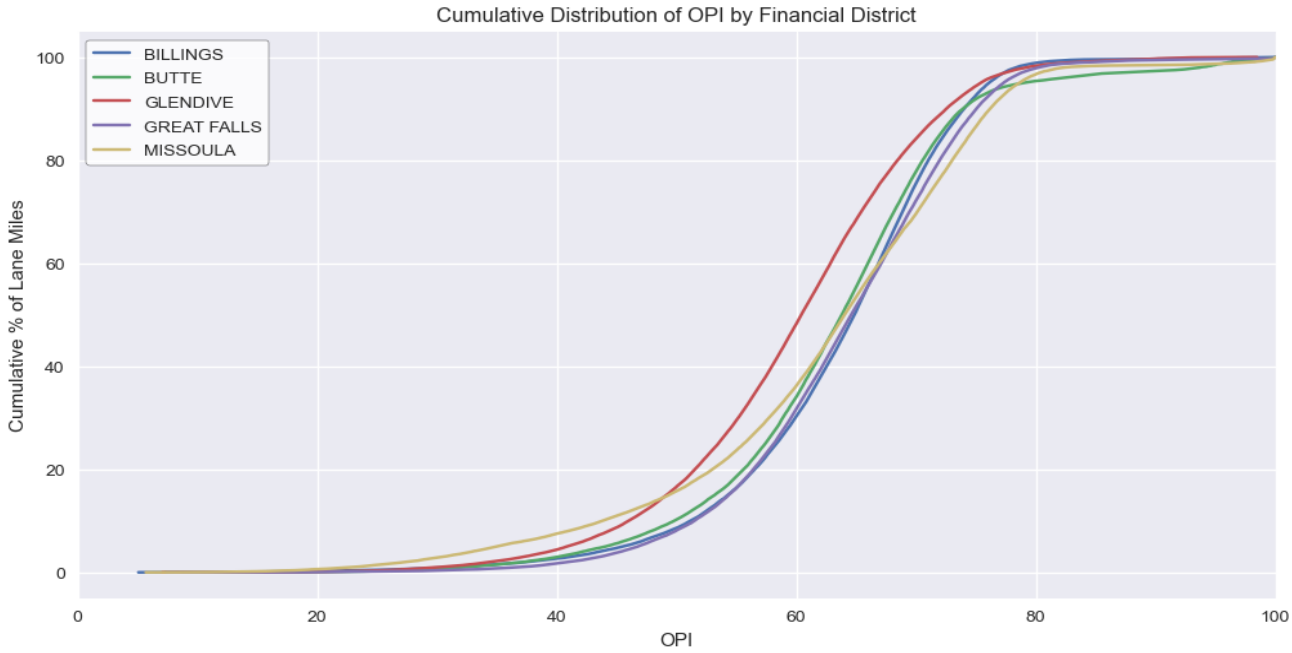


Figure 29 - Cumulative Distribution of OPI by District

Pavement Age

The age of a roadway segment is calculated from the last construction project with plant mix surfacing. Figure 30 depicts the age of the network by mileage since the last surfacing, as well as the associated Ride Index by year. As expected, the ride index tends to get worse (lower) with age. Ride Index averages above 80 until pavement age is greater than ten. The ride index exhibits a nearly linear decline with age. Table 2 below lists each system's 2023 & 2024 average age. All systems experienced an increase in pavement age, with a 0.5-year increase in the age of NHS and Primary systems, a 0.7-year increase in the age of the Secondary system, and a 0.8-year increase in the age of the Interstate system.

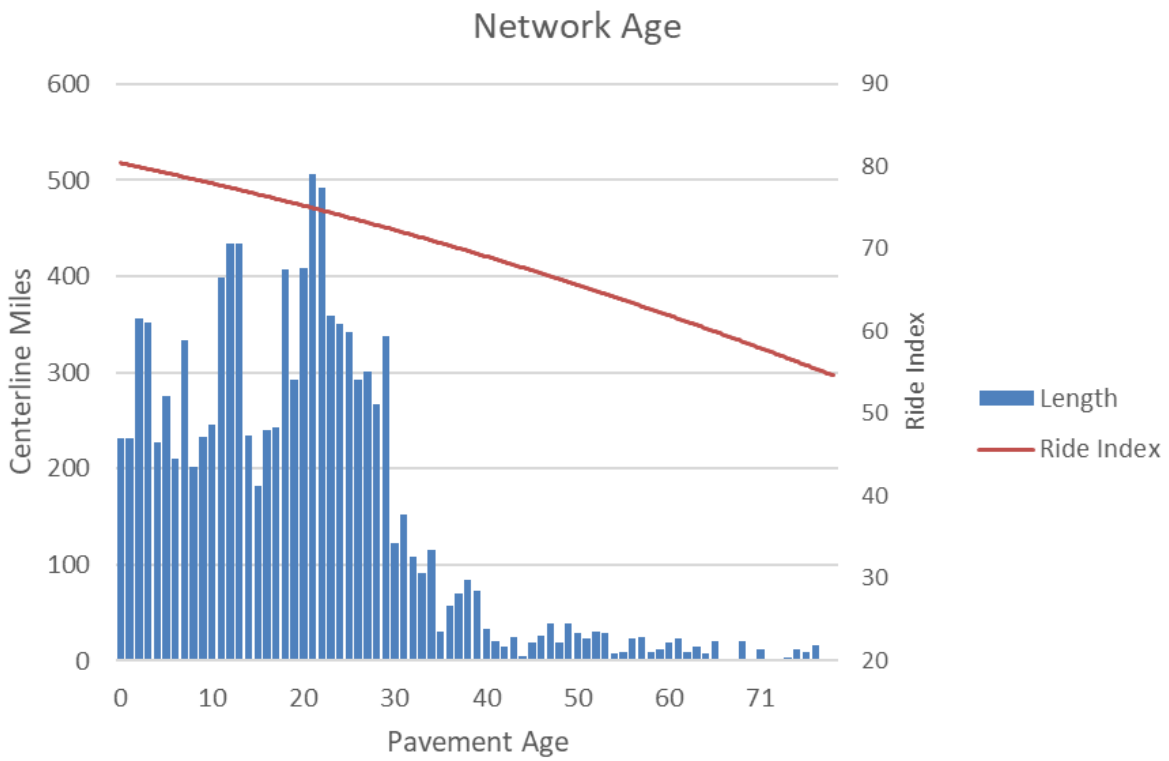


Figure 30 - Network Age and Ride Index

* Combined Interstate, Non-Interstate NHS, Primary and Secondary

Table 2 - Average System Age Since Last Treatment with Surfacing

	Interstate	NHS	Primary	Secondary
2023	15.80	16.81	17.06	24.34
2024	16.07	17.27	16.96	25.15

3 Federal Metric NHS Pavement Condition

MDT quantifies condition reporting at the project segment length (construction project limits). Federal reporting requirements include condition reporting for the Interstate and Non-Interstate NHS systems at 0.1-mile intervals. For each individual 0.1-mile interval, three key metrics are measured based on the pavement type. For asphalt pavements, this includes ride, as international roughness index (IRI), rutting in inches, and the percentage of the wheel path that exhibits cracking. For concrete pavements, the metrics are IRI, faulting in inches and percent of the pavement slabs exhibiting cracking. The three individual ratings are combined for an overall classification. To achieve an FHWA condition rating of "Good", the ride, rutting (or faulting), and cracking ratings must all be in the good category. A "Poor" classification indicates that two or all three of the metrics are rated poor. "Fair" is any other combination. This data is reported annually via the Highway Performance Monitoring System, or HPMS.

Figure 31 depicts the 2024 data assessed using the Federal metrics, while Figure 32 compares the differences in Federal metrics across the last three collection cycles. When combining ride, rut, and cracking, 42.2 percent of the Interstate route mileage rates as good, a 0.7 percent decrease from 2023. Non-Interstate NHS routes experienced a 0.2 percent decrease in good lane miles from 2023 and a slight decrease from 1.5 to 1.4 percent in poor condition. The NHS has 89 miles rated poor by the Federal metrics, while Interstate has 13 miles rated poor. These numbers may vary slightly from the data reported for HPMS based on the handling of lane miles and/or missing data but are in the same general range.

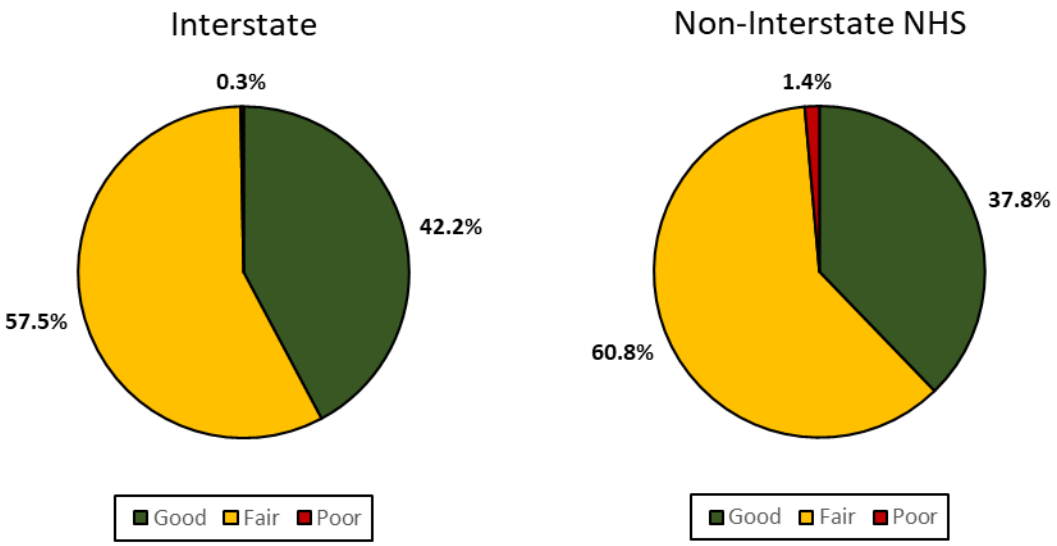


Figure 31 - FHWA Performance Measures

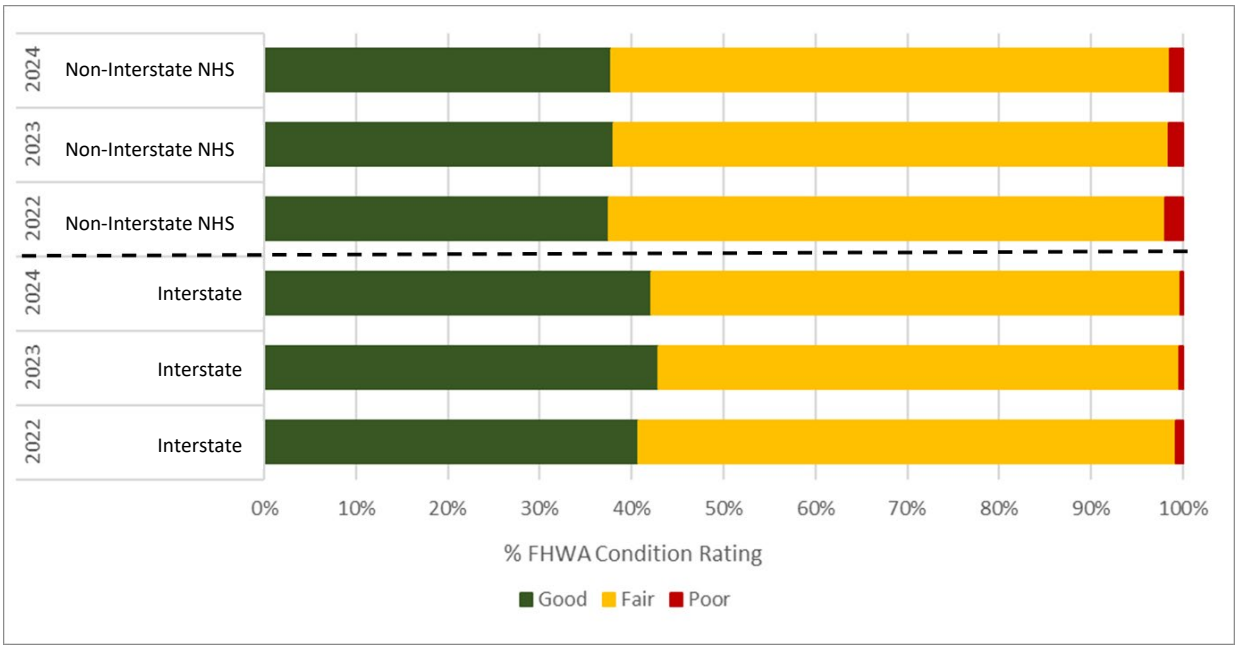


Figure 32 - Change in FHWA performance measures over previous three collection cycles.

4 Work Program Recommendations for 2025

Pavement preservation is a maintenance philosophy that encourages keeping good roads good. The preservation decision tree used in PvMS analysis emphasizes light preservation like Crack Seal and Covers. Other pavement preservation treatments include crack seals, thin overlays, and thin mill and overlays. More invasive pavement treatments include minor rehabilitation, major rehabilitation, and reconstruction. Minor rehabilitation is defined as treatment to the top .3' of plant mix surfacing. Major rehabilitation is any treatment that removes plant mix surfacing to expose base gravel. Reconstruction is work that removes all plant mix surfacing and base gravel to expose subgrade material. The total centerline miles for each recommended treatment by surfacing type are: 55 miles for reconstruction; 1344 miles for rehabilitation; and 8286 miles for preservation, respectively. Figure 33 summarizes treatment type recommendations in 2024 versus recommendations in 2025. Table 3 summarizes the total centerline miles for each recommended treatment.

Table 3 – Centerline Miles of Recommended Treatments

	Reconstruction	Rehabilitation	Preservation
2024	102	1,191	6,706
2025	55	1,344	8,286

MDT's Pavement Analysis section has reworked the decision trees that result in treatment recommendations. The changes were needed in order to align with MDT's *Guidelines for Nomination and Development of Pavement Projects* agreement with FHWA. Specific pavement preservation treatments, such as crack seal and cover, thin overlays, etc. will be replaced by light, medium, and heavy preservation categories which include those treatments and many others. These changes will allow district staff and pavement designers to coordinate to select the correct treatment at the correct time. A supplemental report will be released in 2025 with this new philosophy and will be the standard moving forward.

Detailed treatment types are recommended by the PvMS and made available through PDF and web reports for each district.

Figure 33 - Recommended Treatment Backlog

As shown in Figure 34 the predominant recommended treatment is Crack Seal and Cover with 5547 miles. As a light preservation treatment, the age clock does not reset with a Crack Seal. Thin Overlays reset the age clock with the new surface and the 2025 projection recommends 1845 miles of needed overlays.

By mileage, overlays on the Secondary system continue to be the dominant recommended treatment with a total of 1085 miles. Nearly one-third of the minor rehabilitations recommended by the analysis are also on the Secondary system (276 miles). The frequency of recommendation for higher level treatments are indicators of underfunding this system where the higher-level treatments account for more miles than the lighter preservation treatments.

The backlog of recommended treatments by district is depicted in Figure 35. Glendive district has the most mileage of recommended treatment with 2646 miles, including 1214 miles of overlay and rehabilitation treatments. The Missoula district has the most rutting treatment recommendations for 295 miles and reconstruction with 38 miles.

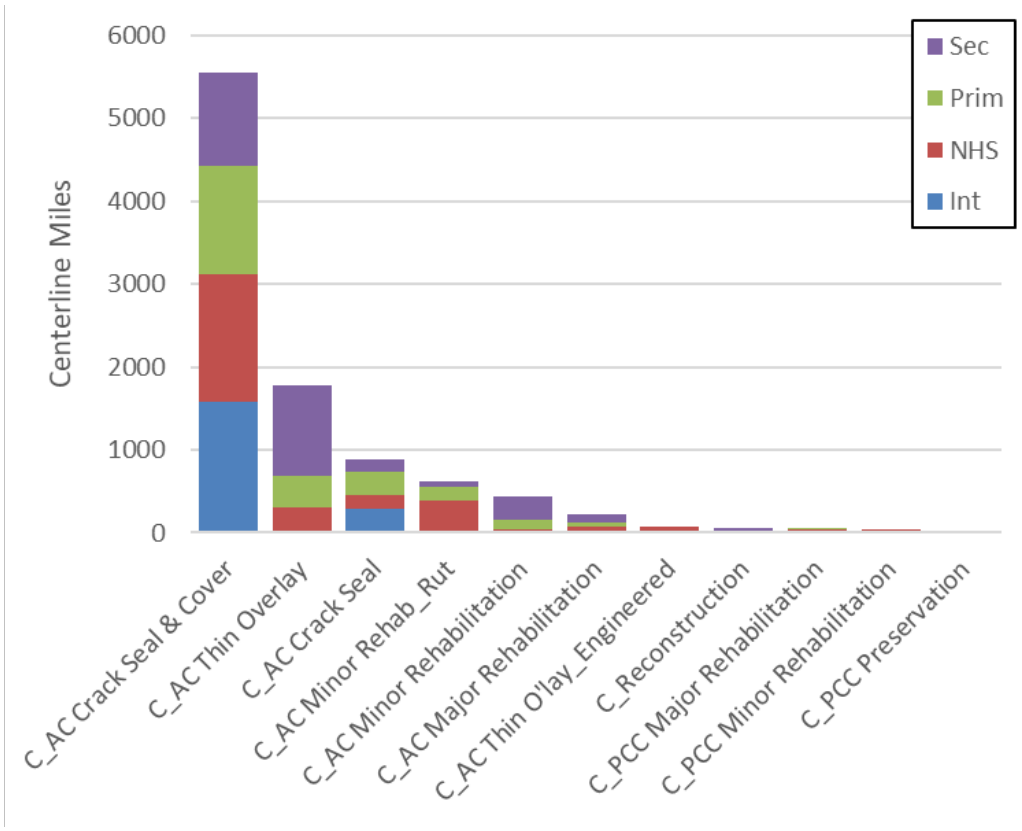


Figure 34 - Recommended Treatment Backlog by System

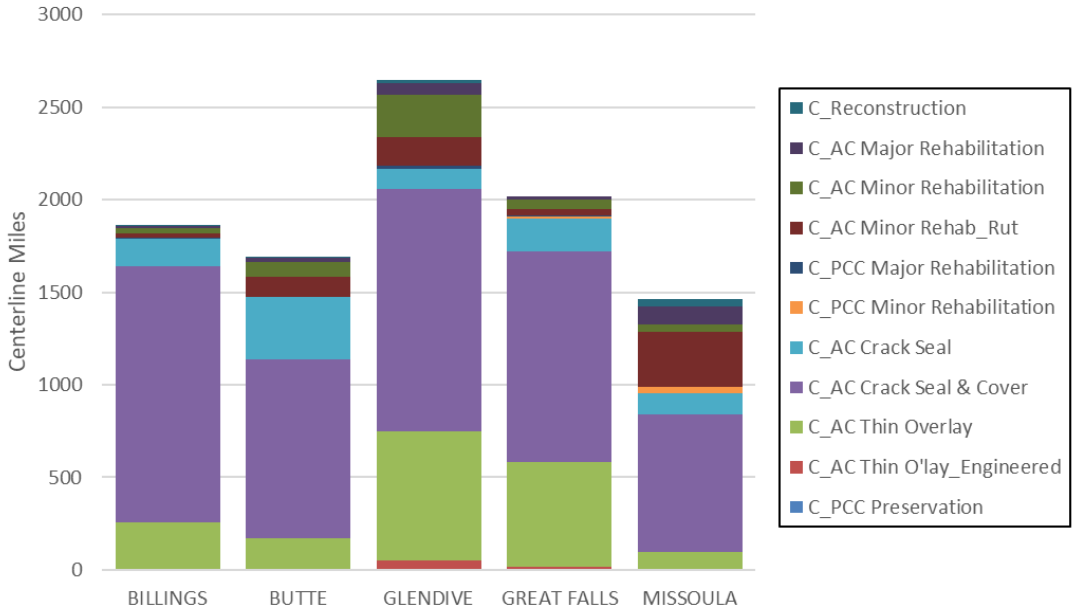
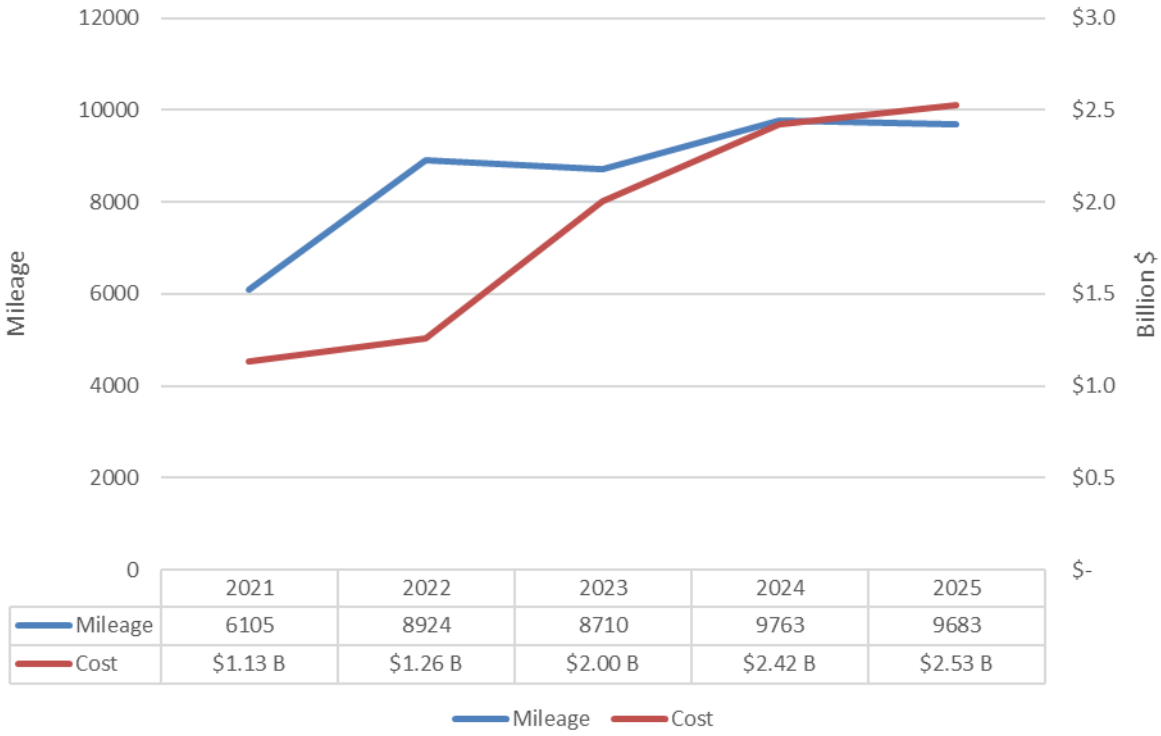


Figure 35 - 2025 Recommended Treatment Backlog by District

Preservation of Pavement is an important strategy used to keep good roads in good condition by choosing the right treatment at the right time. The balance between maintaining good roads in good condition and addressing road segments in more deeply deteriorated condition is a difficult choice. Sealing treatments offer a lower cost choice to keep the surface rejuvenated and help mitigate potential moisture damage to the substructure. Preservation approaches including multi-level treatments with varying life extensions provide the best opportunity to address more miles. For example, annual preservation nominations should include standalone crack seal and chip seals to maintain surface conditions, while including plant mix treatments like overlays and recycling to address surface distress.

4.1 Fiscal Need Highlights for 2025

Fiscal need represents the financial implications of the recommended treatments generated by a scenario using unlimited funding. The 2025 fiscal need for the Interstate, Non-Interstate NHS, Primary and Secondary systems pavement is $2.5 billion. This is a $105 million increase compared to the 2024 projection (Figure 36). Contributing factors to the increased cost include the rise in material costs and the greater number of miles requiring rehabilitation. The reduction in mileage is likely due to the continued aggressive preservation approach.

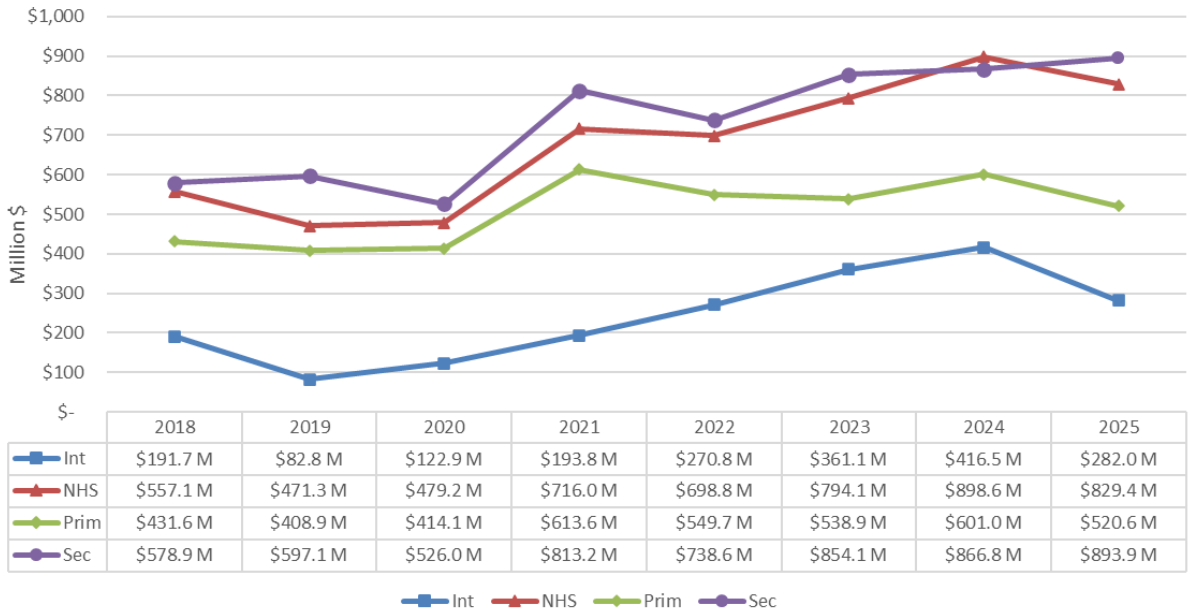


	2021	2022	2023	2024	2025
Mileage	6105	8924	8710	9763	9683
Cost	$1.13 B	$1.26 B	$2.00 B	$2.42 B	$2.53 B

Figure 36 - Statewide Backlog Mileage and Cost Trends

Figure 37 compares the historical needs by system. The $105 million increase appears less significant when adjusted for inflation. Although nominal costs increased due to higher unit costs, the inflation-adjusted costs showed a decreasing trend for all systems except Secondary. The increased financial need from 2024 to 2025 did not exceed the rate of inflation in a manner that

resulted in decreased inflation adjusted need for most systems. The Secondary system and Non-Interstate NHS system now represent the highest fiscal needs, with the Secondary system leading at $893 million, marking a $27 million increase from 2024. Figure 38 depicts the statewide need distribution by treatment. Lighter preservation treatments account for $1.5 billion of total needs. Most of the need on the Interstate is light preservation treatments, consistent with the generally good condition of the Interstate system.



	2018	2019	2020	2021	2022	2023	2024	2025
Int	$191.7 M	$82.8 M	$122.9 M	$193.8 M	$270.8 M	$361.1 M	$416.5 M	$282.0 M
NHS	$557.1 M	$471.3 M	$479.2 M	$716.0 M	$698.8 M	$794.1 M	$898.6 M	$829.4 M
Prim	$431.6 M	$408.9 M	$414.1 M	$613.6 M	$549.7 M	$538.9 M	$601.0 M	$520.6 M
Sec	$578.9 M	$597.1 M	$526.0 M	$813.2 M	$738.6 M	$854.1 M	$866.8 M	$893.9 M

Figure 37 - Fiscal Needs by System Normalized for Inflation Using Treatment Unit Costs

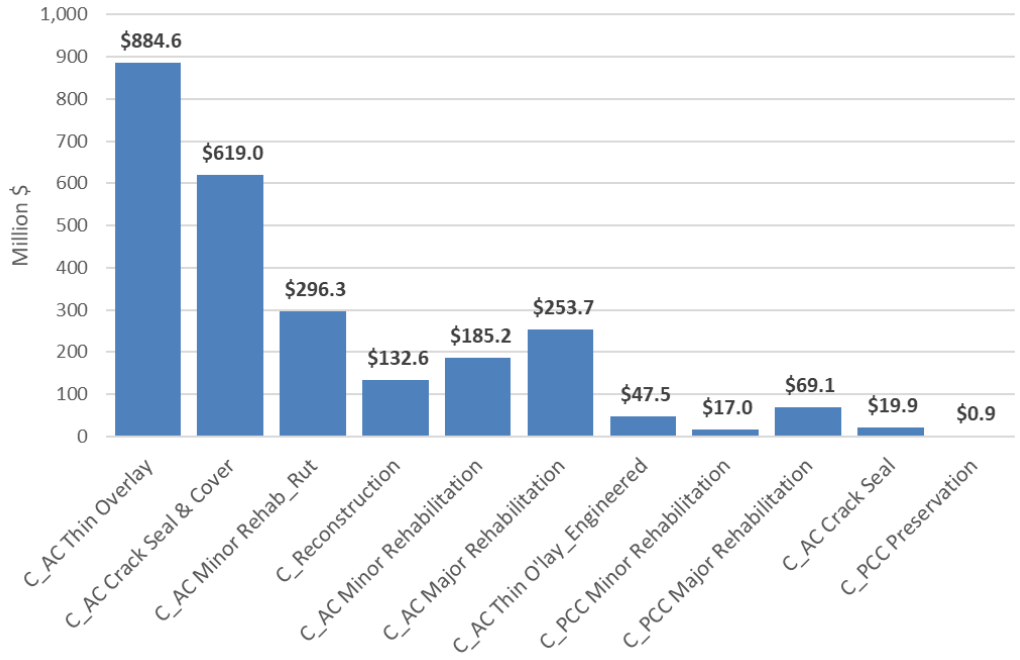


Figure 38 - 2025 Funding Needs by Treatment

Figure 39 highlights funding needs by specific system for each district. The Non-Interstate NHS has significant needs in Glendive and Missoula districts with approximately $260 million each. In addition to the needs on the NHS, the Glendive district has over $230 million in needs on the Primary and Secondary systems. The Great Falls district's fiscal need is heavily driven by the Secondary system. The scenario analysis for this report projects a pavement preservation funding need of over $1.5 billion for the entire state. While challenges funding the Secondary system continue, emphasis on preservation is needed to prevent continued growth in the rehabilitation treatment needs. Further delay in addressing the Secondary preservation needs will result in decreased system performance and condition, requiring more expensive treatments to repair.

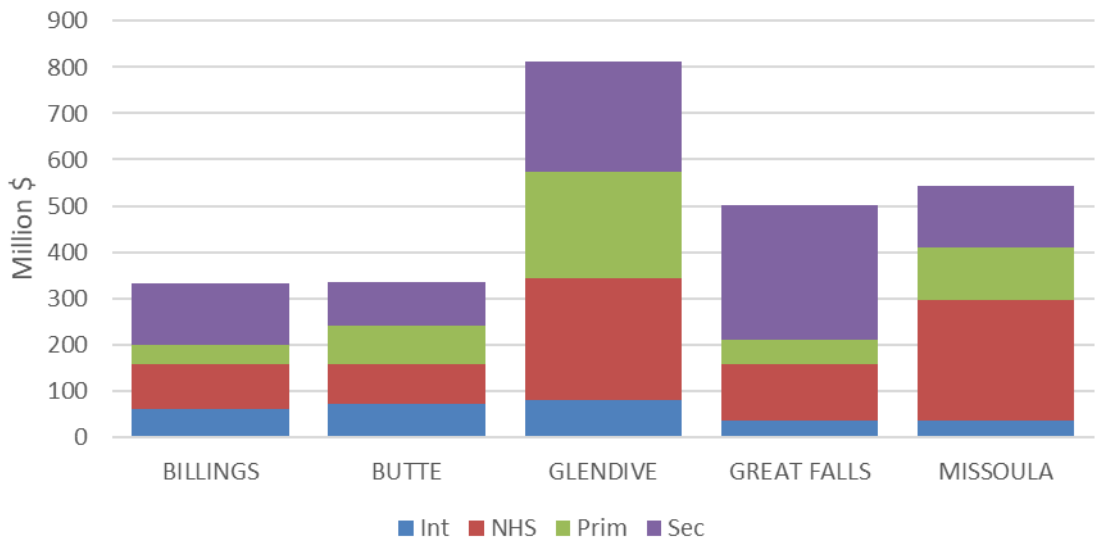


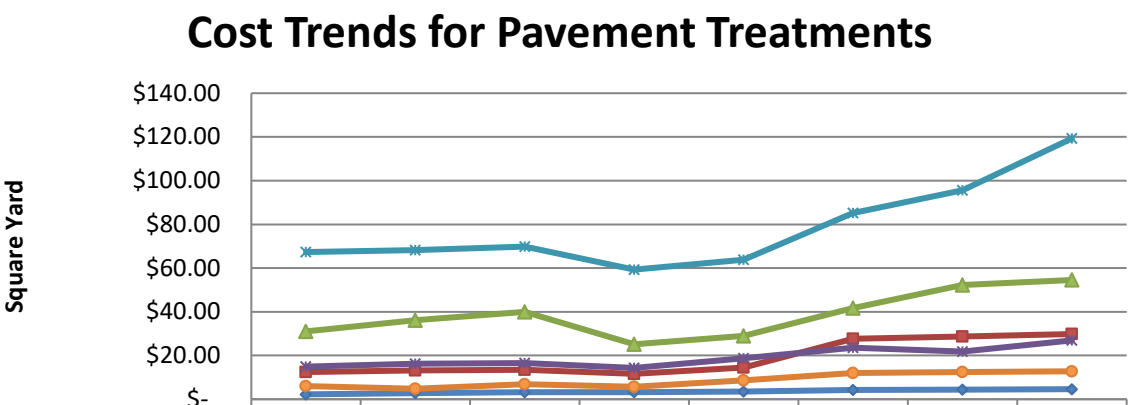
Figure 39 – District Funding Needs by System

4.2 Treatment Cost Analysis

Annually, Pavement Management determines pavement treatment costs using the current year's construction costs. Pavement project bid tabulations are evaluated by determining the project's treatment type (i.e., Reconstruction, Rehabilitation, Thin Overlay, or Seal & Cover). For consistency, bid items included in the treatment cost analysis are established by using MDT's *Guidelines for Nomination and Development of Pavement Projects.* This document outlines additional included work based on the scope of the project. This work slightly changed in 2024. Previous work was not truly representative of construction cost. Major rehabilitation and Reconstruction saw a greater increase in cost due to this change. More realistic cost estimations will enhance optimization and funding analysis in the future.

The reported cost per square yard (cost/yd^2) is the project cost divided by the project's pavement surface area. Each treatment cost is averaged from data for the previous construction year and used to develop the individual project costs for the year and summarized in the fiscal need section. The cost trends are shown in Figure 40.

Materials costs increased again in 2024, continuing the general increase in all treatment types since 2020. In addition to cost increase, the change to cost analysis philosophy contributed to each treatment reaching its highest cost on record in 2025. The complexity of Major Rehabilitation and Reconstruction projects affects the cost averages for those treatments. Reconstruction experienced by far the greatest increase in costs. This further highlights the need to keep good pavements good through preservation.



	2017	2018	2019	2020	2021	2022	2023	2024
Seal and Cover	$2.24	$2.78	$3.16	$3.26	$3.51	$4.30	$4.40	$4.60
Thin Overlay	$12.43	$13.24	$13.52	$11.63	$14.44	$27.69	$28.66	$29.83
Minor Rehab	$14.95	$16.25	$16.53	$14.33	$18.79	$23.60	$21.88	$26.93
Major Rehab	$31.07	$36.11	$39.96	$25.14	$28.94	$41.79	$52.29	$54.55
Reconstruction	$67.31	$68.16	$69.81	$59.30	$63.78	$85.22	$95.65	$119.32
Micro Surfacing	$6.00	$4.81	$6.91	$5.77	$8.70	$11.98	$12.40	$12.78

Figure 40 - Cost Trends for Pavement Treatments

5 Conclusion and Recommendations

Montana's highway systems continue to perform well overall, with over 95 percent of the roadways being in good or fair condition. The traveling public will have their best driving experience with the least amount of pavement distress on the Interstate system. Montana's Interstates continue to enjoy excellent ride quality and low pavement rutting throughout the system. The NHS and Primary systems will be a very similar experience for the public. The ride quality of these systems will be similar, but the NHS system is slightly more rutted. The secondary system will be the least enjoyable system to drive from the public's perspective. The Secondary system is minimally rutted, but only 12% of the system has a good Ride Index and the highest value of poor Ride Index at 15%. Generally speaking, Montana enjoys very high cracking indices across all systems, indicating good performance of our flexible pavements. This is likely due to Montana's robust chip seal and crack seal efforts through construction and maintenance funding.

While the highway network is performing well, there is still a major funding gap in the Secondary System. MDT is beyond the point of being able to use pavement preservation tactics to keep good roads good as much of the Secondary System has degraded beyond a preservation treatment recommendation. At the current level of backlog, funding, and if there was no continued deterioration, the Secondary System would take 21 years to clear the backlog. In comparison, the NHS and Primary Systems would take about 5 to 6 years. Action needs to be taken to address this issue. It is our recommendation that the department and stakeholders set goals and expectations for the quality of the Secondary Road System. These quality expectations can be modeled in the pavement management system to reevaluate the backlog. Then the Department needs to engage with the legislature to modify the project selection process and secure funding to bring the system in compliance with established performance goals. This will be a team effort and Pavement Analysis stands by to assist.

Although most pavement distress indices are consistent between districts and systems, Missoula district has a serious rutting issue on the NHS and Primary systems. Nearly 70% of the state's worst rutting mileage can be found in Missoula district. Pavement Analysis believes there is an asphalt mix design issue that could be a major contributing factor. As evidenced by the data presented in this report, the district has the lowest cracking distress and the highest rutting distress. This suggests there is an imbalance in the asphalt mix design. That said, Missoula district, on average, sees more precipitation and has significant tourism traffic, both could be compounding these rutting issues. It is recommended that an internal investigation or research project be conducted to further understand the issue and identify a solution.

Due to the growing preservation backlog, Pavement Analysis engaged with internal MDT stakeholders to address decision tree and treatment recommendation in the Pavement Management System. As a result of this work, treatment deferral years were adjusted to align with pavement preservation cycle more realistically. Pavement preservation categories were also aligned with MDT's *Guidelines for Nomination and Development of Pavement Projects* to allow for the correct pavement treatments to be applied by district and pavement design coordination. This work should decrease pavement preservation backlog and will more reasonably align with MDT's pavement preservation program. A supplemental report documenting these changes and the general effect on the treatment recommendations will be released in mid-2025.

To conclude, three key action items need to be addressed by MDT.

1. The continued degradation of the Secondary Roads System needs to be addressed. Performance goals need to be identified, and a project strategy evaluated to establish an accompanying funding plan. Significant engagement should be anticipated with local, legislative, and MDT stakeholders.
2. The asphalt pavement rutting issue in Missoula district needs to be researched for cause and recommendations for improvement identified. The rutting conditions in this district are comparatively worse than other distresses. The initial recommendation is a Materials Bureau led investigation or MDT Research project to identify a higher performing mix design.
3. Districts continue to work with Pavement Analysis team to address district specific issues and distresses to improve pavement asset performance based on each district's challenges.

6 Pavement Management Data Summary and Reporting

MDT's Pavement Analysis Section annually conducts a Pavement Condition Survey (PCS) of Montana's Interstate, Primary and Secondary highway systems.

Data Quality Management

The Transportation Asset Management Plan (TAMP) requires MDT to maintain a Data Quality Management Plan (DQMP) for the measurement and reporting of pavement distress data. MDT's DQMP includes multiple steps to quality check and verify collected data. The plan was updated in 2024. The quality management tasks are divided into three categories: equipment certifications/verifications, distress data quality control checks, and pavement management index quality control checks.

Equipment Certifications and Verifications

In advance of the collection season the Data Collection Van (DCV) operators conduct several certifications and verifications to ensure the two data collection systems are functioning properly and within range. Table 3 and 4 present a summary of these quality assurances.

Table 4 - Annual Quality Assurance

Assurance	North Van	South Van	Notes or Corrective Actions
Block Calibration	Pass	Pass	
Bounce Test	Pass	Pass	
Rut Verification	Pass	Pass	
DMI Verification	Pass	Pass	
Image Verification	Pass	Pass	
5-Mile Baseline	Pass	Pass	
Distress Detection Ground Truth	Pass	Pass	
Profiler Certification	Pass	Pass	

Table 5 - Weekly Quality Assurance

Assurance	North Van	South Van	Notes or Corrective Actions
Block Calibration	Pass	Pass	
Bounce Test	Pass	Pass	
Rut Verification	Pass	Pass	
DMI Verification	Pass	Pass	
Image Verification	Pass	Pass	
5-Mile Baseline	Pass	Pass	

Distress Data QC

The distress data and imagery are collected weekly with two DCVs. On average the collection teams collect between 750 to 1,200 miles of data each week. These data are quality checked as summarized in Table 5.

Table 6 - Weekly Quality Control

Check	Completion	Result	Notes or Corrective Actions
Initial Data Checks	Complete	Pass	IRI, Rut, and Imagery all met standards.
Cracking Distress Checks	Complete	Pass	

Annual Distress Data and Index QC

The last step in the data quality process is to conduct post-collection season checks on the data and calculated index values. Table 6 summarizes the checks conducted.

Table 7 - Annual Quality Control

Quality Check	Completion	Result	Notes or Corrective Actions
Final Data Check	Complete	Pass	IRI, Rut, and Imagery all met standards.
Cracking Distress Check	Complete	Pass	An issue was discovered with how the system recorded the spatial location of transverse cracks in 2023. The software has been updated to correct the issue. This issue was not seen in 2024.
Pavement Management Index Check	Complete	Pass	All indexes passed checks

Data Acceptance
The intent of the DQMP is to validate that data deliverables meet the quality standards. The results and subsequent acceptance of these quality checks are presented in Table 7.

Table 8 - Acceptance of Data

Deliverable	Acceptance Limit	Result	Corrective Actions (as needed)
IRI, Rut, Faulting, Cross Slope, Longitudinal Grade, GPS Coordinates	95% compliance with standards	Pass	
Cracking Distress Ratings	80%	Pass	
Locations of Segments	98%	Pass	
Pavement Images	N/A, Evaluated for obstruction or interference	Pass	

7 Reporting

The Pavement Analysis Section maintains a database which includes annual PCS data, and maintenance and construction history. The database is used to conduct a systematic, objective evaluation identifying the maintenance, rehabilitation, and reconstruction needs.

The current pavement condition, recommendations for future pavement treatments, and an estimation of the fiscal resources required to keep the highway systems in good condition are available in multiple formats listed below as well as in print. The “Report Development Section” details collection and condition metric information. It is available with the district printed reports and on the Intranet.

Data in this Report as well as additional pavement related information is available on both MDT Intranet and the Jasper Reports

This year's report is also available electronically as follows:

1. Jasper Reports. The report can be accessed by logging into MDT's Jasper Reports on the Intranet. "Resources">"Online Applications">"Jasper Reports" under GENERAL heading> click "View" >"Library"> scroll to "PvMS Condition Treatment Dashboard" Leave 'Year" blank for current year. Select report by district or route.
2. MDT Intranet: The trend analysis portion of the report can be found by clicking on "Resources">"Reports">"Pavement Analysis -- Pavement Condition and Treatment Report".
3. MDT Intranet: Condition and recommended treatments portion of the report can be found by clicking on "Resources">"Online Applications">"Pavement Analysis -- Pavement Condition Treatment Report" or "Field Review Report".
4. Direct link is here: Pavement Analysis and Condition Treatment Report - Montana Department of Transportation (mt.gov)

Definitions of Recommended Treatments

The definitions of recommended treatments follow the Guidelines for Nomination and Development of Pavement Projects. This document, approved by the Federal Highway Administration, MDT and the Transportation Commission provides clear guidance for the development of Preventive Maintenance, Rehabilitation and Reconstruction projects.

Feedback and Additional Analysis

Your input and feedback are very important to us. Specific system, route, management section, treatment, or condition reports and summaries can be generated upon request. If you have an idea or suggestion on how to improve our analysis and/or reporting, please contact Chad DeAustin cdeaustin@mt.gov or DJ Berg djberg@mt.gov .

Acknowledgements

The production of this report was greatly benefited by the efforts of numerous individuals both within and outside the Pavement Analysis Section.

Pavement Management and Data Collection staff*:* DJ Berg, Chad DeAustin, Kim D'Arcy, Trent Rouse, Trevor South, Bryce Shaneyfelt, G.W. White, Lillian Kurzhal