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A Data-Driven Assessment of Michigan's Road Program

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A Data-Driven Assessment of Michigan's Road Program

Contents

Tables

Charts

Figures

Abbreviations

ABC	Automated Bus Consortium
ADT	Average Daily Traffic
CAV	Connected/Automated Vehicle
CL mile	Centerline or System Mile
CPI-U	Consumer Price Index (urban consumers)
DSRC	Dedicated Short-Range Communication
FAE	Federal Aid Eligible
HMA	Hot Mix Asphalt
IRI	International Roughness Index
JCP	Jointed Concrete Pavement
MHCCI	Michigan Highway Construction Cost Index
MI-PASER	Michigan Pavement Surface Evaluation and Rating
NBI	National Bridge Inventory
NHCCI	National Highway Construction Cost Index
NHS	National Highway System
OAG	Office of Auditor General
PCM	[Federal] Pavement Condition Metric
PSR	Pavement Serviceability Rating
ROW	Right-of-Way
TAMC	Transportation Asset Management Council
USGS	United States Geological Survey

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A Data-Driven Assessment of Michigan's Road Program

Summary

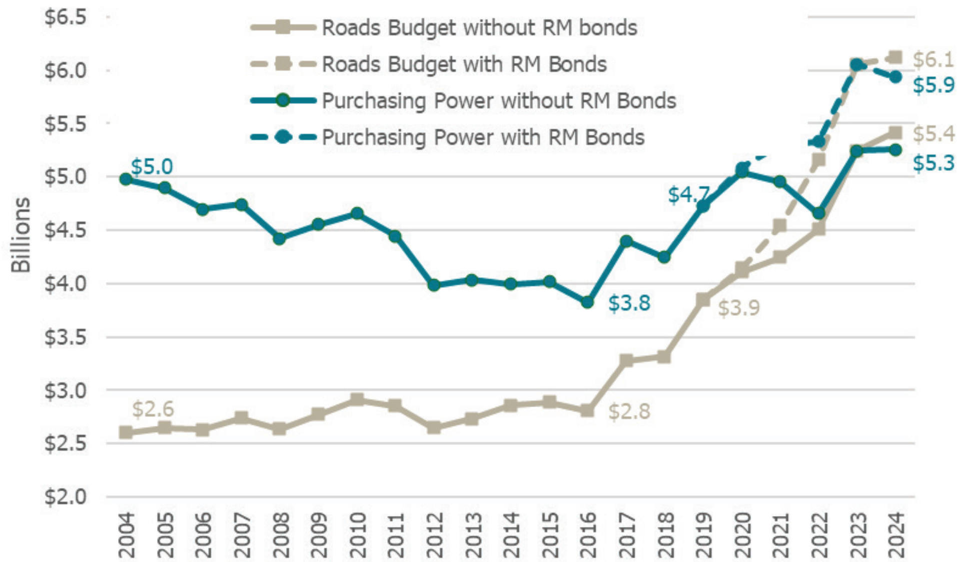
This report provides an objective fact-based analysis to help inform ongoing public discussions regarding Michigan's road funding. It provides an assessment of key data describing Michigan's statewide road program, including road and bridge funding and system conditions. Michigan's road program performance – the efficacy in utilizing given funding levels to maintain the public road network – is found to have declined between 2004 and 2024 and is now less effective than many other states.

This analysis suggests that ongoing road funding discussions should include an evaluation of options to improve Michigan's road program performance. Primary among policy implications are recommendations to review the efficacy of Michigan's approach to pavement management and to prioritize a legislative repeal and replacement of Public Act 51 of 1951, the law that determines road funding distribution and allocation.

Road Funding

- State and federal transportation funding specifically allocated to Michigan's road program (including road and bridge funding) remained relatively flat from \$2.6 billion in 2004 to \$2.8 billion in 2016. Following enactment of the 2015 road funding package and Rebuilding Michigan bond program, road funding has more than doubled, increasing to \$6.1 billion in 2024.
- Although nominal funding doubled from 2016 to 2024, construction cost inflation reduced the gain in purchasing power by almost 50 percent.
- When construction cost inflation is considered, the purchasing power of Michigan's road program is about 18 percent greater in 2024 compared to 2004, and greater than any point during this period.
- If Rebuilding Michigan bond funding were removed from the analysis, the purchasing power of Michigan's road program is about six percent greater in 2024 than in 2004, and greater than any point during this period. Michigan's road funding in 2024 was at a historical high, dating back to at least 2004.
- Analysis of national financial data from 2012 to 2021 shows that Michigan ranks 30th among all 50 states in road funding over this period.

Chart A
Michigan Road Budget and Purchasing Power in 2023 Inflation-adjusted Dollars, FY2004-FY2024



Sources: House Fiscal Agency and MDOT.

Road System Condition

- As measured by the Michigan Transportation Asset Management Council using a metric called MI-PASER, the percentage of federal aid eligible pavement in poor condition increased from 12 percent in 2004 to 33 percent in 2023. Pavement in fair condition declined from 64 to 41 percent. The percentage of pavement in good condition remained relatively flat over this period.
- MI-PASER data suggests that state-owned trunklines, administered by the Michigan Department of Transportation (MDOT), have been maintained in better condition than locally maintained roads from 2004 to 2023. Nevertheless, MDOT's federal aid pavement in poor condition increased from seven percent to 21 percent. The proportion of MDOT pavement in fair condition declined from 64 to 48 percent, while percentage pavement in good condition remained relatively flat.
- MI-PASER is a partially subjective assessment of pavement condition, collected via "windshield survey." MI-PASER data can be useful in evaluating pavement conditions within a broader analysis. However, the accuracy and utility of MI-PASER data is questionable and should not be relied upon as the sole measure of pavement condition.
- Federal reporting of pavement conditions on the National Highway System (NHS) requires the use of a standardized objective metric called the International Roughness Index (IRI). As measured by IRI, the percentage of Michigan's NHS routes in poor condition has remained relatively flat from 2004 to 2022. NHS pavement in good

condition over this period increased from 46 to 62 percent, with a corresponding decline of pavement in fair condition from 41 percent to 22 percent.

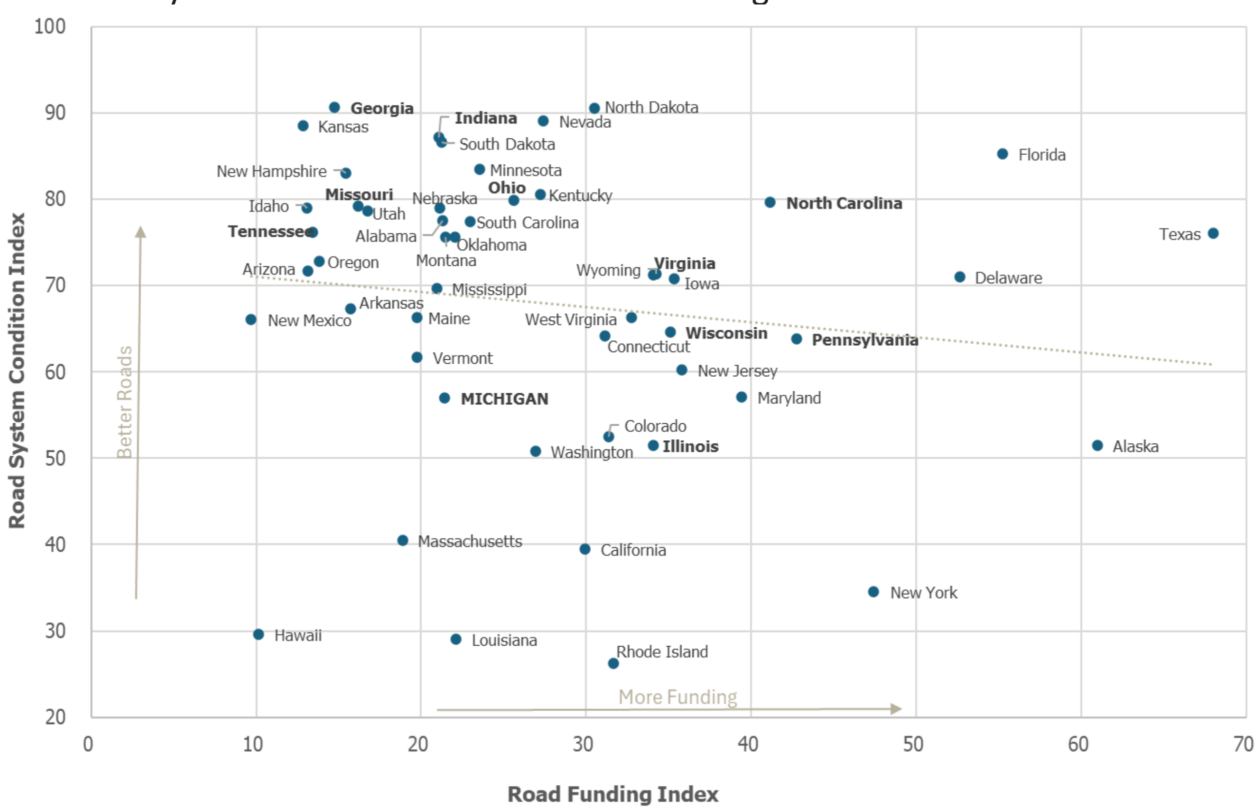
- IRI data shows that Michigan's rural NHS routes are in substantially better condition than urban NHS routes.
- The condition of Michigan's bridge infrastructure has generally improved between 2004 and 2024. Michigan's bridge deck area in poor condition has declined from 23 percent in 2004 to seven percent in 2024.
- Overall, Michigan ranks 40th among states in condition of the statewide public road network according to the latest available data.

System Condition/Funding Performance Comparison

- Michigan's rank of 30th in road funding and rank of 40th in system condition suggests that Michigan could be achieving better system conditions with given funding levels.
- Michigan's road system performance – the ability to utilize given funding levels to provide a quality road network – trails peer states like

Chart B

State Road System Condition Index vs. Road Funding Index



Sources: See Table 1, page 15 for data sources compiled into the Road Funding Index score. See Table 4, page 38 for data sources used in the Road System Condition Index Score.

Note: Michigan and peer states rendered in bold.

Ohio, Indiana, Missouri, Tennessee, and Georgia. These states report better system conditions than Michigan with similar or lesser funding.

- The performance of Michigan's statewide road program appears to have declined since 2004 as indicated by long-term decline in the percentage of pavement rated in fair condition.
- Neither a cross-sectional performance comparison of all 50 states, nor a longitudinal comparison of funding and system condition in Michigan, shows a clear correlation between increased funding levels and improved system condition. Road funding levels appear to be only one factor in determining road system conditions. Other factors such as funding distribution and project selection appear more influential.

Policy Implications

- Despite conventional wisdom, Michigan does not rank near last among states in either road funding (30th) or system condition (40th). Increasing road funding at this time is likely appropriate for various reasons. However, it would be prudent to evaluate policy options to improve the *performance* of Michigan's road program – the ability to utilize given funding to achieve quality system conditions.
- A statewide road program is very complex, with many aspects that may impose inefficiencies and waste. This report highlights some elements of Michigan's road program that may be reformed to improve efficiency and facilitate improved performance regardless of overall funding.
- Michigan's road funding law, Public Act 51 of 1951, should be repealed and replaced with new legislation that provides a rational formula for the distribution and allocation of state revenue-sharing based on the needs of today's transportation system and citizens. The measure of needs should incorporate metrics that better reflect the role of each road and the relative cost of constructing and maintaining the roads and bridges.
- The legislature should direct an independent road user cost allocation study, including the costs imposed by trucks of various classes and the distribution of truck traffic across Michigan's public road network.
- The legislature should consider authorizing local-option revenue sources for local road funding.
- The legislature should direct an independent assessment of the efficacy of pavement management programs in Michigan.
- Any new road funding should be indexed to road construction cost inflation to the extent practical.
- The difficulty of permitting new aggregate mines has increased road construction costs by an estimated one to two percent, on average. This is likely a highly localized issue best addressed with targeted policy intervention rather than a statewide approach.
- Legislation should be pursued to strengthen the state's role in encouraging and directing multi-agency collaborative infrastructure projects.

A Data-Driven Assessment of Michigan's Road Program

1 Introduction

This report provides an independent assessment of Michigan's road funding and system condition from 2004 to the most recent available data.[a]

This report may be of use to residents and policymakers by establishing facts and context for discussions regarding road funding in Michigan. Road funding advocates claim that nearly $4 billion per year is needed to bring Michigan's roads and bridges into acceptable condition.

In 2024, Michigan's road programs received about $3.4 billion in state revenue. Increasing this amount by $4 billion would more than double existing state funding and is sure to require difficult policy choices – increasing taxes, redirecting funding from other needs, or some combination of these two approaches.

An element that is missing from current policy discussions is an independent assessment of Michigan's road programs *performance* – the ability to translate funding dollars into quality infrastructure.

This report finds that Michigan's overall road infrastructure ranks 40th among states. Further, it finds that Michigan ranks 30th nationally in road funding. In other words, Michigan is underperforming. The data shows that, compared to the national average, Michigan road agencies are collectively less capable of utilizing available funding levels to provide quality infrastructure.

This report also provides a time-series evaluation of Michigan's road funding levels and system conditions since 2004. This analysis finds that funding levels and system conditions are correlated, but loosely. System conditions do not consistently rise and fall with funding levels as one might expect.

Michigan's road funding levels generally declined from 2004 to 2016. During this period, some measurements of system conditions actually improved. From 2016 to 2024, road funding rapidly increased and system conditions generally improved, but not universally. For example, Michigan's bridges rated in good condition declined from 42 percent to 34 percent over this period.

a In this report, references to Michigan's road program or road funding is understood to include both roads and bridges.

One consistent and disconcerting trend is that Michigan's pavement rated in fair condition steadily declined over the entire two decades analyzed. This suggests an approach to road funding that emphasizes costly reconstruction and rehabilitation projects, rather than routine scheduled maintenance to cost-effectively preserve existing pavement in fair condition. This dynamic may help to explain why Michigan now underperforms compared to many other states.

Considering Michigan's generally sub-par road conditions, it is appropriate to discuss increasing funding of Michigan's road program. However, a prudent and responsible approach would also evaluate options to improve program efficiency and efficacy.

This report does not arrive at a dollar figure representing Michigan's road funding 'needs,' nor does it provide detailed guidance on how to provide additional revenue. However, this report provides objective data and independent analysis that can better inform discussions related to Michigan's road program funding and policy.

2 Road Program Funding Levels

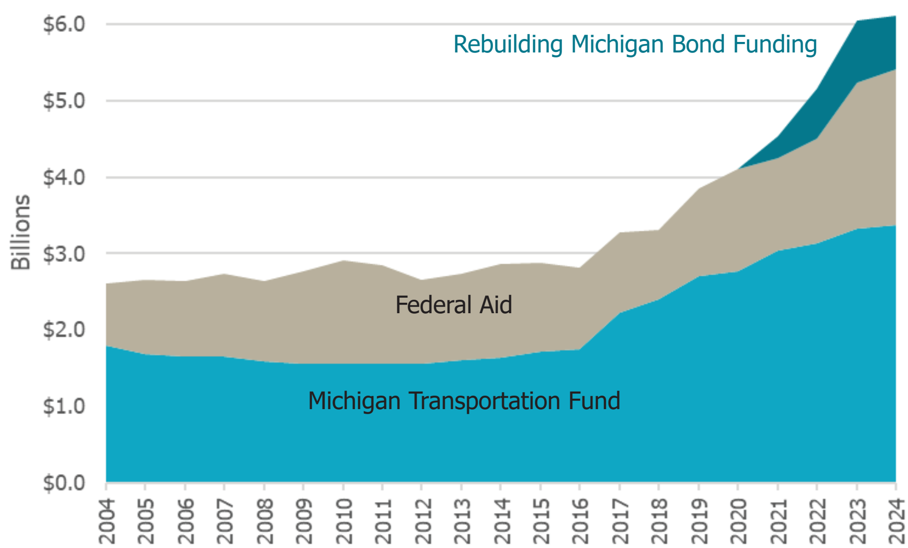
Funding for Michigan's transportation programs comes from a combination of local, state, and federal revenue. The largest share comes from the Michigan Transportation Fund (MTF), followed by federal aid. While appropriations can vary by year, roughly 85 percent of transportation funding is applied specifically to the statewide road program (including bridge projects).[b1]

This analysis focuses exclusively on road and bridge funding.

2.1 Funding in Nominal Dollars

Chart 1 shows funding of Michigan's road program from Fiscal Year (FY)2004 to FY2024 in nominal dollars.[c]

Chart 1
Michigan's Road Program Spending, FY2004-FY2024



Sources: *MTF from* W. Hamilton, House Fiscal Agency, Fiscal Brief; MTF Distribution to Local Road Agencies. Appendix B, Subtotal "Road" Programs. March 2024. *Federal Aid from* W. Hamilton, House Fiscal Agency, Fiscal Brief; Federal Aid in Michigan's Transportation Budget – Focus on the Federal Aid Highway Program, Table D, Total Federal Aid Highway Funds. 2023 and 2024 Federal Aid is estimated by assuming that 95 percent of budgeted federal revenue (from HFA FY2023 and FY2024 Transportation Budget Briefings) is applied to road programs (as was the case in FY2022). *Bond funding from* MDOT 2023 Annual Financial Report, p. 63, Rebuilding Michigan Bond Expenditures. 2024 Rebuilding Michigan bond expenditures were not yet available for this analysis and is estimated at $700 million.

b The remainder is allocated to public transportation and aeronautics. Additional transportation revenue is allocated for various items before being allocated through the MTF (e.g., rail programs, wetland mitigation, etc.).

c A caveat to Chart 1 and subsequent use of financial data in this report is that local funding for local roads is not included. The data includes funding from the Michigan Transportation fund that is distributed by formula (Public Act 51), federal aid that is distributed by MDOT as per the State Transportation Improvement Plan, and Rebuilding Michigan Bond expenditures on state trunkline routes. While local revenue is a significant funding mechanism for the statewide road program, data is unavailable.

Road funding from the Michigan Transportation Fund remained nearly flat from FY2004 to FY2016 ($1.79 billion to $1.75 billion). Following the 2015 road funding package (see box),[2] MTF appropriations began increasing in FY2017, reaching $3.4 billion in FY2024.

Federal aid funding provided $809 million in FY2004, increased to $1.36 billion in FY2010 (buoyed by 2008 stimulus funding), and then declined to $916 million in FY2018.[3]

With increased federal appropriations through the 2021 Infrastructure Investment and Jobs Act (IIJA), federal funding has since increased to approximately $1.7 billion in FY2024.

With state and federal sources combined, road funding remained relatively flat from FY2004 ($2.6 billion) until FY2016 ($2.8 billion). With post-2016 increases in both state and federal funding, appropriated funding increased to about $5.4 billion in FY2024.

Chart 1 also shows expenditures from the Rebuilding Michigan bond program. This is not appropriated funding but deficit spending that will have to be repaid, with interest, with future state revenue. However, it is worthwhile to include this bond funding in an analysis to better capture the effective funding and purchasing power of Michigan's road agencies in relation to system conditions. Rebuilding Michigan bond expenditures averaged about $725 million per year from 2022 to 2024.[d,4]

2015 Road Funding Legislation

- Increased fuel tax on gasoline and diesel to 26.3 cents/gal effective January 1, 2017 (from 19 and 15 cents per gallon, respectively).
- Indexed fuel taxes to CPI-U inflation beginning January 1, 2022 (capped at five percent annual increase).
- Increased vehicle registration fees by 20 percent, effective January 1, 2017. (Registration fees are based partly on vehicle value, providing a *de facto* inflation adjustment).
- Earmarked $600 million in state income tax revenue to the MTF, effective FY2021.

2.2 Inflation-Adjusted Funding

When the Rebuilding Michigan bond expenditures are included, road funding more than doubled from FY2016 to FY2024 ($2.8 billion to $6.2 billion). However, this period of funding increases has overlapped with a period of high inflation.

The Federal Highway Administration (FHWA) has maintained the National Highway Construction Cost Index (NHCCI) since 2003. The NHCCI can be

d Expenditures from the Rebuilding Michigan Bond program were: $35 million in FY2020, $297 million in FY2021, $654 million in FY2022, $810 million in FY2023. FY2024 expenditures are estimated at $700 million.

used both to track price changes associated with highway construction costs, and to convert nominal budgeted dollars on highway construction to real or constant dollar expenditures. Per the seasonally adjusted NHC-CI, FHWA estimates rapid 62 percent construction cost inflation between the fourth quarter of 2020 and the same period in 2023.[5]

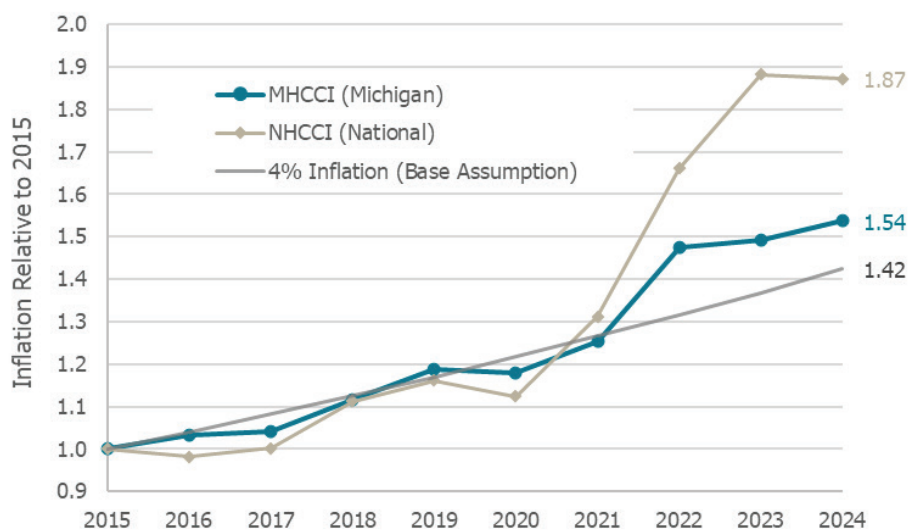
Fortunately, construction cost inflation in Michigan has not been so drastic. The Michigan Department of Transportation (MDOT) developed the Michigan Highway Construction Cost Index (MHCCI) in 2020 (with data going back to 2010).[6]

The MHCCI estimates that construction costs in Michigan increased by 26.4 percent from 2020 to 2023, far lower than the 62 percent national average.

While Michigan's recent construction cost inflation was less than the national rate, it was still much more than would typically be expected. MDOT has traditionally assumed a four percent annual cost escalation. This would have resulted in 12.5 percent cost inflation from 2020 to 2023, less than half of what occurred.

Chart 2 compares highway construction cost inflation in Michigan to the national rate, and to expected four percent inflation, from 2015 to 2024.

Chart 2
Highway Construction Cost Inflation, 2015-2024



Sources: MHCCI provided by MDOT. 2024 MHCCI inflation is estimated at 3 percent. NHCCI from FHWA Office of Policy and Governmental Affairs – NHCCI Interactive Dashboard. NHCCI data reflects seasonally adjusted 4th quarter (Q4) figure, except for 2024 which uses Q2 data. Four-percent base assumption from conversations with MDOT.

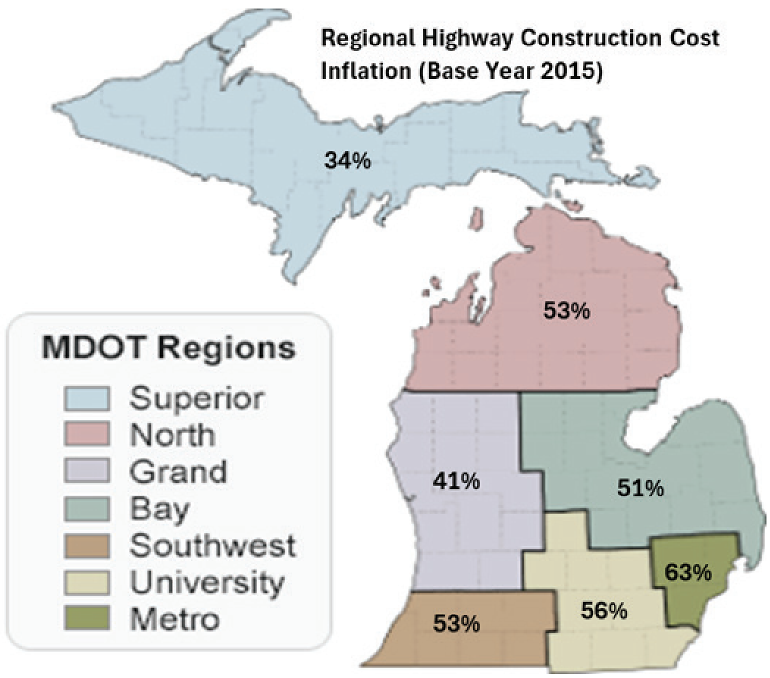
Note: Both NHCCI and MHCCI data are in calendar years.

Michigan's road funding has more than doubled in nominal dollars since 2015. However, inflation increased the costs of highway construction by 54 percent from 2015 to 2024. What cost a dollar in 2015 now costs over a dollar-fifty.[e]

Regional Variations in Inflation

An important aspect of construction cost inflation is that it can vary widely between, and even within, states.[7] The MHCCI estimates inflation rates within Michigan regions, as well as statewide. As shown in Figure 1 there is significant variation in inflation across Michigan regions.

Figure 1
Construction Cost Inflation by Michigan Region, 2015-2023



Source: MHCCI data provided by MDOT.

Using 2015 as a baseline, statewide cost inflation increased by 49 percent through 2023. Yet MDOT estimates that regional inflation over this period ranged from 34 percent in the Upper Peninsula (Superior region) to 63 percent in the Metro Detroit region. Considering these differences in cost inflation from 2015 to 2023, it is likely that additional funding pressure has been imposed on road agencies in high inflation regions like metro Detroit.

MDOT has some ability to allocate funding levels between regions to take

e Not all road agency expenditures are subject to construction cost inflation. However, budget items such as administration, engineering, and services are also subject to inflation, though likely at a lesser rate than construction costs.

local costs into consideration.[f] However, local road agencies are stuck paying the local market rate for construction and maintenance projects. Further, local road agencies receive much of their funding from state revenue, which is distributed according to a fixed formula prescribed by Public Act (PA) 51 of 1951. PA 51 distributions do not incorporate variable construction costs across the state.

From 2016 to 2024, road funding increased by $3.3 billion (in nominal dollars, including bond funding). Yet when adjusted for inflation to 2023 dollars, this is only a $2.1 billion increase.

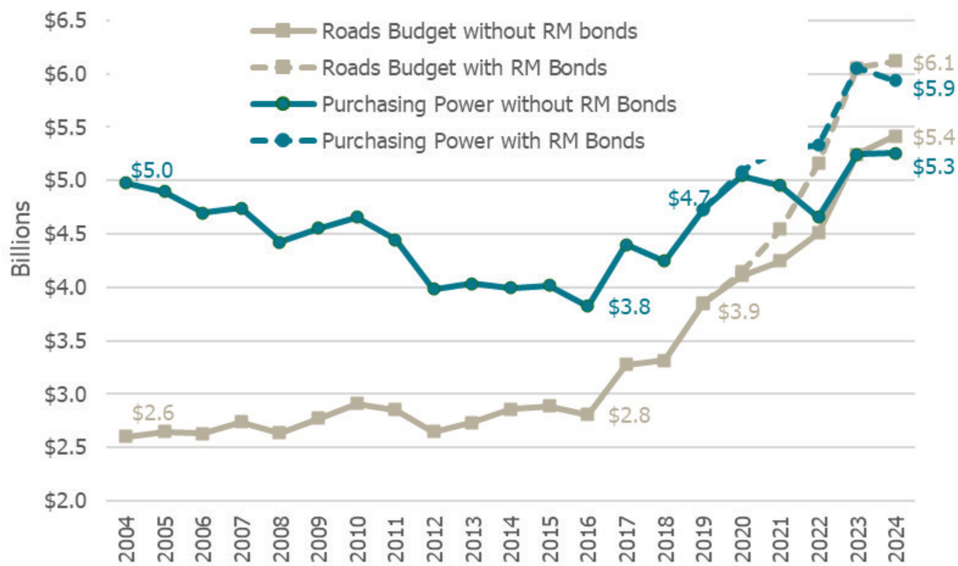
Local road agencies in higher-cost regions may be especially challenged to repair and maintain roads with their formula-based allocations of state funding.

Purchasing Power of Michigan's Road Funding

As previously discussed, Michigan's road program funding was nearly flat at around $2.7 billion from 2004 to 2016, but has since increased significantly to over $6 billion in 2024 (Chart 1, page 3). However, construction cost inflation erodes the purchasing power of budgeted dollars over time.

Chart 3

Michigan Road Budget and Purchasing Power in 2023 Inflation-adjusted Dollars, FY2004-FY2024



Sources: See Chart 1 (page 3) for sources of non-inflation adjusted expenditures and bond funding. 2023-equivalent purchasing power was calculated by adjusting half of funding data to the MHCCI (Chart 2, page 5) and the other half to the Detroit Regional Consumer Price Index for all urban consumers (CPI-U) inflation rate (U.S. Bureau of Labor Statistics). Construction Cost Inflation from the MHCCI is not available from 2004 to 2010 and is estimated at four percent. For 2024, both MHCCI and CPI inflation are estimated at three percent.

Notes: Purchasing power was adjusted to 2023 dollars to avoid any misestimation of 2024 inflation from imposing inaccuracies on the 2004-2023 data set. While financial data is in Michigan fiscal years (October 1 – September 30), inflation data is in *calendar years*, imposing some uncertainty on the precision of the calculation of purchasing power in each year.

f It is unclear how, or if, MDOT considers regionally variable construction costs in project planning and programming.

Chart 3 shows the estimated purchasing power of Michigan's road funding from 2004 to 2024 in inflation-adjusted 2023 dollars.

In FY2004, Michigan's road funding totaled $2.6 billion. This represents approximately $5 billion in equivalent 2023 inflation-adjusted dollars. Because of nearly flat funding from state and federal sources from FY2004 to FY2016, the purchasing power of Michigan's road funding experienced a steady inflation-driven decline until state revenue increased in FY2017. Even with funding increases, purchasing power did not exceed FY2004 levels until FY2020. While nominal dollar expenditures continued to increase substantially from FY2020 to FY2023, high inflation during this period moderated gains in purchasing power.

These findings have implications for ongoing efforts to create a sustainable funding solution for Michigan's roads and bridges. When funding levels are flat, the purchasing power for construction projects generally declines year-over-year.

From 2016 to 2024, road funding increased by $3.3 billion (in nominal dollars, including bond funding). Yet when adjusted for inflation to 2023 dollars, this is only a $2.1 billion increase.

For example, as funding levels remained relatively flat from FY2004 to FY2016, the purchasing power of this funding declined by over 20 percent. Funding has more than doubled from FY2016 to FY2014 – yet when inflation is considered, the purchasing power of this funding has increased by only about 50 percent.

The 2015 road funding package not only raised fuel taxes, but implemented annual inflationary increases beginning in 2022. This will mitigate losses in the purchasing power of Michigan revenue in future years. However, fuel taxes did not increase from 2017 to 2022, which included a period of rapid cost inflation. Further, fuel taxes are to be indexed to the U.S. Consumer Price Index for all urban consumers (CPI-U), which typically runs below the rate of construction cost inflation. Additionally, annual fuel tax rate increases are capped at five percent. By comparison, in 2022, the CPI-U increased over eight percent and Michigan's highway construction costs increased over 18 percent.

When determining how to craft new road funding legislation, policymakers will have to address the tension between the fuel tax rate being indexed to the CPI-U to generate revenue growth, potential reductions in fuel consumption due to increasingly fuel-efficient and electrified vehicles, and construction cost inflation escalating faster than the CPI-U.

An additional consideration is that the Rebuilding Michigan bond program contributed about $725 million in funding each year from 2022 to 2024. As the bond funding is expended, funding will be reduced by this amount and appropriated funds will have to be dedicated to long-term annual debt servicing.

If policymakers intend to maintain the current level of purchasing power in future years, additional funding will be required. The conclusion of Rebuilding Michigan bond funding, combined with uncertain federal aid and expected inflation implies a future reduction in road funding that has been described as a pending "fiscal cliff" for Michigan road funding.

From a different perspective, funding years 2021 through 2024 might be framed as a "fiscal bump." Even if the Rebuilding Michigan bond funding is not included, Michigan's inflation-adjusted road funding was higher in 2023 than at any point since at least 2004.

2.3 State Comparisons

It is often stated that Michigan has 'historically underfunded' its roads.[g] This begs the question, *compared to what?*

Sections 2.1 and 2.2 evaluate Michigan's road funding over time. This section evaluates Michigan's road funding compared to other states using the most recent available data.

It can be useful to compare funding levels across states to establish a baseline for how much funding is appropriate or typical. However, such comparisons must be conducted carefully to derive meaningful results. Selecting data from a particular source or particular year, or analyzed in a particular way, may render comparisons that misrepresent the functional differences between states.

A novel multifactorial Road Funding Index was developed to provide an objective cross-state comparison of road funding levels.[8]

To account for myriad challenges in making meaningful state comparisons, the Road Funding Index combines five categories of financial data from FHWA and Census tables, evaluated across the period from 2012 to 2021.

The raw financial data was then scaled with respect to variable construction costs between states and normalized in four different ways:

1. Funding per system centerline mile
2. Funding per system lane-mile plus bridge costs
3. Funding per capita
4. Funding per truck vehicle miles traveled (Truck VMT)

The multiple sources of financial data reflect different aspects of the funding process (i.e., revenues, disbursements, expenditures, and capital outlay). Given this, it was necessary to abstract away from raw dollar figures, as the data is not directly comparable. This was done by scaling

g E.g., Michigan Business Network. MITA Urges Action on Road Funding. January 16, 2025. "For decades, Michigan has underfunded critical road and bridge construction, leading to the $3.9 billion annual infrastructure funding deficit we are now faced with." https://michiganbusinessnetwork.com/mita-urges-action-on-road-funding/

the range of normalized financial data to a 0-100 index score for each set of cost-corrected, normalized data.[h] Specifically, the state with the highest funding level for any category received a score of 100, while the least-funded state received a score of zero.

This evaluation included all 50 states with particular attention paid to a selection of ten Michigan peer states (see box).

Table 1 (page 11) provides the summary results of the Road Funding Index.

The first four table columns provide the component index scores and rankings reflecting the four methods by which funding data was evaluated. The final column shows the final Road Funding Index score and national ranking. The final Index score is a simple average of the four component index scores.

Peer State Selection

While national comparisons to all 50 states can be useful, policy analysis can be enhanced by identifying a subset of peer states to use as a basis of comparison. It is important to adopt an approach thoughtfully, as these comparison states may influence subsequent findings. Michigan's peer states were selected as those most similar to Michigan across the following metrics:

- 2020 state population
- Population change from 2010 to 2020
- Centerline miles in statewide public road system
- Urban land area percentage
- Urban population percentage
- Population density
- Per capita income
- Vehicle miles travelled per capita
- Percentage of urban vehicle miles travelled by trucks
- Average daily traffic per lane on all arterials
- Climate

The resulting peer states are as follows, ordered by most "Michigan-like."

1. Ohio
2. Indiana
3. Virginia
4. Georgia
5. Illinois
6. Missouri
7. Pennsylvania
8. Wisconsin
9. North Carolina
10. Tennessee

See Appendix A for details.

h The Road Funding Index has been peer-reviewed and accepted for presentation at the 104th Annual Meeting of the Transportation Research Board, held January 2025 in Washington, D.C.

Table 1
State Road Funding Index and Rankings

State	$/Clmile		$/LaneMile+Bridge		$/Cap		$/TruckVMT		Overall Funding	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Texas	79.4	2	79.5	2	64.9	4	48.2	2	67.98	1
Alaska	34.5	14	39.2	13	70.7	3	99.5	1	60.94	2
Florida	82.7	1	80.9	1	32.6	19	24.7	21	55.23	3
Delaware	67.3	3	67.4	3	36.5	15	39.3	6	52.61	4
New York	60.4	4	63.4	4	24.6	34	41.2	4	47.43	5
Pennsylvania	**45.6**	**9**	**48.5**	**8**	**31.8**	**23**	**44.9**	**3**	**42.72**	**6**
North Carolina	**47.8**	**8**	**49.9**	**7**	**37.1**	**14**	**29.8**	**11**	**41.15**	**7**
Maryland	55.2	6	54.1	6	19.1	40	29.1	14	39.39	8
New Jersey	57.8	5	56.5	5	15.5	45	13.3	36	35.77	9
Iowa	17.9	31	19.5	28	63.8	5	40.2	5	35.33	10
Wisconsin	**29.1**	**17**	**31.8**	**16**	**49.3**	**9**	**30.1**	**10**	**35.07**	**11**
Wyoming	15.7	35	17.0	35	88.3	1	16.0	31	34.25	12
Virginia	**40.5**	**12**	**40.4**	**12**	**26.1**	**32**	**29.3**	**12**	**34.08**	**13**
Illinois	**36.5**	**13**	**38.7**	**14**	**31.8**	**22**	**29.2**	**13**	**34.07**	**14**
West Virginia	25.6	20	27.5	20	49.8	8	28.2	16	32.76	15
Rhode Island	42.3	11	44.0	11	14.5	46	25.8	19	31.67	16
Colorado	25.6	19	27.9	19	33.9	17	38.0	7	31.35	17
Connecticut	43.7	10	44.4	10	17.2	42	19.3	26	31.15	18
North Dakota	3.0	48	3.6	48	87.3	2	28.2	17	30.52	19
California	50.1	7	47.6	9	13.2	47	8.8	43	29.91	20
Nevada	23.5	23	25.3	22	30.3	25	30.5	9	27.38	21
Kentucky	25.1	21	26.8	21	37.5	13	19.5	25	27.23	22
Washington	28.7	18	30.8	18	23.5	37	24.6	22	26.90	23
Ohio	**30.5**	**16**	**31.3**	**17**	**23.8**	**36**	**16.8**	**29**	**25.58**	**24**
Minnesota	14.1	39	15.6	37	35.8	16	28.8	15	23.56	25
South Carolina	23.1	24	24.3	23	30.3	24	14.1	34	22.95	26
Louisiana	24.2	22	23.3	25	26.2	30	14.7	32	22.09	27
Oklahoma	15.0	36	15.9	36	45.3	11	11.9	38	22.03	28
Montana	3.4	47	3.8	47	55.2	6	23.4	23	21.46	29
MICHIGAN	**19.6**	**27**	**21.0**	**26**	**19.2**	**39**	**26.0**	**18**	**21.44**	**30**
Alabama	17.7	32	18.6	30	32.0	21	16.8	28	21.29	31
South Dakota	0.2	50	0.2	50	53.5	7	31.1	8	21.26	32
Nebraska	6.8	44	7.6	44	49.2	10	21.0	24	21.13	33
Indiana	**22.2**	**25**	**23.5**	**24**	**26.7**	**29**	**11.9**	**39**	**21.07**	**34**
Mississippi	14.7	37	15.1	38	38.0	12	16.1	30	20.97	35
Maine	16.6	33	18.4	31	26.1	31	18.0	27	19.76	36
Vermont	12.3	41	13.5	40	28.3	26	24.9	20	19.75	37
Massachusetts	30.7	15	31.9	15	9.4	49	3.5	47	18.88	38
Utah	19.2	28	20.8	27	24.5	35	2.5	48	16.76	39
Missouri	**12.9**	**40**	**13.4**	**41**	**28.3**	**27**	**10.1**	**42**	**16.19**	**40**
Arkansas	7.6	43	8.2	43	33.7	18	13.4	35	15.73	41
New Hampshire	16.2	34	17.6	34	16.1	44	11.8	40	15.41	42
Georgia	**18.5**	**29**	**19.2**	**29**	**17.6**	**41**	**3.7**	**46**	**14.76**	**43**
Oregon	11.0	42	12.0	42	21.1	38	11.1	41	13.81	44
Tennessee	**14.2**	**38**	**14.4**	**39**	**16.7**	**43**	**8.4**	**44**	**13.42**	**45**
Arizona	18.1	30	17.8	33	12.2	48	4.3	45	13.11	46
Idaho	6.3	45	7.0	45	25.6	33	13.3	37	13.05	47
Kansas	2.1	49	2.2	49	32.5	20	14.5	33	12.83	48
Hawaii	20.4	26	18.3	32	0.0	50	2.0	49	10.17	49
New Mexico	4.6	46	4.8	46	27.8	28	1.7	50	9.71	50

Sources: FHWA Highway Statistics Series Table HF-1 "Revenues Used for Highways, All Levels of Government," and Table HF-2 "Total Disbursements for Highways, All Units of Government." U.S. Census Annual Survey of State and Local Government Finances. Financial data from Table years 2012-2021. Financial data was corrected for variable costs using FHWA bridge unit replacement costs (2020). Data was normalized to CL miles by FHWA Table MH-10 (2020), to lane miles by FHWA Table HM-60 (2020) with bridge data from the National Bridge Inventory (2020) to population by Census 2020 state population, and to Truck VMT by FHWA Table PS-1 (2020).

Columns are color-coded to facilitate identification of trends in the data. The most generously funded states are shaded in green; the least-funded states are shaded in red. Michigan and its ten peer states are rendered in bold font.

It is useful to evaluate the component scores in Table 1 to better understand how methods of analysis can impact the outcome of state comparisons.

By funding per centerline mile of public road, Michigan ranks 27th nationally, and 8th among the 11-state peer group.

By funding per lane mile with a bridge cost adjustment factor, Michigan ranks 26th nationally and 8th/11 among peer states.

By funding per capita, Michigan ranks 39th nationally, and 9th/11 among peer states. States with large, relatively dense, population centers (such as metro Detroit) tend to rank lower in this category than in funding by system size, and Michigan is no exception.

The final component index score is funding per truck vehicle miles travelled (VMT). This is important to include because truck traffic is the primary driver of pavement deterioration and thus related costs.[9] Michigan has relatively low truck VMT,[10] reflecting its peninsular geography.

By funding per truck VMT, Michigan ranks 18th nationally, and 6th/11 among peer states

The final Road Funding Index score is a simple average of the four component index scores.

Michigan ranks 30th nationally, slightly below the median state.

The top five most well-funded states are Texas, Alaska, Florida, Delaware, and New York. These states rank above the median state in all four component index scores, with the exception of New York which ranks 34th in funding per capita.

Texas and Florida rank high largely because of comparatively low construction costs in those states and a cost-correction factor applied to the raw financial data. Construction costs in Texas are about 69 percent lower than a typical state.[i] (Texas is a significant outlier with the lowest construction costs nationally. This is likely due to factors like low labor costs, a construction season uninterrupted by winter, and economies of scale available to the state.) If the Road Funding Index score used nominal dollars rather than correcting for variable costs, Texas would rank 16th

i The comparison "typical state" in this report is a hypothetical state with construction costs between the mean and median construction costs of all 50 states.

nationally. Construction costs in Florida are about 31 percent lower than a typical state. Without correcting for variable costs, Florida would rank 10th. Alaska, Delaware, and New York would still rank in the top five if not corrected for construction costs.

The five least-funded states are New Mexico, Hawaii, Kansas, Idaho, and Arizona. Hawaii's low ranking is due to the cost-correction factor applied to financial data. Construction costs in Hawaii are over 6 times more than a typical state.[j] Without adjusting for variable costs, Hawaii would rank 4th nationally in funding levels. Yet when adjusted for purchasing power, it ranks 49th.

Michigan is the 30th most well-funded state in the nation, ranking higher than the peer states of Indiana, Missouri, Georgia, and Tennessee.

The other least-funded states received this ranking through a combination of modest nominal funding and relatively typical construction costs. Without adjusting for construction costs, New Mexico (50th) would rank 48th. Kansas (48th) would rank 44th. Idaho (47th) would rank 39th. Arizona (46th) would rank 38th nationally by nominal funding.

Construction costs in Michigan are about 10 percent higher than the typical state. Yet, adjusting for variable costs does not change Michigan's national ranking by much. Without adjusting for construction costs, Michigan (30th), would rank 31st nationally in road funding.

Compared to peer states, Michigan ranks 7th of 11 in funding. Michigan's road program has overall been more generously funded than the peer states of Indiana, Missouri, Georgia, and Tennessee.

Conversely, Michigan's road program has been underfunded compared to the peer states of Ohio, Illinois, Virginia, Wisconsin, North Carolina, and Pennsylvania.[k]

Overall, using 2012-2021 data,[l] Michigan road funding levels are slightly below average – both nationally and compared to peer states.

j Hawaii is a significant outlier in construction costs at 641 percent that of a typical state. The next highest cost states are Massachusetts (251 percent), New Jersey (213 percent), and Delaware (208 percent). Construction costs in Michigan are 110 percent that of a typical state, meaning that construction in Michigan costs about 10 percent more than typical.

k See Appendix B for details regarding selection of peer states.

l While data include years 2012 to 2021, the final three years of this period, 2019-2021, were double counted to better reflect most current funding levels while still considering historical funding levels.

3 Road System Condition

This chapter provides an overview of key condition data on Michigan's public road network.

As with funding data, the data and methods of analysis employed in evaluating system conditions can drastically affect conclusions. It is critical that any road condition assessment clarify the metrics and method(s) of analysis employed.

3.1 MI-PASER Condition Data

Michigan is unique among states in having adopted a statewide pavement condition assessment method based on the Pavement Surface Evaluation and Rating (PASER) developed by the University of Wisconsin in 1987. Michigan uses a modified version of the PASER standard (MI-PASER). MI-PASER pavement ratings are scored by each road agency and collected by the Michigan Transportation Asset Management Council (TAMC).

The Transportation Asset Management Council was created in 2002 to implement a statewide pavement management program to better predict funding needs.[m,11] This was no easy task. In addition to MDOT, there are 614 local road agencies in Michigan (83 county road commissions or departments and 531 city and village road agencies). To meet the statutory requirements of a statewide pavement management system without excessive financial burden, the TAMC adopted MI-PASER as an efficient low-cost system where road conditions are determined via "windshield survey." Essentially, each agency has a data-collection team drive its road network and rate each segment on a 1-10 scale (8-10=good, 5-7=fair, 1-4=poor).

Federal Aid Eligible (FAE) Roads

The federal aid eligible system includes all roads that are eligible for federal aid through the national Highway Trust Fund. The FHWA has a classification system for roads that distinguishes road types as principal arterials, minor arterials, major collectors, minor collectors, and local roads. All classifications except for local roads are federal aid eligible.

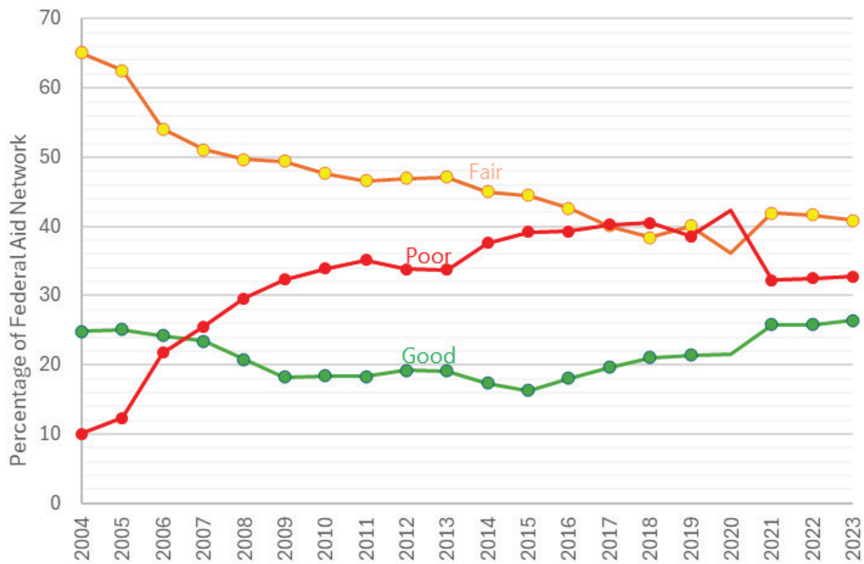
Any road that is used for anything other than short-distance local travel is typically eligible for federal aid. MDOT works with the FHWA to determine which routes are federal aid eligible. Michigan's FAE system includes about 36,500 miles of road – about 30 percent of the public road network by system mile.

About 27 percent of the FAE network is state trunkline, owned by MDOT. All MDOT roads are federal aid eligible.

m The primary difference between classic PASER and MI-PASER is the classification of the rating scores. In classic PASER, scores of 6-10 are rated good, 4-5 are fair, and 1-3 are poor. In MI-PASER, scores 8-10 are good, 5-7 are fair, and 1-4 are poor. Thus, MI-PASER is less likely to rate pavement in good condition, and more likely to rate pavement in fair and poor condition (2024 TAMC Data Collection Training Manual).

TAMC began collecting MI-PASER scores on the federal aid eligible (FAE) network in 2004 (see box). The distribution of Good/Fair/Poor ratings by lane-mile are shown in Chart 4.

Chart 4
MI-PASER Ratings of Michigan's Federal Aid Eligible Road Network by Lane-mile, 2004-2023



Source: Michigan.gov TAMC Dashboard – Pavement Conditions, Federal Aid.

Note: 2020 data was not collected but estimated and reported by TAMC.

TAMC reports that the percentage of Michigan's FAE network in good condition has remained fairly steady since the adoption of MI-PASER. In 2004, 25 percent of the network was determined to be in good condition. This percentage slowly declined until reaching a low point (16 percent) in 2015, then rebounding to 26 percent by 2023.

The percentage of pavements in fair and poor conditions changed rapidly following the adoption of MI-PASER. In 2004, TAMC rated 10 percent of the FAE network in poor condition. This increased to 32 percent in only five years,[n] then continued to increase, albeit at a slower pace, until reaching a peak of 40.5 percent in 2018.[o] This leveled off and remained at about 33 percent through 2023.

In 2004, 64 percent of FAE pavement was rated fair. Pavement in fair

n As previously noted, MI-PASER is collected via "windshield survey." As such, this metrics is largely subjective (subject to human interpretation and biases). It is likely that the rapid change in system conditions is more related to this aspect of subjectivity rather than reflecting ground-truth road conditions.

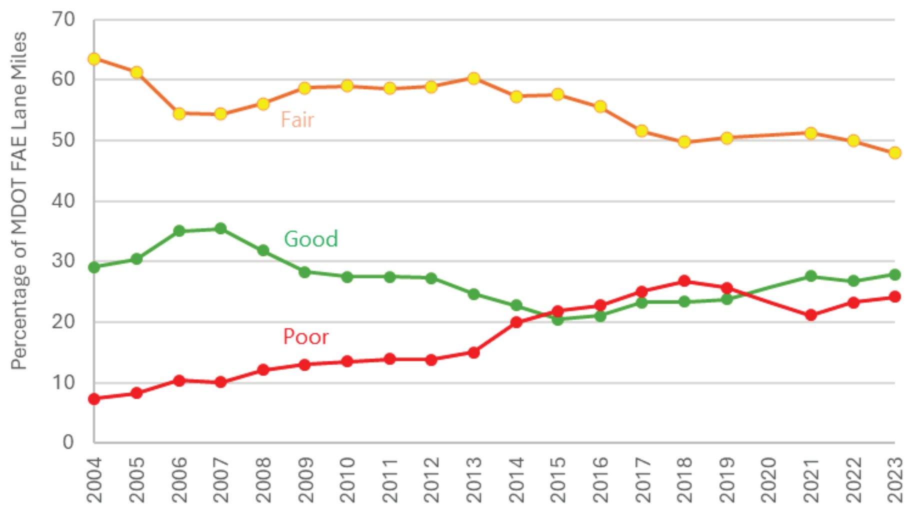
o Chart 4 shows a peak of percentage pavement in poor condition of 42 percent in 2020. However, this data was not collected but estimated by TAMC and is likely inaccurate. Considering that this TAMC-estimated data shows a one-year aberration in data trends, it is likely that if MI-PASER data had been collected in 2020, such a rapid decline in pavement conditions would not have been reported. As subsequently discussed in this report, TAMC typically forecasts a more rapid rate of pavement condition deterioration than is subsequently measured (Chart 7, page 18).

condition then gradually declined to 36 percent in 2020, though has since recovered 41 percent in 2023.

TAMC's MI-PASER data allows for separate evaluations of state-owned trunklines (Chart 5) and locally owned FAE routes (Chart 6).[p]

Chart 5

MI-PASER Ratings of MDOT-owned FAE Network, 2004-2023



Source: Michigan.gov TAMC Dashboard – Pavement Conditions, Federal Aid.

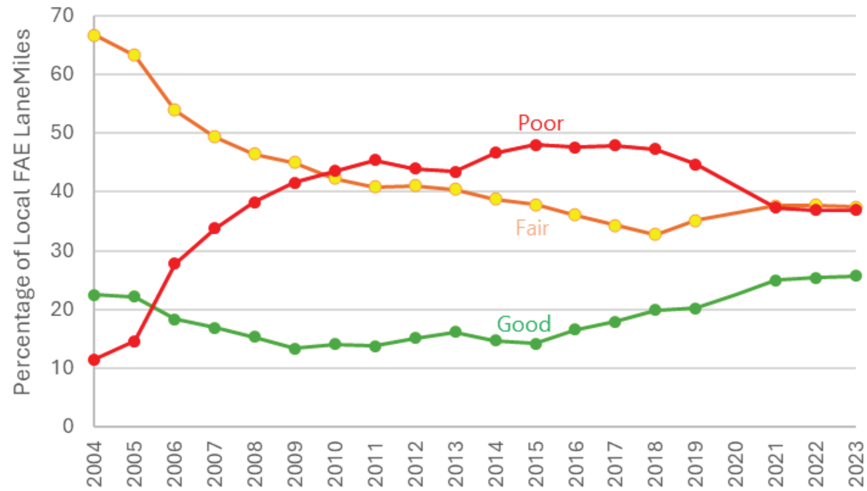
Note: 2020 data is estimated.

Chart 5 Shows the conditions rated by MI-PASER on the MDOT-owned FAE network, which is essentially MDOT's entire system.

The trends in reported MI-PASER condition of MDOT's trunkline routes have generally been more consistent than the overall FAE network. The drastic increase in poor pavement and decrease in fair pavement shown in Chart 4 are due to the locally-owned portion of Michigan's FAE network, as shown in Chart 6.

p TAMC reported estimated data for 2020 on the entire FAE network, but did not estimate data for the state and local road networks individually. While Chart 4 adopts TAMC reported estimates on the full FAE network, Chart 5 and Chart 6 reflect data for 2020 based on interpolation of 2019 and 2021 data.

Chart 6
MI-PASER Ratings of Local-owned FAE Network, 2004-2023



Source: Michigan.gov TAMC Dashboard – Pavement Conditions, Federal Aid.

Note: 2020 data is estimated.

Local road agencies own about 70 percent of Michigan's federal aid eligible roads by system mile. It is largely local FAE routes that influenced the rapid decline in reported pavement conditions in the initial years of MI-PASER data collection.

For both MDOT and local FAE routes, about 10 percent were rated in poor condition in 2004. By 2006, MDOT's FAE routes in poor condition remained near 10 percent, while local routes in poor condition drastically increased to 28 percent.

MDOT's FAE pavement in poor condition peaked in 2018 at 27 percent and remains near that level. By contrast, local FAE pavement rated in poor condition peaked near 50 percent from 2015 through 2018 before declining to 37 percent in 2023.

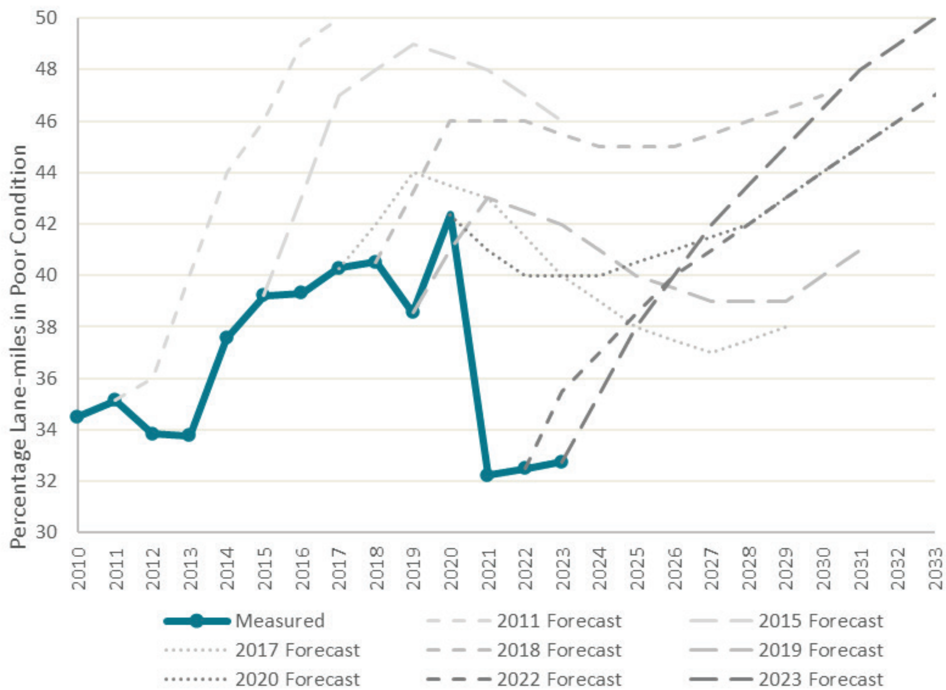
Both MDOT and local road agencies have seen substantial decreases in pavement rated in fair condition from 2004 to 2023. However, most of the reduction in local FAE pavement in fair condition occurred before 2013, while most of the reductions in MDOT FAE pavement in fair condition occurred after 2013.

It is unlikely that actual pavement conditions declined as rapidly as was reported by local agencies in the initial years of MI-PASER data collection. It is not clear why local agency MI-PASER raters recorded such a rapid decline in pavement condition. However, there are many potential reasons related to the inherent subjectivity of the metric. MI-PASER is typically recorded at traffic speed via "windshield survey." While agencies receive training and instruction for how to translate objective metrics such as cracking and roughness into a MI-PASER score, there are multiple factors that impede the human ability to accurately assess the structural condition of a pavement from behind the windshield of a moving vehicle.

MI-PASER Pavement Condition Forecasting

In addition to reporting MI-PASER condition data, TAMC also provides pavement condition forecasts (Chart 7).

Chart 7
Measured and Forecasted Percentage of FAE Pavement in Poor Condition using MI-PASER, 2011-2030



Sources: TAMC Reporting Dashboard (measured PASER data) and TAMC Annual Reports (forecasts).

Notes: 2020 "measured" data was not measured but estimated and reported by TAMC. Some forecast years are not shown for clarity.

Chart 7 provides multiple pavement conditions forecasts provided by TAMC since 2011. Specifically, it shows the percentage of the FAE network forecasted to be rated a MI-PASER score of 4 or lower, reflecting pavement in poor condition.

For example, in 2023, TAMC forecasted, based on current state funding policy, that FAE pavement in poor condition would increase from 33 percent to 50 percent in ten years.

Notably, TAMC forecasts of MI-PASER condition ratings have historically not been predictive – consistently forecasting a faster deterioration in pavement conditions than has been subsequently reported. This has implications for the efficacy of pavement management programs that emphasize MI-PASER forecasts, as well as funding needs estimates derived from such forecasts.

Challenges With Using MI-PASER in Asset Management

Michigan was one of the first states to implement a statewide pavement asset management program. The Transportation Asset Management Council was directed to create "a statewide asset management strategy and the processes and necessary tools needed to implement such a strategy beginning with the federal-aid eligible highway system."[12]

A key policy goal in creating a statewide asset management strategy was to clarify statewide funding needs. Previous to the creation of TAMC, Michigan's legislature had hundreds of individual agencies expressing funding needs, many using different, uncoordinated metrics and methods. It was unclear how much funding was needed at a state level.

The legislation that created TAMC did not require all 615 road agencies in the state to use the same metric to evaluate road conditions. However, for the sake of simplicity, one single metric was adopted: a modified version of the Pavement Surface Evaluation and Rating system (MI-PASER).

A benefit of MI-PASER is that anyone can collect pavement condition ratings. Following training, MI-PASER ratings are collected via "windshield survey" by agency employees driving a segment of road and then recording a 1-10 score. Before the adoption of MI-PASER, most small road agencies did something similar, but each used different evaluation criteria. MI-PASER was meant to standardize this informal evaluation method. As stated in the original PASER rating manual:

> Local rural and small city pavements are often managed informally, based on the staff's judgment and experience. … Using a slightly more formalized technique can make it easier to manage pavements effectively.[13]

PASER was not intended to be the basis for a statewide pavement management program. As also stated in the PASER manual:

> A comprehensive pavement management system involves collecting data and assessing several road characteristics: roughness (ride), surface distress (condition), surface skid characteristics, and structure (pavement strength and deflection). Planners can combine this condition data with economic analysis to develop short-range and long-range plans for a variety of budget levels. However, many local agencies lack the resources for such a full-scale system. [14]

By adopting MI-PASER as the basis for a statewide pavement management system, Michigan has implemented a metric that was meant for "local rural and small city pavements," but is now being used in the largest urban cities and counties. PASER was never intended to do this.

Since the implementation of MI-PASER, the measured percentage of the FAE network in poor condition has skyrocketed. Further, pavement condition forecasts using MI-PASER have consistently been inaccurate.

A recent and frequently cited analysis based on MI-PASER data determined that Michigan needs nearly an additional $4 billion per year to bring our roads into acceptable condition.[15] This would more than double current state funding levels. To provide a sense of the scale of such an increase, providing $4 billion annually in new revenue would require an additional $400/year from every Michigan resident, or $1,000/year per household.

> Michigan's statewide pavement asset management approach utilizes a measure of pavement analysis (PASER) introduced nearly 40 years ago and intended as a "slightly more formalized technique" for "local rural and small city pavements" managed by agencies "that lack the resources [for] a comprehensive pavement management system."

The use of MI-PASER in Michigan's pavement management strategies should be independently evaluated.

In recent decades, the automated collection of objective engineering-quality data has become far more economical than when PASER was introduced in 1987, or when MI-PASER was adopted in 2004. Engineering-quality metrics like the International Roughness Index, percent cracking, rutting, and faulting can now be collected at low cost, and substantial research is available to enable the use of these metrics in a high-quality pavement management program.

TAMC has successfully institutionalized a framework for statewide pavement asset management. But available data suggests that this framework has not resulted in efficient pavement management or improved pavement conditions. Operation details of TAMC's program should be independently assessed and updated to provide a system that promotes accurate estimations of funding needs and enables investment decisions that make efficient use of road funding.

3.2 Pavement Roughness Condition Data

As previously noted, Michigan's statewide pavement management system is primarily based on MI-PASER, which is a unique and subjective assessment of road conditions. MI-PASER is not a widely accepted method of determining pavement conditions outside of Michigan. One of the most widely used and accepted metrics reflecting pavement conditions is the International Roughness Index (IRI).

IRI is an expression of irregularities in the pavement surface that adversely affects the ride quality of a vehicle (and thus the user experience).[16]

The Federal Highway Administration has long required states to collect and report IRI on the National Highway System (NHS).[17] Only about six percent of Michigan's public road network (by mile) is included in the NHS. However, the NHS includes Michigan's most heavily travelled and

The National Highway System (NHS)

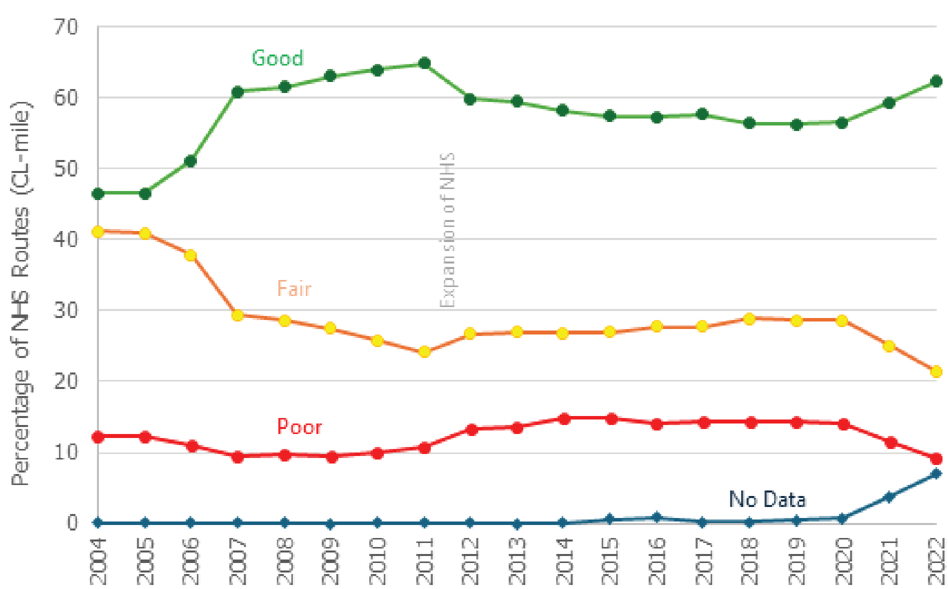
The National Highway System is a subset of federal aid eligible routes important to the nation's economy, defense, and mobility. This includes:

- Interstate highways
- Principle arterials as classified by FHWA, including non-Interstate limited-access highways and some high-traffic surface streets.
- Strategic Highway Network (STRAHNET): Routes important to the United States' strategic defense policy and which provide defense access, continuity and emergency capabilities for defense purposes.
- Intermodal Connectors: Routes that provide access between major intermodal facilities and other subsystems of the NHS.

economically critical routes, including all limited-access highways.

Evaluating the condition of IRI on the NHS is about as close to a 'ground truth' assessment of statewide pavement conditions as the data will allow. Chart 8 shows IRI pavement conditions on Michigan's NHS system from 2004 to 2022.

Chart 8
International Roughness Index (IRI) on NHS, 2004-2022



Source: FHWA Highway Statistics Series Table HM-47, Multiple Years.

Notes: The NHS was expanded in 2012 to include all routes federally classified as principal arterials. The "NoData" category increase in 2021-2022 may relate to ongoing construction during those years. (A road agency cannot report road condition data when it is undergoing construction.) The FHWA did not report IRI data on the NHS in 2021, thus this data year was estimated by interpolating between 2020 and 2022.

From 2004 to 2022, the percentage of NHS pavement in poor condition by IRI has remained relatively flat (in contrast to MI-PASER data). However, the percentage of pavement in good condition has substantially increased (with a corresponding decline in pavement in fair condition).

The data shown in Chart 8 cannot be directly compared to previous charts showing pavement conditions as measured by MI-PASER (e.g., Chart 4). This is because the MI-PASER data assesses a larger percentage of the public road system than IRI. Further, the two metrics assess different aspects of road conditions. Also, MI-PASER is inherently more critical – more likely to rate a given pavement as poor.[q]

However, as the NHS is a subset of the FAE network, it would be reasonable to assume that trends in system conditions should correlate. The most applicable comparison is MI-PASER condition on MDOT-owned state trunklines (Chart 5, page 16) to Chart 8 (IRI ratings on the NHS), as MDOT owns 81 percent of Michigan's NHS routes by system miles.

Both the MDOT MI-PASER data and the NHS IRI data show an increase in pavement in good condition from 2004 to 2007. However, the MI-PASER data then show a steady decline to 2015, while the IRI data show slight improvement until 2012, at which point the NHS system was expanded under the federal surface transportation program reauthorization law, MAP-21.[18] The expansion of the NHS correlated with a drop in percentage pavement in good condition, and corresponding increases in pavement in fair and poor condition. This appears to be due to the post-2011 NHS data including principal arterials that previously were not included in the NHS.

While this comparison is imperfect given that MI-PASER and IRI data are applied to different elements of the public road system, one would expect more similarity as there is significant overlap in the routes assessed. The lack of correlation may relate to the subjective nature and relative unreliability of MI-PASER. Where available, IRI data should be emphasized in assessments of Michigan's pavement conditions.

The NHS data cannot be broken down into state and locally owned routes as with the MI-PASER data. However, the NHS IRI data in Chart 8 can be broken-out into urban (Chart 9) and rural routes (Chart 10).

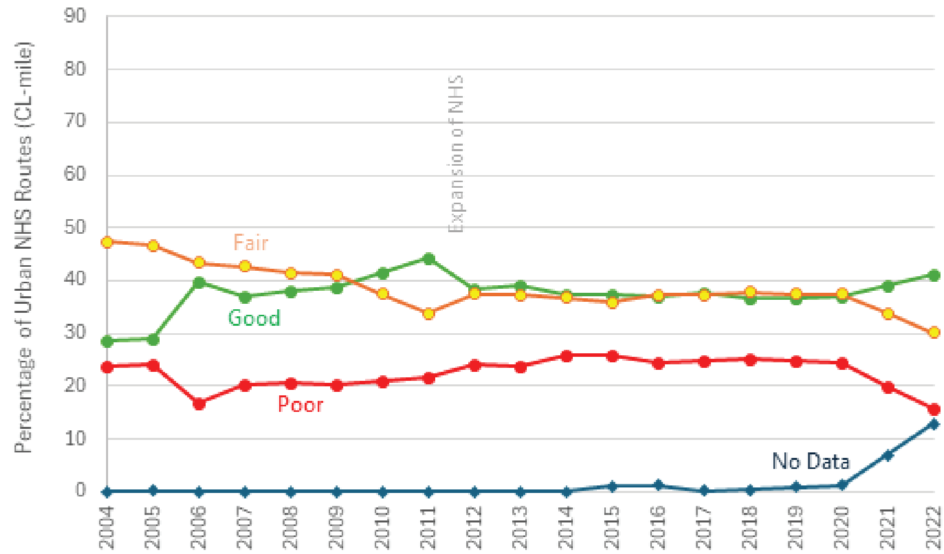
International Roughness Index (IRI)

IRI is a standardized index of pavement roughness that reflects the deviation of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics and ride quality. Specifically, IRI represents the vertical (upward and downward) displacement a passenger would experience traveling at the posted speed limit in a standard vehicle.

An IRI score of less that 95 inches per mile is categorized as good. IRI scores of 95 to 170 inches/mile are fair, and greater than 170 inches per mile are poor.

q The Michigan version of PASER (MI-PASER) revised classic PASER to decrease the ratings labeled as good, and increase the rating labeled as fair and poor. Additionally, as previously mentioned, MI-PASER is a subject non-engineering quality metric susceptible to multiple human biases.

Chart 9
Pavement Condition by IRI on Urban NHS, 2004-2022



Source: FHWA Highway Statistics Series Table HM-47, Multiple Years.

Note: The NHS was expanded in 2012 to include all routes federally classified as principal arterials.

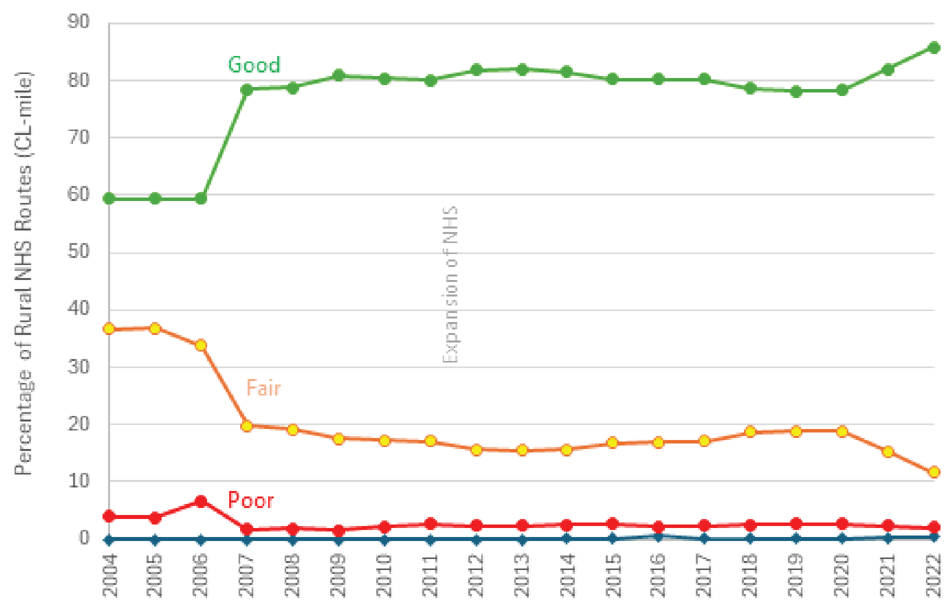
As shown in Chart 9, the share of urban NHS routes in poor condition was fairly steady from 2004 to 2020, ranging from about 20 to 25 percent. Also from 2004 to 2020, pavement in good condition increased from 29 percent to 37 percent while pavement in fair condition declined from 47 to 37 percent.

From 2020 to 2022, there was an increase in pavement in good condition, while pavement in poor condition declined to an historic low of 15 percent. However, data for 2022 is questionable, as IRI condition was not reported on 13 percent of urban NHS routes.[r]

IRI data on rural NHS routes tell a different story (Chart 10).

r The unusually high percentage of unreported routes may be related to ongoing construction during the 2022 period of data collection.

Chart 10
Pavement Condition by IRI on Rural NHS, 2004-2022



Source: FHWA Highway Statistics Series Table HM-47, Multiple Years.

Notes: The NHS was expanded in 2012 to include all routes federally classified as principal arterials. The blue line with diamond data points reflects percentage of rural NHS routs for which no data was reported, and is typically less than one percent.

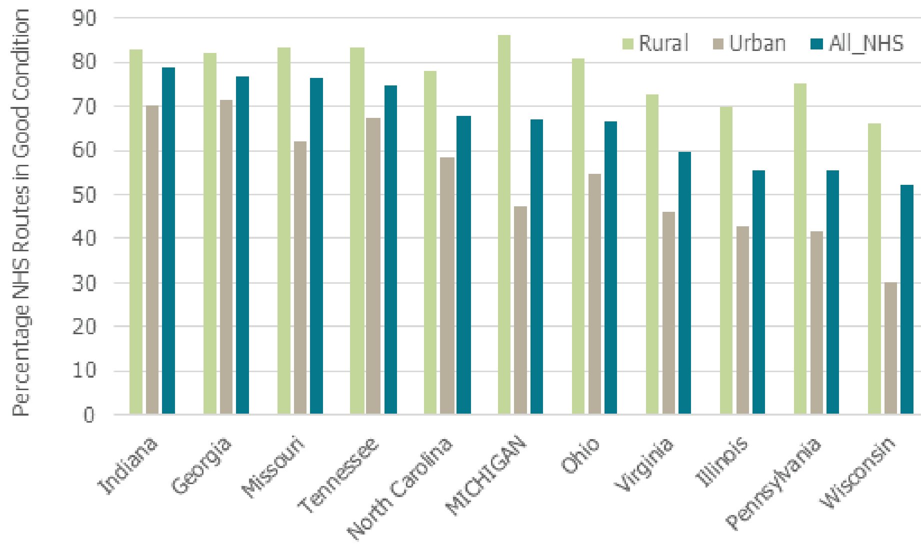
As shown in Chart 10, the percentage of rural NHS pavement in good condition was about 60 percent in 2004 and improved to nearly 90 percent by 2022. This is much better than the 29 to 41 percent range reported on urban NHS routes. Rural routes in fair condition declined from 37 to 12 percent. The percentage of rural NHS routes in poor condition has been negligible over this period, holding at two percent in 2022.

Comparing Chart 9 to Chart 10 shows that Michigan has done a much better job of maintaining rural pavements than urban routes on the NHS.

While the difference in condition between Michigan's urban and rural NHS pavements is notable, it is not entirely unusual. Chart 11 shows NHS pavement rated in good condition by IRI for Michigan and its peer states, distinguished by urban and rural routes.

Chart 11

Percentage of Rural, Urban, and All NHS Routes in Good Condition by IRI, 2022



Source: FHWA Highway Statistics Series Table HM-47, 2022.

In the 11-state peer group, Michigan boasts the highest percentage of rural NHS pavement in good condition (86.2 percent, ranking 7th nationally). Michigan's percentage of urban NHS pavement in good condition ranks 7th best of the 11 peer states (47.3 percent, ranking 35th nationally).

As shown in Chart 11, it is typical for states' rural NHS pavement to be in better condition than urban routes.[s] However, Michigan's performance gap between urban and rural pavements is stark. With 86 percent of rural NHS routes and 47 percent of urban routes in good condition, Michigan's rural/urban spread of 39 percentage points is largest across all states except Nebraska and California.

Michiganders tend to believe that our roads are among the worst in the nation. So it might be surprising that in 2022,[t] Michigan reported 67 percent of all NHS routes in good condition by IRI, ranking 24th nationally.[19] Michigan is not performing quite as well in preventing NHS pavement from falling into disrepair; 7.1 percent of NHS routes are rated poor by IRI, ranking 33rd nationally.

Twelve percent of Michigan's urban NHS is rated in poor condition (ranking 35th nationally), while only two percent of rural NHS routes are rated in poor condition (ranking 17th nationally). Table 2 summarizes pavement conditions on Michigan's NHS routes.

s In 2022, 49 states reported a greater percentage of rural NHS routes in good condition compared to rural, with Washington as the only exception.

t Most recent available data at time of analysis.

Table 2
Michigan Rankings Pavement Condition by IRI by Urban, Rural, and All NHS routes, 2022

Metric	**Peer State Rank (/11)**	**National Rank (/50)**
% All NHS Routes in Good Condition by IRI	6	24
% All NHS Routes in Poor Condition by IRI	8	33
% Urban NHS Routes in Good Condition by IRI	7	35
% Urban NHS Routes in Poor Condition by IRI	8	35
% Rural NHS Routes in Good Condition by IRI	1	7
% Rural NHS Routes in Poor Condition by IRI	7	17
Average Rank	**6.2**	**25.2**

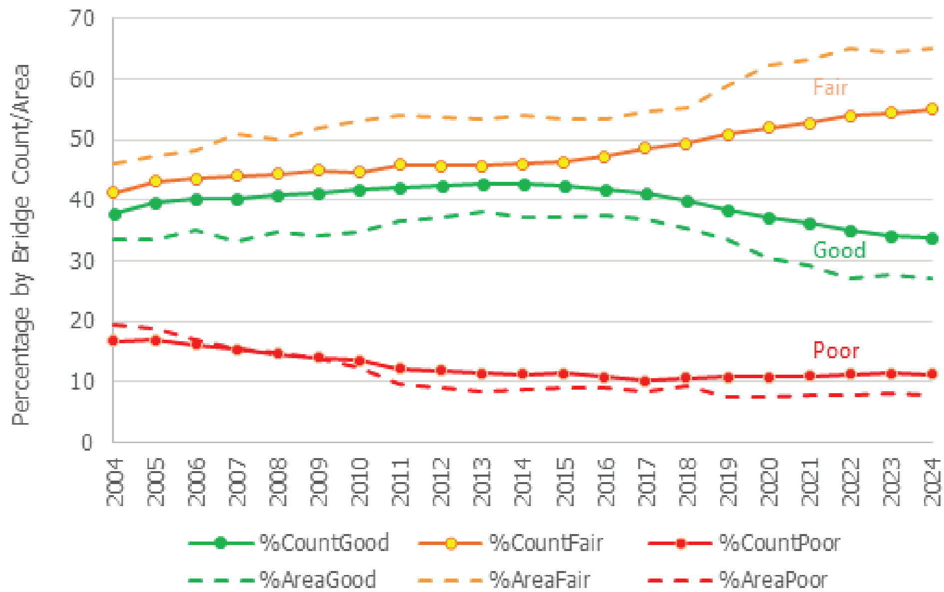
Source: FHWA Highway Statistics Series Table HM-47, 2022.

This analysis shows that Michigan's urban pavements – which receive much more traffic – are in much poorer condition than its rural pavements. This suggests that there may be value in evaluating and revising how road funding is distributed across the state's urban and rural roads.

3.3 Bridge Conditions

Chart 12 shows Michigan's bridge conditions from 2004 to 2024 as reported through the National Bridge Inventory (NBI).

Chart 12
Michigan Bridge Conditions (All Bridges), 2004-2024



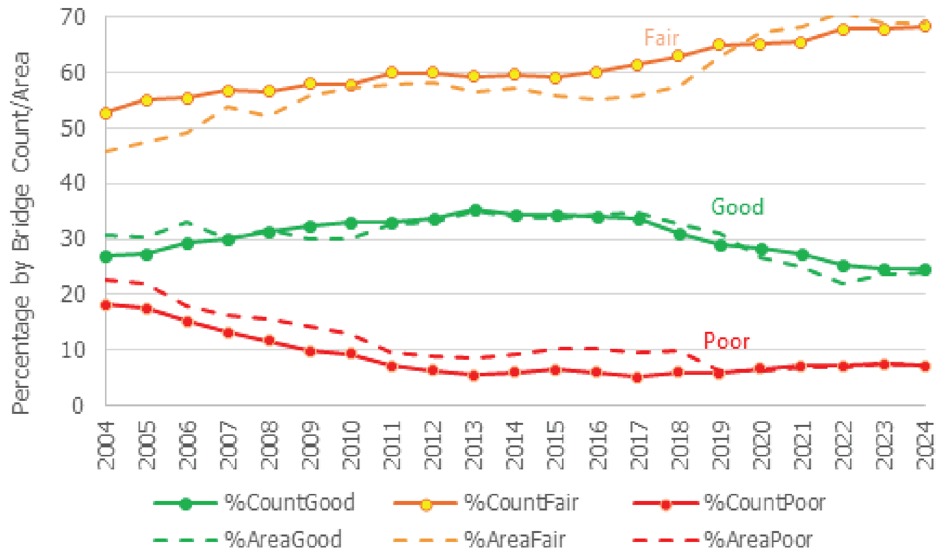
Source: FHWA National Bridge Inventory.

Michigan has successfully reduced the percentage of bridge infrastructure in poor condition over the past two decades as reported through the National Bridge Inventory (NBI). In 2004, about 17 percent of Michigan's bridges were in poor condition, representing nearly 20 percent of bridge infrastructure by deck area. In 2024, the percentage of Michigan's bridges in poor condition was reduced to 11 percent, representing less than eight percent of bridge infrastructure by deck area.

On the other hand, the percentage of Michigan's bridges in good condition has been slowly declining for the past decade. However, this is not necessarily a bad thing as the percentage of bridges in poor condition has also declined over this period. Minimizing bridges in poor condition is especially important, as these bridges may have structural problems that lead to safety issues and potential closures or weight restrictions.

Chart 13 shows the condition of Michigan's bridges on the National Highway System. NHS routes include all limited-access highways and arterials; thus, NHS bridges tend to be larger and more costly. In 2024, Michigan reported 2,978 NHS bridges – 27 percent of all bridges in the system. While only 27 percent of Michigan bridges by count, NHS bridges make up 54 percent of Michigan's road bridge infrastructure by deck area.

Chart 13
Michigan NHS Bridge Conditions, 2004-2024



Source: FHWA National Bridge Inventory.

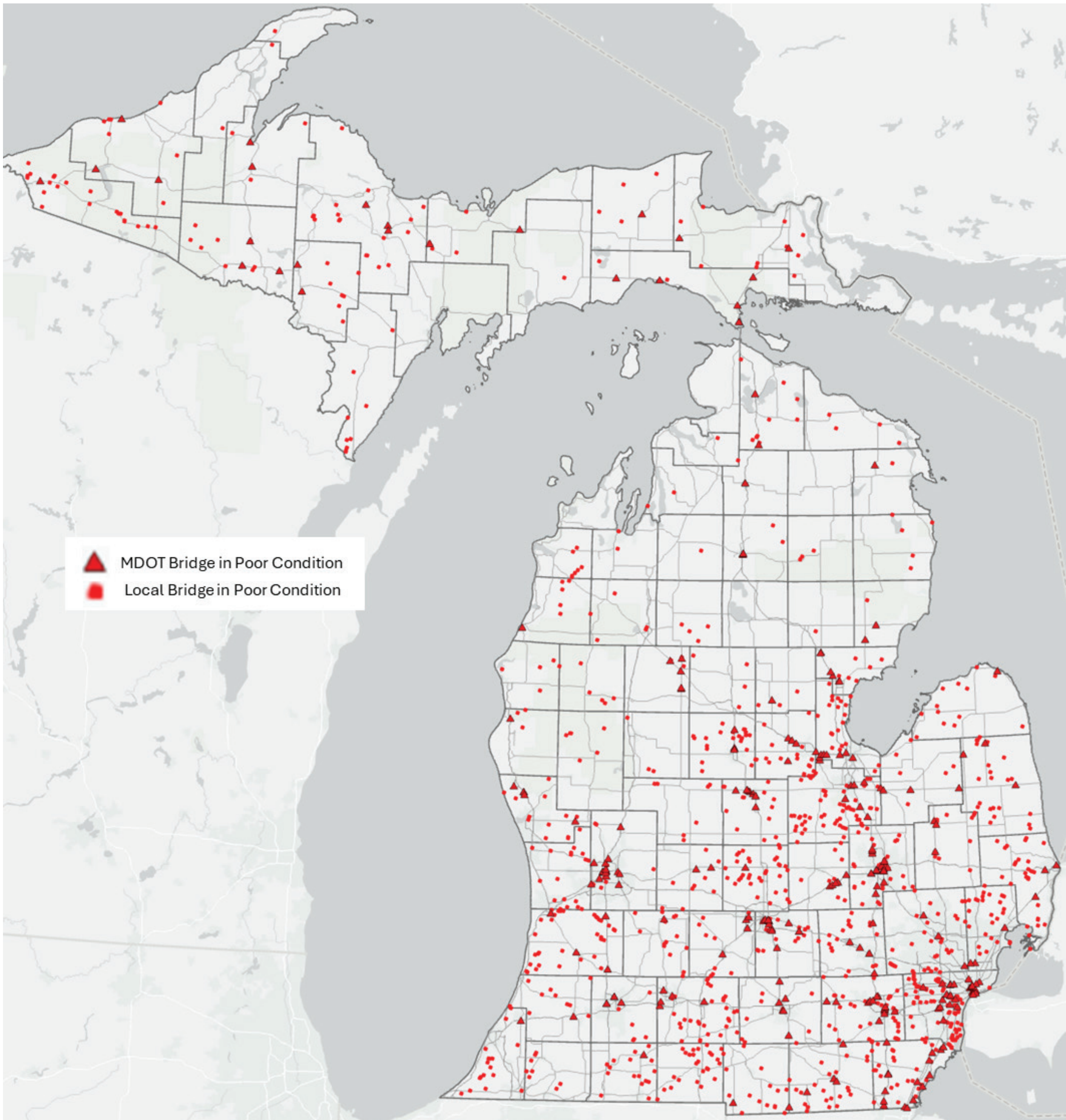
The condition of Michigan's NHS bridges trends closely with the condition of all bridges. Overall, a lesser percentage of NHS bridges are in good condition than all public road bridges, but a lesser percentage of NHS bridges are in poor condition than the full network.

The distribution of Michigan's bridges rated in poor condition in 2024 is shown in Figure 2 (as reported by MDOT).

The MDOT database contains data on 11,312 bridges. Of these, 1,277 (11.3 percent) are rated in poor condition.[u] Most of Michigan's bridges in poor condition are in the southern half of the lower peninsula. Bridges in poor condition on MDOT-owned trunklines tend to be located near populated areas.

u The MDOT database of bridge conditions provides data that is close, but not identical, to NBI reporting. Reasons for the minor discrepancy are unclear.

Figure 2
Michigan Bridges in Poor Condition, 2024



Source: MDOT via DTMB Michigan Open Data Portal.

3.4 State Comparisons

Evaluating the overall condition of a statewide public road network is not straightforward. Pavement conditions are reported using a variety of metrics applied to a variety of road types. Data collection practices may vary, with states using different types of equipment or manual methods, leading to differences in data quality. Reporting in some states is less complete than others, resulting in data gaps and reduced confidence that the reported data accurately reflects the condition of the network. Further, there is often an extended lag in reporting. For some information used, the most recently available data reflects conditions as far back as four years.[v]

To address these challenges, this analysis evaluates 17 individual metrics across various road classifications.[20]

Table 3 provides Michigan's national and peer state ranking for each of the metrics assessed.

Definitions for Table 3

Faulting: A failure mode specific to jointed concrete pavements (JCP) and is simply a direct measurement of the vertical difference in pavement surface elevation at the joint. Roadway segments are considered in poor condition by faulting when the average fault is greater than 0.15 inches.

Cracking: A metric assessing the percentage of pavement showing visible cracks.

Rutting: A failure mode specific to flexible asphalt pavements exhibiting structural failure (ruts) of either the pavement surface or subsurface base layers.

Roughness: A standardized metric assessing pavement roughness as experienced by road user - typically measured by IRI but may include Present Serviceability Rating (PSR) as an alternative.

Pavement Condition Metric (PCM): A standardized method used to assess the condition of pavements on the NHS by combining fundamental metrics like IRI, cracking, rutting, and faulting, to comprehensively classify pavements as good, fair, or poor.

Arterial: FHWA-defined as a high-capacity road that carries longer-distance traffic flows between important centers of activity, serving as the backbone of a traffic network (including, but not limited to, Interstate highways).

Collector: FHWA-defined as major and minor roads connecting local roads and streets with arterials, balancing traffic demands with land access and providing circulation within residential, commercial, and industrial areas.

v Research conducted in 2024.

Table 3
Metrics Assessed in Road System Condition Index with Michigan's Comparative Peer State and National Rankings

Metric	Peer State Rank (/11)	National Rank (/50)
% FAE Pavement in Poor Condition by Faulting (2020)	10	35
% FAE Pavement in Poor Condition by Cracking (2020)	10	45
% FAE Pavement in Poor Condition by Rutting (2020)	8	26
% FAE Pavement in Poor Condition by Roughness (2020)	8	30
% FAE Expressway Pavement in Poor Condition by IRI (2022)	10	37
% FAE Arterial Pavement in Poor Condition by IRI (2022)	8	34
% FAE Collector Pavement in Poor Condition by Roughness (IRI/PCM) (2022)	6	23
% NHS Pavement in Good Condition by IRI (2022)	6	24
% NHS Pavement in Poor Condition by IRI (2022)	8	33
% NHS VMT on Pavement in Good Condition by IRI (2022)	8	36
% NHS VMT on Pavement in Poor Condition by IRI (2022)	8	36
% NHS Interstate Pavement in Good Condition by PCM (2021)	5	18
% NHS Interstate Pavement in Poor Condition by PCM (2021)	11	44
% NHS Non-Interstate Pavement in Good Condition by PCM (2021)	4	22
% NHS Non-Interstate Pavement in Poor Condition by PCM (2021)	11	47
% NHS Bridge Deck Surface in Good Condition (2021)	11	40
% NHS Bridge Deck Surface in Poor Condition (2021)	9	41

Sources: Items 1-11; FHWA Highway Statistics Series. Items 12-17; FHWA Transportation Performance Management Program.

It is difficult to draw conclusions from any individual measure or ranking of pavement condition. Each metric reflects a limited aspect of pavement condition and may be otherwise subject to data quality and reliability issues. Further, most metrics show states "clustered" around the median – thus the actual difference in system condition between a state that ranks 20th compared to a state that ranks 30th may be minimal. To address such complications, a multifactorial statewide Road System Condition Index was developed based on the 17 individual metrics listed in Table 3.

For each metric, the percentage of pavement in good or poor condition is first converted to an individual index score based on the range of reported data across all 50 states.[w]

The 17 individual index scores are then combined into a weighted average that reflects perceived criticality to system pavement condition, data timeliness, and potential data quality issues. No individual metric is weighted more than 10 percent, thus the summary index score overwhelms outlier figures and reflects broad trends. This provides a valuable metric by which to compare pavement quality on a state-by-state basis.

Table 4 (page 33) provides a rank-ordered list of the summary Pavement Condition Index score for all 50 states. An unweighted average is also provided to allow for assessment of how variable weightings on each component index score influence the results.

Table 4 also provides the component index score for each of the 17 individual metrics. This information can be used to better understand the variations by which each state attained its summary score and ranking. Evaluation of individual component scores may also be used to identify outlier data that may be of questionable reliability, as well as to highlight areas where states may perform especially well or poorly.

Columns are color-coded to facilitate identification of trends in the data. Individual index scores above the median state are shaded in green, while scores below the median state are shaded in red. Michigan and its ten peer states are rendered in bold font.

w For example, North Dakota has the highest percentage of Interstate pavement in good condition by PCM, with 82.9 percent. The lowest-ranked state is Louisiana, with 17.1 percent. When converted to the index, North Dakota scores as 100, and Louisiana scores as zero (0). Michigan reports that 70.4 percent of Interstate pavement is in good condition. The difference between Michigan and Louisiana's percentage good data is 81 percent of the difference between North Dakota and Louisiana [(70.4-17.1)/(82.9-17.1) = 0.81]. Thus, Michigan is assigned an index score of 81 for this category.

Table 4
State Road System Condition Index and Rankings

System	Federal Aid				Functional			NHS				NHS (TPM Data)						*Sum Weights*		
Data Year	2020				2022			2022				2021								
Weight	0.2	0.2	0.2	0.3	0.4	0.3	0.2	0.4	0.8	0.6	1.0	0.8	1.0	0.8	1.0	0.8	1.0	10		
State	FAE - JCP Faulting Poor	FAE - Cracking Poor	FAE - HMA Rutting Poor	FAE - IRI/PSR Poor	Expressways Poor - IRI	Arterials Poor - IRI	Collectors Poor - IRI+PSR	NHS - IRI Good	NHS - IRI Poor	NHS - ADT/IRI Good	NHS - ADT/IRI Poor	Interstate - PCM Good	Interstate - PCM Poor	Non-Interstate PCM Good	Non-Interstate PCM Poor	NHS Bridge Good	NHS Bridge Poor	Unweighted Average	**Weighted Average (Index Score)**	**Rank**
Georgia	**99**	**59**	**99**	**96**	**95**	**90**	**82**	**85**	**98**	**86**	**97**	**76**	**97**	**63**	**96**	**100**	**98**	**89.3**	**90.6**	**1**
North Dakota	99	100	98	99	99	94	88	92	97	83	90	100	97	90	100	51	87	92.0	90.5	2
Nevada	92	96	98	79	96	83	58	97	99	71	86	97	92	98	98	57	94	87.9	89.0	3
Kansas	95	77	98	86	94	96	89	99	98	84	93	75	92	78	89	88	85	89.2	88.5	4
Indiana	**97**	**48**	**98**	**70**	**90**	**95**	**97**	**89**	**99**	**83**	**98**	**85**	**90**	**86**	**95**	**59**	**87**	**86.2**	**87.1**	**5**
South Dakota	98	96	99	81	97	85	69	81	95	83	92	98	100	100	100	19	80	86.7	86.6	6
Florida	100	85	80	85	96	83	62	84	96	84	94	81	82	60	92	74	98	84.4	85.2	7
Minnesota	99	83	100	91	96	93	81	86	98	83	100	82	85	86	97	31	65	85.7	83.5	8
New Hampshire	*na*	63	87	71	100	75	59	93	93	100	100	69	100	56	87	70	74	81.0	83.0	9
Kentucky	98	66	99	95	93	85	82	93	95	84	90	75	77	81	91	27	77	82.9	80.6	10
Ohio	**100**	**72**	**96**	**76**	**86**	**62**	**74**	**66**	**79**	**72**	**77**	**85**	**97**	**58**	**86**	**74**	**88**	**79.3**	**79.9**	**11**
North Carolina	**77**	**81**	**98**	**88**	**91**	**73**	**77**	**68**	**92**	**75**	**89**	**88**	**95**	**35**	**92**	**52**	**83**	**79.7**	**79.6**	**12**
Missouri	**97**	**73**	**82**	**56**	**92**	**65**	**41**	**84**	**93**	**82**	**87**	**95**	**100**	**86**	**94**	**25**	**57**	**77.0**	**79.2**	**13**
Nebraska	98	96	95	96	86	90	86	69	77	51	47	92	97	76	83	69	88	82.1	79.0	14
Idaho	76	98	70	90	95	91	92	90	97	91	97	62	92	46	95	16	78	81.0	79.0	15
Utah	93	92	0	66	96	82	48	72	97	63	90	77	95	63	94	27	100	73.8	78.6	16
Alabama	39	0	94	91	89	100	99	100	100	92	95	83	69	39	81	25	98	76.1	77.5	17
South Carolina	99	22	87	93	93	83	59	66	92	73	91	89	95	43	89	41	74	75.8	77.4	18
Tennessee	**95**	**45**	**97**	**100**	**93**	**86**	**85**	**81**	**89**	**84**	**88**	**82**	**95**	**46**	**69**	**32**	**70**	**78.7**	**76.2**	**19**
Texas	90	94	97	60	87	59	50	58	79	48	69	72	97	68	91	57	94	74.7	76.0	20
Oklahoma	87	55	99	98	84	81	86	61	82	64	79	78	72	52	80	55	96	77.0	75.6	21
Montana	48	97	79	83	98	92	66	82	95	85	92	59	92	49	90	16	72	76.3	75.6	22
Oregon	88	58	87	94	94	90	86	74	88	74	79	62	97	33	79	3	94	75.3	72.8	23
Arizona	97	71	96	60	88	61	38	62	82	67	79	50	77	32	82	69	95	70.9	71.7	24
Wyoming	94	78	93	99	93	97	89	90	99	83	92	37	46	49	92	17	69	77.5	71.3	25
Virginia	**0**	**98**	**99**	**82**	**92**	**78**	**52**	**53**	**87**	**58**	**78**	**61**	**97**	**33**	**97**	**29**	**82**	**69.1**	**71.3**	**26**
Delaware	79	72	99	75	70	72	65	59	82	55	73	70	82	60	95	17	84	71.1	71.0	27
Iowa	97	59	91	92	92	81	0	52	78	54	77	63	90	41	73	57	86	69.5	70.8	28
Mississippi	65	46	93	51	88	64	29	62	76	69	76	82	82	41	69	66	75	66.7	69.6	29
Arkansas	90	83	83	43	81	89	96	64	81	63	70	73	67	35	60	49	79	71.0	67.3	30
West Virginia	91	69	92	39	86	81	100	54	79	68	83	86	90	58	94	0	15	69.6	66.3	31
Maine	*na*	76	26	64	99	75	56	87	86	91	90	21	95	51	61	22	57	66.1	66.3	32
New Mexico	87	72	81	33	85	47	12	74	85	76	81	56	56	39	81	38	86	64.0	66.1	33
Wisconsin	**86**	**86**	**97**	**54**	**84**	**43**	**49**	**39**	**61**	**38**	**49**	**74**	**92**	**38**	**69**	**60**	**85**	**65.0**	**64.6**	**34**
Connecticut	*na*	82	99	36	91	36	20	40	73	67	81	78	95	41	87	6	53	61.5	64.2	35
Pennsylvania	**97**	**86**	**86**	**48**	**80**	**55**	**31**	**45**	**64**	**48**	**50**	**79**	**90**	**40**	**89**	**25**	**74**	**63.9**	**63.9**	**36**
Vermont	*na*	51	2	68	94	78	0	86	86	87	85	4	74	37	44	53	80	58.0	61.7	37
New Jersey	39	66	99	32	77	77	99	36	40	60	51	89	97	48	64	16	60	61.8	60.2	38
Maryland	92	53	70	48	77	40	30	56	48	66	56	58	85	27	53	21	85	56.8	57.1	39
MICHIGAN	**77**	**43**	**93**	**62**	**82**	**60**	**62**	**66**	**77**	**58**	**61**	**81**	**54**	**48**	**33**	**17**	**58**	**60.8**	**57.0**	**40**
Colorado	85	68	99	61	69	54	43	45	73	32	51	40	0	44	77	41	80	56.6	52.5	41
Alaska	*na*	87	49	68	64	52	39	42	49	62	74	20	77	17	43	38	61	52.7	51.5	42
Illinois	**84**	**0**	**93**	**66**	**85**	**55**	**57**	**45**	**64**	**49**	**51**	**74**	**90**	**25**	**40**	**18**	**25**	**54.2**	**51.5**	**43**
Washington	91	95	75	46	80	45	37	41	62	53	57	44	51	8	69	33	47	55.0	50.9	44
Massachusetts	*na*	95	82	48	83	14	98	22	21	58	31	83	100	0	0	9	26	48.1	40.5	45
California	95	70	97	35	68	33	2	14	17	22	17	46	44	14	49	53	63	43.4	39.5	46
New York	41	28	94	52	50	37	52	30	39	19	0	43	72	5	43	22	31	38.7	34.6	47
Hawaii	88	83	94	19	0	37	2	1	31	0	5	2	0	19	72	22	89	33.2	29.6	48
Louisiana	67	33	9	58	50	45	39	23	49	28	27	0	15	0	4	40	67	32.6	29.0	49
Rhode Island	*na*	48	84	0	80	0	20	0	0	43	15	56	97	7	0	9	0	28.6	26.3	50

Sources: FHWA Highway Statistics Series Table HM-47g (2020), Table HM-47h (2020), Table HM-47f (2020), Table HM-47i, Table HM-64 (2022), Table HM-63 (2022), Table HM-47 (2022), Table HM-47a (2022), FHWA Transportation Performance Management Program (2021).

Michigan's highest individual score (93) reflects the percentage of FAE routes in poor condition by rutting. This is one of the categories where the data is not only dated but is of questionable reliability due to variable approaches in data collection and statistical sampling. Considering that, the category is de-weighted, contributing only two percent of the summary Index score.

Michigan's second-highest score reflects pavement roughness (IRI) on expressways. This includes Interstates as well as non-Interstate limited-access highways. Michigan reports 4.2 percent of expressways in poor condition by IRI, translating to an index score of 82. While this is a relatively high score with respect to all categories, it is somewhat related to the scoring methodology and the "long tail" distribution of the underlying data for this metric. Specifically, the scores are skewed by Hawaii reporting 23.8 percent of expressways in poor condition by IRI. For reference, the median state index score for this category is 88, thus Michigan is slightly underperforming here despite the nominally high score.

Michigan ranks 40th in a multifactorial analysis of road system condition. Among Michigan's peer states, only Illinois has a road system in poorer condition.

Michigan also scores high in Interstate lane-miles in good condition by PCM (81). This is a bright spot in Michigan's evaluation, as this is a fairly reliable, pertinent metric and places Michigan as 18th best among all states. This category contributes eight percent of the overall index score.

In other categories, Michigan tends to rank from average to moderately below average.

Michigan's lowest score (17) reflects the percentage of NHS bridge surface area in good condition. Michigan's second-lowest score (33) reflects the percentage of non-Interstate NHS pavement in poor condition by PCM. Low scores in these categories were influential on Michigan's overall index score, as they are weighted relatively highly (eight and 10 percent each, respectively).

Using this method, Michigan ranks 40th nationally with a weighted average Index score of 57.0. This ranks 10th of the 11-state peer group, with only Illinois ranking lower.[x,21]

Bridge Conditions

The Road System Condition Index emphasizes *pavement* surface conditions.[y] It is worthwhile to also consider a comparative assessment of *bridge* conditions using data available through the National Bridge Inven-

x The Road System Condition Index was finalized in March 2024. The intent is to refine and update this research in 2025. Please email epdennis@crcmich.org to provide feedback.

y Two of the 17 metrics included in the Index score do evaluate bridge conditions to some extent, accounting for 18 percent of the overall weighting. However, the bridge data used in the Index score assesses only bridge surface condition on NHS bridges. The NBI data is more up-to-date and reflects a more comprehensive structural analysis of bridges.

tory (NBI).[z]

Michigan reported 11,371 public road bridges to the NBI in 2024.[22] Of these, 3,861 (33.7 percent) were rated in good condition. Michigan ranks 36th nationally for bridges in good condition, and 10th of 11 peer states with Virginia scoring lower.

Michigan reported 1,281 bridges (11.3 percent) in poor condition.[aa] This ranks 43rd nationally and 10th of 11 peer states with Pennsylvania ranking lower.

Table 5

NBI Rating of Percentage Bridges in Good and Poor Condition by Bridge Count, 2024

		Good		Poor	
State	**Count**	Percentage	Rank	Percentage	Rank
Nevada	2,099	58.3%	5	1.1%	1
Arizona	8,573	63.5%	2	1.2%	2
Texas	56,729	51.3%	12	1.2%	3
Delaware	872	40.5%	24	1.3%	4
Georgia	15,069	74.8%	1	1.6%	5
Virginia	14,121	33.0%	38	3.4%	10
Tennessee	20,379	42.5%	20	4.4%	11
Ohio	26,729	61.1%	3	4.7%	17
Indiana	19,495	42.2%	22	5.2%	20
Wisconsin	14,446	51.0%	13	6.5%	29
North Carolina	19,210	43.8%	19	6.8%	31
Missouri	24,618	37.6%	28	8.9%	39
Illinois	26,928	45.6%	17	9.3%	40
Michigan	**11,371**	**33.7%**	**36**	**11.3%**	**43**
Pennsylvania	23,299	34.0%	34	12.6%	45
Rhode Island	783	22.9%	49	15.2%	46
Maine	2,518	24.9%	48	15.4%	47
South Dakota	5,887	33.8%	35	16.4%	48
West Virginia	7,348	25.2%	46	18.6%	49
Iowa	23,719	38.8%	26	19.2%	50

Source: National Bridge Inventory, 2024.

Note: Table is rank ordered by lowest percentage of bridges in poor condition, showing top five, bottom five, and Michigan's peer states.

z NBI data was not included in the System Condition Index due to time and resource constraints. A 2025 update of the System Condition Index is planned and will likely include the NBI data discussed in this section.

aa Bridges in poor condition were previously described as "structurally deficient." The NBI no longer uses this term, but bridges in poor condition may have structural deficiencies that impose weight restrictions or risk of failure.

Table 6 summarizes bridge conditions in Michigan.

Table 6
Michigan Rankings of Bridge Conditions by National Bridge Inventory Assessment, 2024

Metric	Peer State Rank (/11)	National Rank (/50)
% All Bridges in Good Condition by Count	10	36
% All Bridges in Poor Condition by Count	10	43
% All Bridges in Good Condition by Deck Area	11	40
% All Bridges in Poor Condition by Deck Area	10	41
% NHS Bridges in Good Condition by Count	10	38
% NHS Bridges in Poor Condition by Count	10	45
% NHS Bridges in Good Condition by Deck Area	10	38
% NHS Bridges in Poor Condition by Deck Area	10	44
Average Rank	**10.1**	**40.6**

Source: National Bridge Inventory.

The condition of Michigan's bridges has generally improved since 2004 (section 3.3, page 32). Despite this, Michigan still ranks well below the median state in bridge conditions as of 2024.

Michigan's average ranking for bridge infrastructure in good condition is 38.0, while the average ranking for poor condition is 43.3. This supports a trend also seen in the pavement data where Michigan ranks comparatively better in percentage of infrastructure in good condition as opposed to poor. While the gap between Michigan's bridge infrastructure rankings in good and poor condition is less notable than with pavement rankings, this provides further observation that, compared to a typical state, Michigan appears challenged to maintain infrastructure in fair condition through cost-effective routine maintenance.

However, unlike pavement, Michigan's ability to cost-effectively maintain bridges in fair condition does not appear to have declined since 2004, and may have improved (see Chart 12, page 32). Michigan's low rankings in bridge infrastructure appears to be more related to insufficient funding allocated to the statewide bridge program as opposed to inefficient asset management. Unfortunately, available data does not allow for state-by-state comparisons of bridge funding specifically.

4 System Condition/Funding Performance Comparison

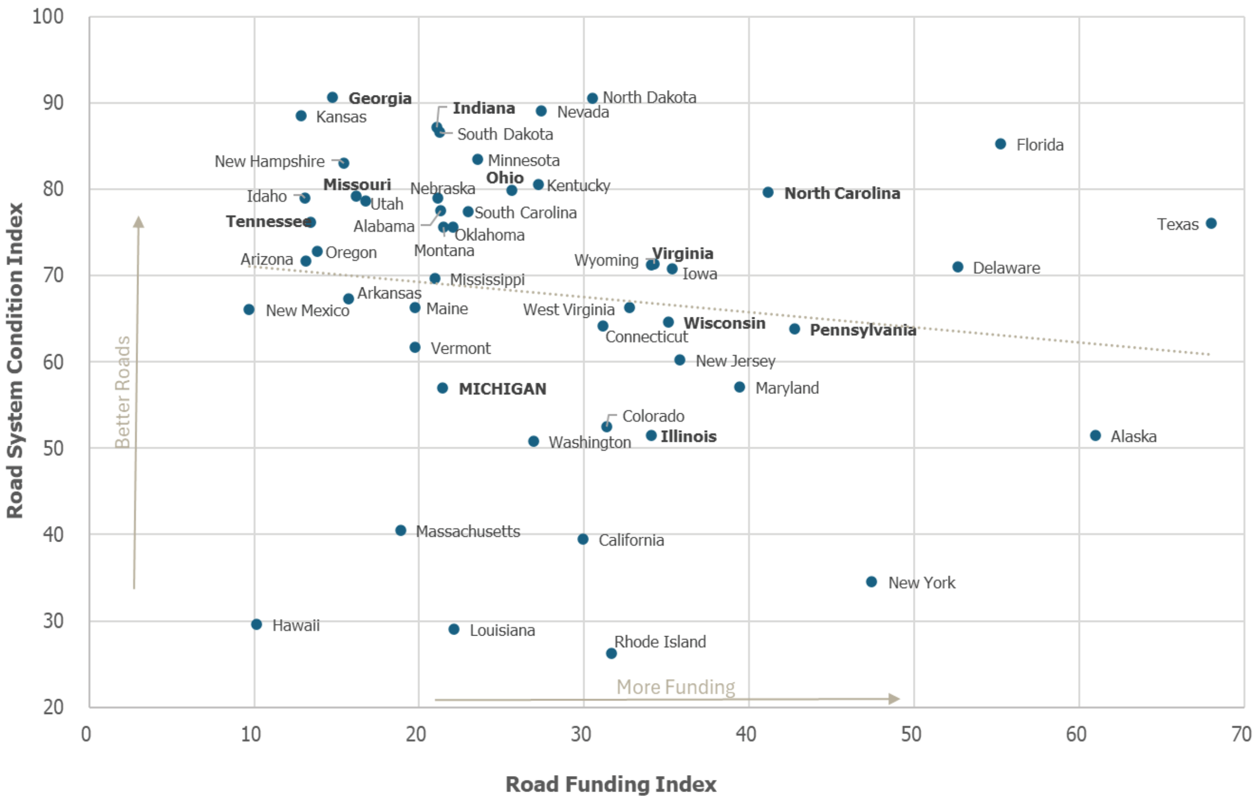
This chapter assesses all 50 states' road program performance by comparing road funding to system conditions.

4.1 State Comparisons

A novel Road Funding Index (Table 1, page 11) and Road System Condition Index (Table 4, page 33) were created for all 50 states. Plotting these index scores together provides unique insight into comparative state 'performance' – the ability to utilize available funding to effectively maintain the statewide road network (Chart 14).

Chart 14

State Road System Condition Index vs. Road Funding Index



Sources: See Table 1, page 11 for data sources compiled into the Road Funding Index score. See Table 4, page 33 for data sources used in the Road System Condition Index Score.

Note: Michigan and peer states rendered in bold.

Chart 14 has important implications for road funding policy for both Michigan and the nation. One would expect that states with higher road funding levels would achieve better system conditions. However, the data does not show this.

According to the data – analyzed as comprehensively and objectively as practical – states with more generously funded road programs are no more likely to achieve better system conditions. Comparing across all 50 states, there is practically no correlation between funding and condition.

A state-by-state road program performance comparison shows that states with higher funding levels are statistically no more likely to achieve better system conditions.

One trend evident in Chart 14 is that most states appear able to achieve relatively good system conditions with relatively modest funding levels. Twenty-four states are clustered in the upper left quadrant, with a System Condition Index score of greater than 60 and a Funding Index score of less than 30. This suggests that most states have road funding levels that would allow them to rank among the top states in system conditions, assuming that funding is effectively applied.

This can also be observed when focusing on Michigan and its peer states. As shown in Chart 14 (and Table 4), nine of Michigan's ten peer states have achieved better system conditions than Michigan. Five of these states have achieved better condition with similar or lower funding levels (Georgia, Indiana, Ohio, Missouri, and Tennessee) (see also Table 1).

Michigan's remaining six peer states (North Carolina, Virginia, Wisconsin, Pennsylvania, and Illinois) have been more generously funded than Michigan from 2012 to 2021. With the exception of Illinois, these states have also achieved better system condition than Michigan. However, the overall trend both nationally and with peer states shows that states that receive greater funding levels do not typically have better roads and bridges.

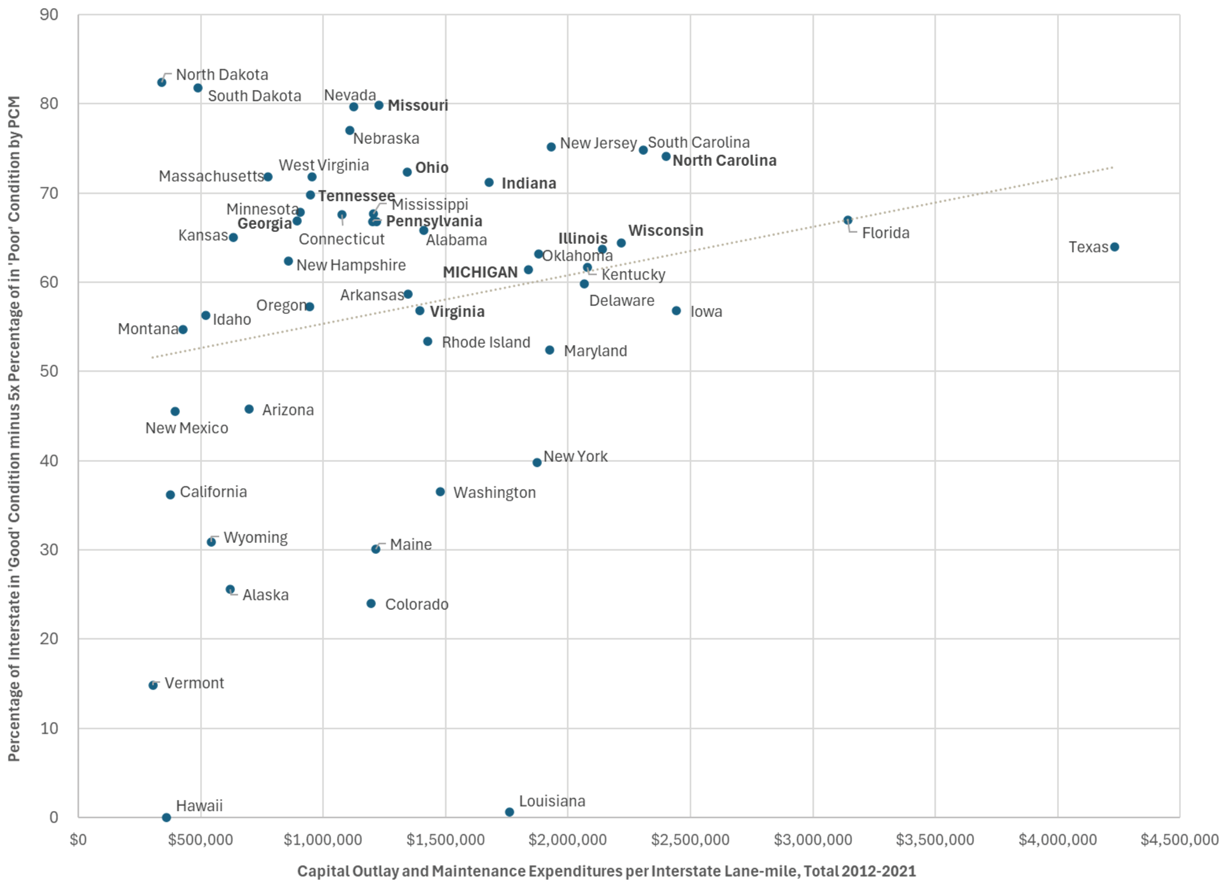
As Michigan works towards creating an effective road program, inspiration should be taken from higher performing states like Indiana and Ohio, rather than generously funded but inefficient states like Wisconsin and Pennsylvania. [ab]

Interstate Highway Condition vs. Funding

To further evaluate the relationship between funding and condition at the state level, each state's Interstate routes are compared, specifically. Chart 15 provides a more constrained, but more direct basis to compare states' abilities to translate funding into system quality. Rather than using the Funding and Condition Index scores, Chart 15 shows the condition of the Interstate system as measured by PCM in 2022 compared to reported expenditures for the preceding decade.

ab While comprehensive, this method of comparison is abstract and limited by the datasets available at the national level. One significant caveat in this performance analysis is that the statewide financial data includes all road funding within a state (including revenue and expenditures by local agencies), while the system condition data is limited to the fraction of each state's public road network that is federal aid eligible. Thus, the performance assessment compares all funding within a state to only a fraction of that state's public road network. Despite this caveat, this is a valuable and meaningful comparison as the FAE network includes all major roads that receive the majority of traffic and funding.

Chart 15
Interstate Pavement Condition as Measured by PCM in 2022 vs Interstate Funding from 2012 to 2021



Sources: Interstate expenditure data from FHWA Highway Statistics Series Table SF-12, "State Highway Agency Capital Outlay and Maintenance," multiple years. Interstate condition data from FHWA Transportation Performance Management Program (2022 data).

Notes: Funding data has been scaled with respect to variable construction costs as per FHWA NBI bridge costs data (2020). This is the same approach to cost correction used in the Road Funding Index (Table 1, page 15). Michigan and peer states are rendered in bold font.

From 2012 to 2021, Michigan spent about $2.0 million per lane mile on its Interstate system, ranking 8th nationally and higher than any peer state.[23]

However, using nominal funding dollars is not the best comparison, as highway construction costs vary by state. The funding data in Chart 15 has been cost-corrected based on state unit cost data for 2020 as reported by the FHWA. After correcting for variable construction costs to obtain equivalent purchasing power of a typical state, Michigan's Interstate funding from 2012 to 2021 represents about $1.8 million per lane-mile. This ranks 13th nationally, and third among peer states (with Wisconsin and Illinois spending more per lane-mile).

In 2022, Michigan reported 70.4 percent of Interstate pavement in good condition by PCM, ranking 18th nationally. Michigan reported 1.8 percent of Interstate pavement in poor condition, ranking 44th nationally. [ac]

Chart 15 allows for simultaneous assessment of both good and poor Interstate pavement to funding by subtracting the percentage of pavement in poor condition multiplied by five from percentage of pavement in good condition. Using this composite metric, Michigan ranks 29th nationally in Interstate pavement condition. Compared to peer states, this is 10th of 11, with only Virginia scoring lower.

> In nominal dollars, Michigan spent $2 million per Interstate lane-mile from 2012 to 2021 ($200,000/lane-mile per year on average). Only seven states spent more on their Interstate network on a per lane-mile basis. When adjusted for variable construction costs, Michigan ranks 13th in Interstate spending.

Unlike the previous cross-state performance comparison using the Index scores (Chart 14, page 43), the Interstate data shown in Chart 15 shows the expected positive relationship between funding and pavement condition at the state level. However, the correlation is weak,[ad] suggesting again that applying more funding to roads is no guarantee that system conditions will improve. This analysis suggests that other factors besides funding are more influential in determining the condition of the Interstate system. This may include factors such as appropriate distribution of funding, project selection, and maintenance practices.

Michigan's Interstate funding rank of 13th and condition rank of 29th on the Interstate system again suggests that Michigan is suffering a 'performance gap' and could be more effective in applying Interstate funding. Six of Michigan's ten peer states (Missouri, Georgia, Pennsylvania, Tennessee, Ohio, and Indiana) have achieved better Interstate pavement condition with less funding.[ae]

4.2 Longitudinal Comparison of Michigan Road Funding and System Conditions

The analyses in section 4.1 provide a cross-sectional performance comparison by comparing system conditions to funding on a state-by-state basis. This section investigates Michigan's road program performance over time.

Chart 16 compares relative changes in funding levels (Chart 3, page 7) to changes in pavement condition of the FAE network as measured by

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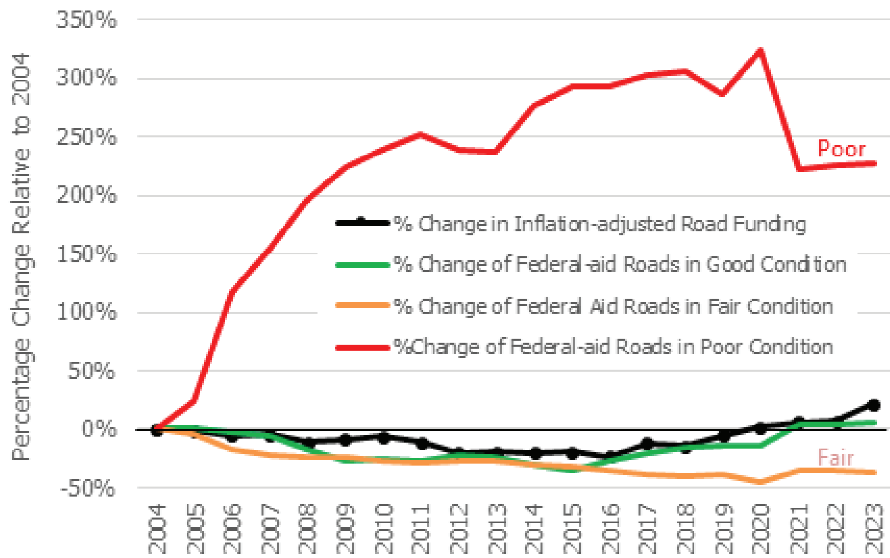
ac While 1.8 percent of the Interstate system in poor condition may seem low, only five states reported a larger percentage of Interstate pavement in poor condition by PCM.

ad The coefficient of determination (R2) of the linear regression line in Chart 15 is 0.047. The R2 measure reflects the ability of the independent variable (in this case, funding) to predict the dependent variable (in this case, Interstate system condition). An R2 of 0.047 indicates that less than five percent of the data that reflects Interstate system conditions can be explained by funding levels.

ae Funding data includes expenditures by tolling authorities.

MI-PASER (Chart 4, page 19). This allows for a visual comparison of how MI-PASER condition data relates to road funding levels over time.

Chart 16
Percentage Change in MI-PASER Pavement Condition and Percentage Change in Inflation Adjusted Funding, FY2004-FY2023



Sources: See Chart 3 (page 11) for sources regarding inflation-adjusted road funding. (Road funding data includes Rebuilding Michigan bond Expenditures.) MI-PASER data is from the TAMC Reporting Dashboard.

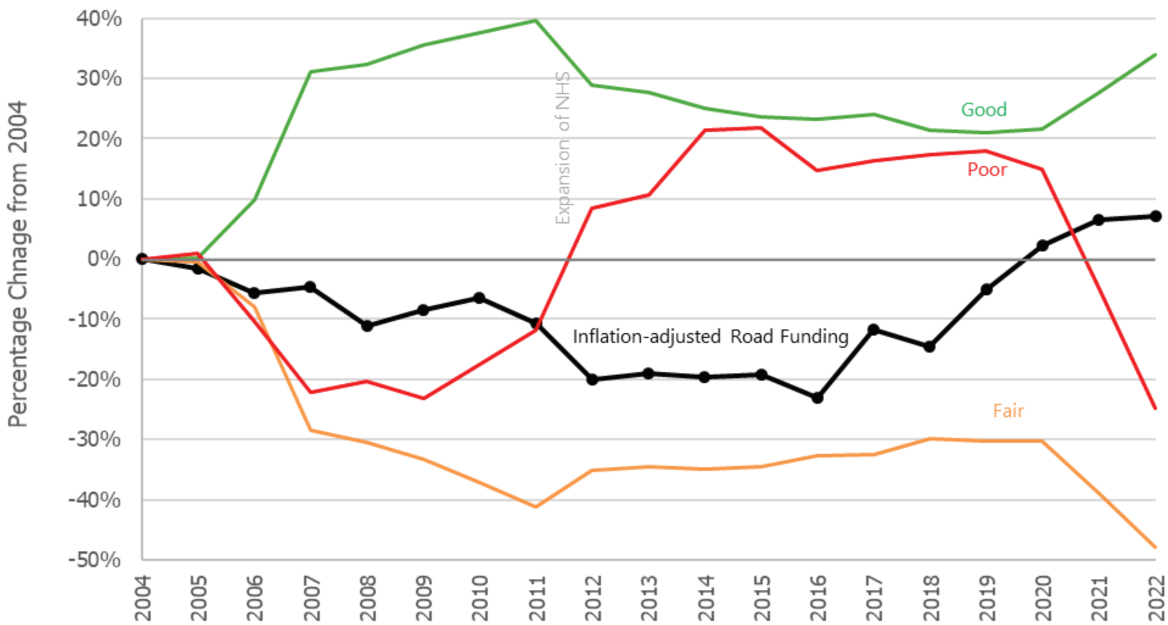
It is difficult to make sense of Chart 16. A visual comparison of relative changes in system condition and funding levels is overwhelmed by a rapid increase in poor pavement following the adoption of MI-PASER in 2004.

In interpreting Chart 16, it is essential to consider that MI-PASER is a subjective metric – subject to human judgement and biases. Thus, pavement conditions as measured by MI-PASER likely have only a tentative relationship with 'ground-truth' conditions.

A more accurate and precise metric for pavement conditions is offered by the International Roughness Index. Chart 17 compares changes in road funding levels (Chart 3, page 7) to changes in pavement conditions on the NHS measured by IRI (Chart 8, page 21) over time.

Chart 17

Percentage Change in NHS IRI Pavement Condition and Percentage Change in Inflation-Adjusted Funding, 2004-2022



Sources: See Chart 3 (page 8) for sources regarding inflation-adjusted road funding. Road funding data includes Rebuilding Michigan bond funding. IRI data from FHWA Highway Statistics Series Table HM-47, multiple years.

Notes: The NHS was expanded in 2012 to include all routes federally classified as principal arterials. Condition data for 2022 includes 12 percent of NHS pavement condition unreported (not shown). IRI data for 2021 was not reported and is estimated.

Chart 17 provides a much more reliable measure of system condition than Chart 16, though it applies to a more limited portion of Michigan's public road network (NHS rather than FAE). However, Chart 17 still displays trends that are not intuitive.

One difficulty in interpreting Chart 17 is that the NHS network was expanded in 2012 to include all routes federally classified as principal arterials. This expansion of the NHS is indicated by an unusual decline in good pavement, and an increase in poor pavement, from 2011 to 2012.

However, from 2004 to 2011, this data applied to a consistent road network, and Michigan experienced a 10 percent decrease in inflation-adjusted funding. Yet over this period, NHS pavement in good condition increased a relative 40 percent.[af] From 2004 to 2011 pavement in poor condition declined by a relative 11 percent.[ag] The percentage of pavement in fair condition declined by a notable 41 percent from 2004 to 2011.[ah]

af In 2004, the percentage of NHS routes in good condition by IRI was 46.5 percent. In 2011, this had improved to 64.9 percent. This 18.4 percent absolute change represents a 39.6 percent relative increase.

ag In 2004, the percentage of NHS routes in poor condition was 12.3 percent. In 2011, this had improved to 10.8 percent. This 1.5 percent absolute change represents a 12.2 percent relative decrease.

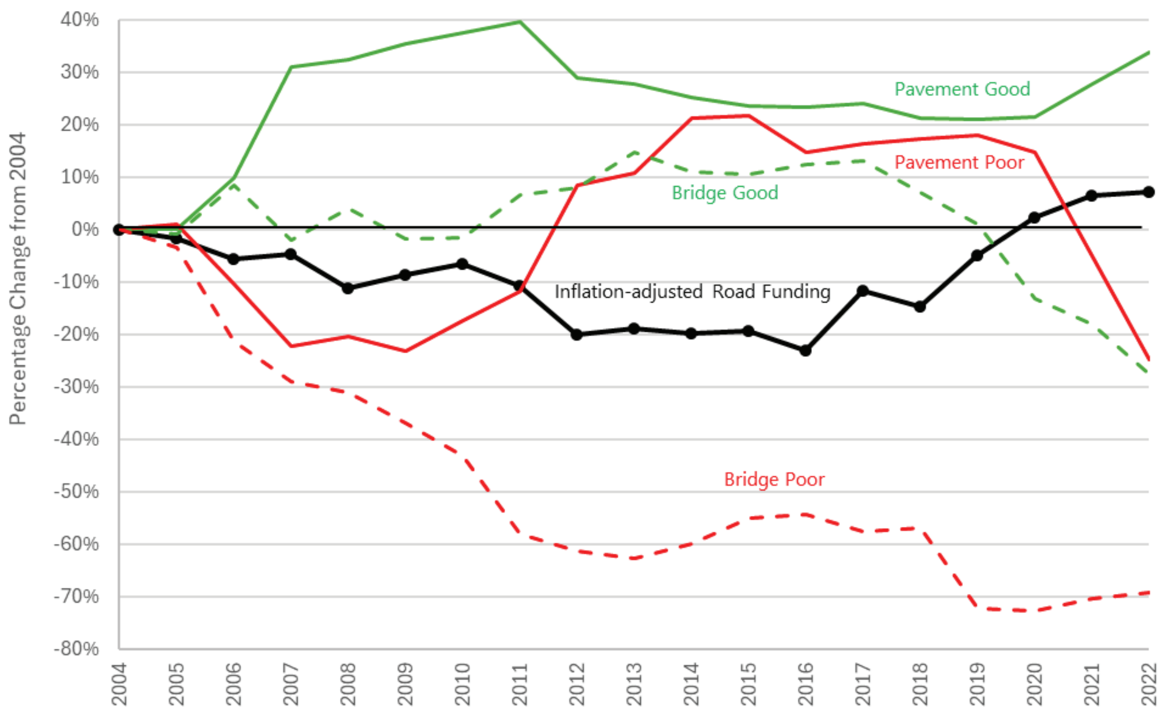
ah In 2004, the percentage of NHS routes in fair condition was 41.2 percent. In 2011, this had decreased to 24.2 percent. This 17 percent absolute change represents a 41.3 percent relative decrease.

After 2012, the trends are more intuitive. Both funding levels and pavement conditions were relatively flat until 2017, when funding increased. With funding increases, it is expected that pavement conditions should improve (with perhaps a two- or three-year delay). It appears that the increased funding has resulted in better pavement conditions from 2020 to 2022, though there was also an increase of unreported data for these years (Chart 8, page 21), imposing a caveat to this finding.

When interpreting these charts, it is important to consider that not all road funding goes to pavement. Some of this funding goes to things like traffic signals and digital infrastructure, shoulders, sidewalks, and bike lanes. The largest non-pavement expense is bridges. Thus, it is useful to consider both pavement and bridge conditions together when evaluating funding performance (Chart 18).

Chart 18

Percentage Change in NHS Pavement Condition as Measured by IRI, Percentage Change in NHS Bridge Condition by Deck Area, and Percentage Change in Inflation-Adjusted Funding, 2004-2022



Sources: See Chart 3 (page 8) for sources regarding inflation-adjusted road funding. IRI data is from FHWA Highway Statistics Series Table HM-47, multiple years. Bridge Condition data is from FHWA National Bridge Inventory, multiple years.

Notes: The NHS was expanded in 2012 to include all routes federally classified as principal arterials. Pavement condition data for 2021 was not reported and was estimated. Pavement condition data for 2022 included 12 percent of routes not reported (not shown).

Chart 18 shows the percentage change in good/poor condition of NHS pavement and bridges compared to inflation-adjusted funding from 2004 to 2022.

Chart 18 was created to evaluate the hypothesis that the improvement of NHS pavement during the period of declining funding (Chart 17, page 49) might be explained by a funding strategy that neglected bridge projects. However, the trends in relative pavement and bridge conditions show no obvious relationship with respect to funding levels over time.

This relationship can be further evaluated by distinguishing the funding data from the period of 2004 to 2016 when the purchasing power of Michigan's road funding steadily declined, from the post-2016 period when road funding increased.

Table 7 summarizes the change in system conditions following the period of decreasing funding from 2004 to 2016. The first row in Table 7 shows Michigan's roads programs funding in 2023 inflation-adjusted dollars, which declined from $5.0 billion in 2004 to $3.8 billion in 2016. This is a relative decrease in funding of 23.2 percent.

The remaining rows of Table 7 show the change in key metrics of system condition from 2004 to 2017. 2017 was chosen as the final year to evaluate system changes as to best reflect the result of changing funding conditions that ended in 2016.

Table 7

Changes in Michigan Road System Conditions from 2004 to 2017

Metric	2004	2017	Absolute Change	Relative Change
Inflation-adjusted Road Funding	$5.0bn	$3.8bn (2016)	-$1.2bn	**-23.2%**
MI-PASER Good on FAE Lane-miles	24.9%	19.7%	-5.2%	-20.9%
MI-PASER Fair on FAE Lane-miles	65.1%	40.1%	-25.0%	-38.4%
MI-PASER Poor on FAE Lane-miles	10.0%	40.3%	+30.3%	+303.0%
IRI Pavement Good on NHS CL-miles	46.5%	57.8%	+11.3%	+24.1%
IRI Pavement Fair on NHS CL-miles	41.2%	27.8%	-13.4%	-32.5%
IRI Pavement Poor on NHS CL-miles	12.3%	14.3%	+2.0%	+16.4%
Bridge Area Good (NBI, All Bridges)	33.4%	36.9%	+3.5%	+10.3%
Bridge Area Fair (NBI, All Bridges)	46.0%	54.5%	+8.5%	+18.5%
Bridge Area Poor (NBI, All Bridges)	19.4%	8.6%	-10.8%	-55.6%

Sources: See Chart 2 (page 5) for inflation adjusted Road funding. MI-PASER data via TAMC reporting dashboard. IRI data from FHWA Highway Statistics Series Table HM-47. Bridge condition data from National Bridge Inventory.

Note: Figures for a given year may not add to 100 percent due to rounding and unreported data.

Table 7 reports system conditions using three metrics – 1) condition of the FAE as measured by MI-PASER, 2) condition of the NHS as measured by IRI, and 3) condition of all bridges in the public road system.

Intuitively, the condition of infrastructure would be expected to decline following a period of declining funding. The percentage of infrastructure in good condition would likely decrease and the share of infrastructure in poor condition would likely increase. It might also be expected that in conditions of limited funding, an effective asset management approach may shift resources to maintenance projects, resulting in a moderate increase of assets in fair condition. Table 7 does not support these expectations.

As reported by MI-PASER, pavement conditions on the FAE network suffered greatly during this period of decreasing funding. Pavement rated in poor condition increased from 10 percent to over 40 percent (a 300 percent relative increase) while both good and fair pavements declined. This change reflects the expected *direction* of conditions measures, but the scale of the increase in pavement in poor condition is drastic.

However, much of this may be a measurement issue. As previously discussed, MI-PASER is a subjective measure of questionable reliability.

The IRI data tells a different story. Following this period of declining road funding, NHS routes in good condition improved from 46.5 to 57.8 percent (a 24 percent relative increase). However, NHS routes in poor condition also increased a bit, while pavement maintained in fair condition declined substantially from 41 to 28 percent (a 33 percent relative decrease).

Unlike pavements, the condition of Michigan's bridge infrastructure objectively improved following this period of declining revenue. Over 11 percent of Michigan's bridge infrastructure was improved out of the poor condition rating (a 56 percent relative reduction), with a corresponding increase in bridges in both good and fair condition.

Table 8 summarizes the change in system conditions following the period of increasing funding from 2016 to 2022. The first row in Table 8 shows Michigan's roads programs funding in 2023 inflation-adjusted dollars, which increased from $3.8 billion in 2004 to $5.3 billion in 2022. This is a relative increase in funding of 39.4 percent in seven years.

The remaining rows of Table 8 show the change in key metrics of system conditions from 2016 to 2023: 2023 was chosen as the final year to evaluate system changes as to best reflect the result of changing funding conditions that ended in 2022.[ai]

ai 2023 was chosen as the final year of system evaluation because it is the most recent year of available MI-PASER data. The latest available data for IRI data is 2022. 2022 IRI data is used to stand-in for 2023 data.

Table 8
Changes in Michigan Road System Conditions from 2016 to 2023

Metric	2016	2023	Absolute Change	Relative Change
Inflation-adjusted Road Funding	$3.8bn	$5.3bn (2022)	+$1.5bn	+39.4%
MI-PASER Good on FAE Lane-miles	18.0%	26.4%	+8.4%	+46.7%
MI-PASER Fair on FAE Lane-miles	42.6%	40.8%	-1.8%	-4.2%
MI-PASER Poor on FAE Lane-miles	39.3%	32.7%	-6.6%	-16.8%
IRI Pavement Good on NHS CL-miles	57.3%	62.3%	+5.0%	+8.7%
IRI Pavement Fair on NHS CL-miles	27.7%	21.5%	-6.2%	-22.4%
IRI Pavement Poor on NHS CL-miles	14.1%	9.2%	-4.9%	-34.7%
Bridge Area Good (NBI, All Bridges)	37.6%	27.6%	-10.0%	-26.6%
Bridge Area Fair (NBI, All Bridges)	53.4%	64.3%	+10.9%	+20.4%
Bridge Area Poor (NBI, All Bridges)	9.0%	8.1%	-0.9%	-10.0%

Sources: See Chart 2, page 5 for inflation adjusted Road funding. MI-PASER data via TAMC reporting dashboard. IRI data from FHWA Highway Statistics Series Table HM-47. Bridge condition data from National Bridge Inventory.

Notes: Figures for a given year may not add to 100 percent due to rounding and unreported data. IRI Data for 2023 was not available at the time of analysis and reflects data collected in 2022.

Michigan's inflation-adjusted road funding reached a low of $3.8 billion in 2016. Funding levels rapidly increased beginning in 2017, reaching $5.3 billion in 2022. The effective $1.5 billion funding increase from 2016 to 2022 represents a healthy 39 percent relative increase over seven years and would be expected to facilitate broad improvements in system conditions. The changing system conditions over this time generally show improvement, with some caveats.

As measured by MI-PASER, FAE pavement in good condition improved from 18 to 26 percent from 2016 to 2023, nearly recovering to the 27 percent found in good condition in 2004. While the percentage of FAE pavements in poor condition decreased from 39 to 33 percent, this is still much higher than the ten percent recorded in 2004, the first year of MI-PASER measurement.

IRI data on National Highway System routes shows an increase in the percentage of pavement in good condition from 57 to 62 percent from 2016 to 2022 (a nine percent relative improvement), building on gains seen in the preceding period of declining funding. Additionally, the percentage of routes in poor condition declined 4.9 percent (a substantial 35 percent relative improvement).

One concerning factor in the IRI data is that the percentage of the NHS network in fair condition also declined – from 27.7 to 21.5 percent of the network.[aj] Ideally, an effective asset management system would be able to increase the amount of pavement in good condition without reducing the amount of pavement in fair condition (unless pavement in poor condition is already reduced to a negligible percentage).

Data indicates a steady decline of the percentage of Michigan's pavement in fair condition since 2004. This indicates an approach to pavement management that prioritized costly rehabilitation and reconstruction projects rather than cost-effective routine maintenance.

This is not an argument that road agencies should adopt a 'worst first' approach to asset management. There are often valid reasons to direct funding towards pavements in fair condition rather than poor condition, assuming it is part of an effective multi-year asset management plan.

However, Michigan's pavement condition data shows a steady decline of pavements in fair condition for the entire period from 2004 to 2022. This suggests an asset management approach that emphasizes costly rehabilitation and reconstruction projects that improve pavement into good condition and then allow it to rapidly fall into poor condition.

Cost-effective asset management would emphasize routine preventative maintenance that maximizes the functional service life of pavement assets without allowing them to fall into poor condition. Pavements in poor condition impose detrimental ride quality and potential safety hazards to road users.

In contrast to pavement management, the data suggests that Michigan's approach to management of bridge infrastructure has improved since 2004. Bridge infrastructure in poor condition (by deck area) declined significantly from 2004 to 2016 and continued improving slightly through 2024 (Chart 12, page 32). This suggests that challenges in Michigan's bridge program, specifically, may be more related to overall funding rather than deficient maintenance and asset management.

On the other hand, during the period of increased funding from 2016 to 2022, the percentage of Michigan's bridge infrastructure in good condition unexpectedly declined from 37.6 to 27.6 percent. This does show some cause for concern if these bridges continue to decline into poor condition, as may occur without appropriate routine maintenance.

Generally, Michigan's road and bridge infrastructure conditions appear to have improved during the period of rapid funding increases from 2016 to 2022, though perhaps not as much as might be expected, and the data is messy.

Overall, it is difficult to establish a clear relationship between road funding and system conditions in Michigan. Intuitively, as funding declines, conditions should worsen; and as funding increases, conditions should improve. An evaluation of available data suggests only a loose correlation between Michigan's road funding and system condition over time. Factors related to how funding is distributed and invested appear to be more influential in determining road and bridge conditions.

aj 2022 IRI data also includes about 7 percent of the network unreported.

5 Summary of Michigan's Road Program

This report provides policymakers and the public with an independent and objective assessment of Michigan's road funding levels and system condition, both over time and compared to other states. The data and analysis presented can better inform policy debates regarding road funding in Michigan.

5.1 Funding Summary

The conventional wisdom is that Michigan has 'historically underfunded' its road program. This argument is typically based on comparisons to other states. However, many data sets and methods are available to compare states. Depending on the data source, data collection year, and method of analysis, Michigan might rank very high or very low.

Chapter 2 evaluates multiple national data sets to derive a state-by-state comparison of road funding levels that is as comprehensive and objective as is practical. The Road Funding Index aggregates five categories of financial data as reported by both FHWA and the Census Bureau. Raw financial data is then cost-corrected based on reported construction costs within each state and then normalized with respect to four different denominators to account for different contexts between state systems.

Using data from 2012 to 2021, Michigan ranks 30th nationally in road funding (Table 1, page 11). Michigan's funding rank is similar to the peer states of Ohio (24th) and Indiana (34th).

Chapter 2 also evaluates Michigan's road funding over time, going back to 2004. In 2024, Michigan was better funded than in any year since 2004. This is true both in nominal funding levels and inflation-adjusted funding. Since 2020, a substantial percentage of state road funding was contributed by the Rebuilding Michigan Bond Program. Even if bond funding is not included, Michigan's road funding was higher in 2024 than at any time since 2004.

5.2 Road System Condition Summary

Comparing road system conditions across states can be even more complicated than comparing funding levels. Comparing states' entire public road networks is not possible. National data covers only the federal aid eligible (FAE) network, which is about 30 percent of roads in Michigan.

Data that is available is reported using multiple metrics, which states may collect and report using different methods with different levels of accuracy and precision. Any attempt to compare system conditions necessarily involves engineering and analytical judgements.

Chapter 3 of this report introduces a Road System Condition Index that combines 17 different metrics of system condition using the latest available national data. This provides a comprehensive and objective basis for a state-by-state comparison.

By this method of analysis, Michigan ranks 40th nationally in statewide road system condition (Table 4, page 33).

Chapter 3 also evaluates evolving system conditions over time, from 2004 to the latest available data.

The broadest assessment of Michigan's roads (in terms of percentage of the public road network covered) is available through the Michigan Transportation Asset Management Council (TAMC). TAMC has employed a measure of pavement condition called MI-PASER to assess Michigan's FAE roads, beginning in 2004.

TAMC's MI-PASER data suggests a substantial decline in pavement conditions since 2004 (Chart 4, page 19). However, MI-PASER is a subjective metric of questionable reliability. The drastic and rapid decline in pavement conditions reported by MI-PASER data is unlikely to reflect actual pavement conditions and is not well-supported by more reliable objective data.

The most reliable available metric of Michigan's pavement condition is the International Roughness Index (IRI). Unfortunately, IRI data is not available on the entire FAE network. However, IRI is available for National Highway System (NHS), which is a subset of the FAE network including the most highly traveled and economically important roads.

By IRI, Michigan's NHS routes in poor condition have remained fairly flat from 2004 to 2022, at about 12 percent. NHS routes in good condition increased from 47 percent in 2004 to 62 percent in 2022, with a corresponding decrease in pavement in fair condition (Chart 8, page 26).

Michigan's rural NHS routes are in much better condition than urban routes. In 2022, 86 percent of the rural NHS was rated in good condition, with only two percent in poor condition (Chart 10, page 29). In contrast, Michigan's urban NHS has only 41 percent in good condition, and 16 percent in poor condition (Chart 11, page 25). Both the urban and rural NHS system has shown a decline in percentage pavement in fair condition from 2004 to 2022.

A steady, long-term decline in the percentage of pavement in fair condition is a consistent feature of Michigan's road system condition reporting since 2004.

Michigan's bridge infrastructure has generally improved since 2004. In 2004, 17 percent of Michigan's bridges were rated in poor condition (20 percent by bridge deck area). By 2024, bridges in poor condition had been reduced to 11 percent (eight percent by bridge deck area). Unlike pavement conditions, the percentage of bridge infrastructure in fair condition has increased since 2004 (Chart 12, page 32).

5.3 Road Program Performance Summary

This report defines a state's road program 'performance' as the ability to utilize given funding levels to efficiently manage and maintain the public road network.

Cross-state Comparison

In theory, states that are better funded should be expected to achieve better system conditions. Section 4.1 provides a cross-state comparison of states' road program performance. Michigan ranks 30th nationally in funding, and 40th in system condition. Thus, on average, Michigan is underperforming compared to a typical state.

However, analysis of national data shows practically zero correlation between a state's funding and subsequent system conditions (Chart 14, page 37). Surprisingly, states with more funding are statistically no more likely to achieve better system conditions.

For example, both Pennsylvania and Wisconsin are better funded than Michigan, ranking 6th and 11th, respectively, in the Road Funding Index (compared to Michigan's rank of 30th). Both states have also achieved better system conditions than Michigan. The Road System Condition Index ranks Pennsylvania 36th, and Wisconsin 34th (compared to Michigan's rank of 40th).

While both Pennsylvania and Wisconsin have achieved slightly better system condition than Michigan, they have spent much more money to achieve that condition. Michigan's funding ranking of 30th and condition rank of 40th results in a negative 'performance gap' of 10 rankings. By comparison, Wisconsin has a negative performance gap of 23 rankings, and Pennsylvania 30 rankings. Michigan is making better use of road funding dollars than either of these two states.

On the other hand, many states are making better use of available funding than Michigan.

For example, Ohio ranks 24th in road funding, and 11th in pavement condition. Indiana has utilized a lower level of funding than Michigan (ranking 34th nationally) to achieve the 5th best system. Most remarkable is Georgia, which ranks 43rd in road funding, and 1st in system condition.

This analysis suggests that practically all states have achieved minimal funding levels that allow for relatively good system condition – assuming that funding is appropriately distributed and invested. The available data strongly suggests that the overall funding of a state's road program has practically zero influence on the resulting system conditions.

Time-series Comparison

A different method to judge performance is to evaluate the historical relationship between road funding and system conditions in a single state. Section 4.2 of this report evaluates Michigan's road program performance over time, beginning in 2004.

International Roughness Index data on the National Highway System shows that Michigan achieved gains in the percentage of system conditions in good condition and reduction of pavement in poor condition during the period of declining purchasing power from 2004 to 2016 (Chart 17, page 42). However, the increase in pavement in good condition came at the expense of pavement in fair condition. The percentage of pavement in fair condition continued to decrease even as funding levels recovered and surpassed 2004 levels.

This suggests that, cumulatively, Michigan's road agencies that manage the NHS network have experienced diminished ability to maintain aging pavement in fair condition through strategic cost-effective maintenance practices since 2004.[ak]

The trends in NHS bridge conditions are distinct from pavement trends. From 2004 to 2022, Michigan reduced the number of NHS bridges in poor condition by 70 percent. NHS bridges in good condition increased slightly through 2013 during a period of reduced funding, but then declined to about 25 percent less than 2024 levels as funding recovered.

The primary difference between NHS pavement and bridge trends since 2004 is that the percentage of bridges maintained in fair condition has consistently increased, while the percentage of pavement in fair condition has consistently decreased. This data suggests that bridge investment strategies have been better than pavement investment strategies at cost-effective maintenance of assets.

Michigan's time-series performance data matches expectations more than it defies them, but the relationship between funding and condition is not consistent. It is impossible to use this data, for example, to extrapolate what funding level might be needed to achieve a given system condition.

This unclear relationship between road funding and system condition in Michigan, combined with the lack of correlation between funding and system condition applied to a 50-state analysis, strongly suggests that road funding levels are not a primary factor in forecasting system conditions.

ak 80 percent of the NHS network is managed by MDOT.

6 Policy Implications

For the proportion of Michigan's road network that can be analyzed, it is evident that Michigan's roads are sub-par. Further, there is very little evidence that these system conditions are primarily a result of underfunding (with bridges as a possible exception).

Michigan is the 30th most well-funded state (Table 1, page 11). This is below the median state, but not near last and above Michigan's ranking of 40th in condition. Further, Michigan ranks 14th nationwide in Interstate funding per lane-mile. [al]This is well above the median state and suggests that Michigan can achieve better than its ranking of 29th in Interstate pavement condition with current Interstate funding levels (Chart 15, page 39).

As Michigan's legislature evaluates options to increase road funding, there should be a parallel effort to better understand how funding can be put to greatest and best use. Better information is needed to enable more effective management of the transportation system.

Based upon the data-informed analyses of road funding and system condition reported here, the following topics deserve more study and attention from policymakers in their efforts to create a sustainable funding system for all of Michigan's road agencies in the future.

6.1 Road Funding Allocation and Distribution (Public Act 51)

Nearly all of Michigan's state road funding revenue is collected into the Michigan Transportation Fund and then distributed according to a formula described by Public Act (PA) 51 of 1951.

Public Act 51 is now 74 years old, past retirement age. In fact, the law was originally envisioned as a 15-year construction program and was scheduled to sunset, but the sunset provision was repealed in 2000 after multiple extensions.

Rather than replace PA 51 with a distribution formula reflecting current needs and leveraging modern technologies and updated understanding of how a transportation network functions, Michigan's legislature has continually propped-up the law through over 300 amendments, introducing numerous carve-outs and adjustments to the formula. The original PA 51 of 1951 was eight pages long. As amended, it spans over 100 pages with various references to other laws. This has resulted in a road funding distribution formula that is practically impossible to understand or audit.[24]

al Michigan's ranking of 14th in Interstate funding uses FHWA Table SF-12 (2012-2021) at $1.8 million per lane-mile. Capital outlay and maintenance expenditures are cost corrected to adjust for variable construction costs between states. If nominal dollars are used, Michigan ranks 8th nationally in Interstate funding at $2.0 million per lane-mile. Funding data includes expenditures by quasi-public agencies such as tolling authorities.

Public Act 51 today is a result of historical inertia. Distribution of road funding remains subject to the same allocation factors written into the law in 1951.

For counties, the most governing allocation factor is the number of registered vehicles within a county. Another factor is the population living in that county, but outside of an incorporated municipality. Also emphasized are miles of "county primary" and "county local" roads.

For cities and villages, the most governing allocation factor is population. The miles of "major" and "local" city streets are also factored in, yet these too are subject to a multiplication factor based on population.[am]

These factors – vehicle registrations, population, and road miles – were a reasonable proxy for estimating funding needs in 1951. The number of resident vehicle registrations and population counts may help to estimate traffic demand. But these registered vehicles and residents frequently travel to other jurisdictions. The mileage of a local system provides a good first estimate of funding needs, but assumes that construction and maintenance costs are equivalent across the state.

It would be imprudent to try to address Michigan's road infrastructure problems by sending additional funding through PA 51. Additional carve-outs and reallocations would likely just make the law more complicated, not more effective. The inability of Michigan policymakers to replace Act 51 is a decades-long failure.

Replacing Public Act 51

In 2024, society has much better methods of estimating road funding needs. In addition to decades of research on asset management, today's abilities in data collection and analysis could not have been anticipated in 1951.

Policymakers should start with a blank canvas and earnestly consider how a modern rational road funding system *should* work. Factors that should be considered in a new funding distribution and allocation formula might include:

- **Route Ownership.** If starting from a blank canvas, it would be prudent to begin with how Michigan distributes road ownership. Michigan's public road network is distributed across 615 individual road agencies. In addition to MDOT, each county has its own road agency, along with 531 cities and villages. This makes for a relatively fragmented and decentralized network. Only 7.9 percent of Michigan's public road network is under the authority of MDOT, ranking 47th nationally. Only 26.2 percent of Michigan's federal aid system is controlled by MDOT, ranking 48th nationally. MDOT owns 81.0 percent

am Townships are entirely left out of this equation.

of NHS routes, ranking 45th nationally. Despite Michigan's DOT having less ownership of the public road network than most states, this percentage has been steadily declining as many local governments have chosen to assume responsibility for former trunklines through their jurisdiction. On the other hand, many of Michigan's townships are larger than small cities and villages but do not own their roads. A redistribution of road ownership that better reflects the use of the road and ability of agencies to maintain the roads could reduce redundancies, improve project planning, and facilitate a better performing statewide road program.

- **Mileage by Road Type.** The PA 51 distribution formula is largely based on the system mileage owned by each authority. Yet all roads are not created equal; a major thoroughfare has more demanding design and maintenance requirements than a low traffic residential street. PA 51 allocates funding, in part, based on road type. County roads are divided into "primary" and "local" roads. City/village streets are divided into "major" and "local" streets. But the law does not dictate how these classifications are assigned. It is up to each jurisdiction to propose what roads in their network are "primary" or "major," on the basis of "general greatest importance." It is unclear if there is a consistent logic in classification of streets. As an alternative, the National Functional Classification system provides a consistent approach to distinguish road types based on their importance to the nation, state, region, and community. The distribution of federal aid from the Highway Trust Fund considers National Functional Classifications, and this should be adopted into the state distribution formula as well.

- **Commercial Traffic Load.** Traffic volume metrics such as ADT are correlated to funding requirements to the extent that they justify additional pavement area. However, ADT alone cannot provide reliable data on the pavement damage imposed by traffic. A typical passenger vehicle or light truck imposes negligible pavement damage. Traffic-related pavement damage is related almost entirely to heavy trucks. Routes with high volumes of truck traffic require higher standards of design and maintenance, or they will deteriorate rapidly. Commercial vehicle traffic metrics are available and should be a meaningful factor in a funding distribution formula to assure that road agencies that accommodate high volumes of truck traffic are fairly compensated for the additional costs imposed by that traffic.

- **Bridge Features.** Bridges are very expensive. Bridge costs are incorporated into Act 51 through various carve-outs before the Michigan Transportation Fund is allocated to agencies. However, the dedicated bridge funding is an insufficient remedy for the primary malady: the distribution formula does not consider bridge costs. This omission is becoming increasingly detrimental as recent environmental regulations are compelling many road agencies to construct new bridges where once a low-cost culvert was considered sufficient. The state maintains a database including all public bridges in the state, including attributes like deck area and traffic load. This data should be factored into a distribution formula.

- **Construction Costs.** The cost of labor and materials involved in road construction can vary significantly in different regions in Michigan. PA 51 embeds an assumption that a road funding dollar sent to every road agency will purchase an equivalent amount of road work. This is not the case. MDOT tracks data on regionally variable construction costs, and this should be incorporated into a distribution formula so that agencies in high-cost regions are not disproportionately challenged to maintain their systems in a state of good repair.

- **Drainage Requirements (Subbase Geology).** Drainage is critical in preventing pavement damage. A paved road is ideally engineered to prevent water from infiltrating beneath the pavement surface, and to remove any water that does infiltrate beneath the pavement surface. When the base beneath a pavement surface is saturated, rapid and severe pavement damage can result, either from the expansion of that water into ice during freeze cycles, or simply from decreased load-bearing capacity. Removing water from beneath the pavement is much more difficult in regions where the subbase (native soil) is slow-draining, such as heavy clay soils. Roads in such regions may require additional drainage features and incur related construction and maintenance costs. Such geological factors would ideally be considered in a distribution formula.

A road funding distribution formula should ideally include factors that directly relate to funding needs.

- **Traffic Volume.** Unlike in 1951, technology now exists to accurately estimate various metrics related to traffic demand. Commonly used metrics include average daily traffic (ADT) and peak hour traffic. Traffic engineers use such metrics to determine design elements such as the number and width of lanes. A distribution formula may use such traffic volume factors in addition to, or as an alternative to, considerations based on pavement area.

- **Pavement Area.** Regardless of functional classification, road construction and maintenance costs increase as pavement area increases. Features such as multiple lanes, wide lanes, bike lanes, and paved shoulders significantly impact the life-cycle costs of roads. An ideal distribution formula would compensate agencies for these additional costs without incentivizing unnecessary road-widening projects.

- **Climate.** Michigan is a large state with variable weather and climate in different regions. MDOT pavement engineers have divided the state into two regions (north and south) as southern Michigan is typically subject to more damaging freeze-thaw cycling. These freeze-thaw cycles impose pavement damage and additional costs that could be factored into a distribution formula. This could be based simply on the north/south regions. A preferable alternative may be to distribute a portion of funding based on actual freeze-thaw cycles experiences in a region in the preceding winter. This would help agencies with maintenance costs that may not have been anticipated.

- **Population.** Population should likely factor into an idea formula, though with less emphasis than in PA 51. One way that population may be used is to provide funding to dense urban areas that require multimodal transportation features.

Repealing and replacing PA 51 with a modern formula that rationally distributes funding according to needs could go much farther in establishing a sustainable statewide road program than throwing more money into the current system.

Some may argue that the PA 51 distribution formula is not a problem, and the problem is that Michigan's roads have been underfunded. This argument is valid only if there was a time between 1951 and 2024 that Michigan road agencies claimed to have adequate funding. If Michigan road agencies have never claimed to be adequately funded, one must conclude that the problem is that they constructed more infrastructure than they had reason to believe they could afford to maintain.

Repealing and replacing PA 51 with a modern law reflective of current needs is the most beneficial policy intervention that the legislature could make. The continual renewal and revision of PA 51 is an historical failure. Continuing to do so would be imprudent.

Research has not identified any instance of a Michigan road agency claiming adequate funding throughout the state's history. In fact, in 1952, J.G. Schaub of the Michigan State Highway Department (now MDOT) stated, "the governor claims we're getting a lot more money than we need [but] costs have gone up and the fifteen-year program has to be lengthened. In the case of further inflation, we won't have enough."[25] As noted by Mr. Schaub, Public Act 51 was intended as a limited 15-year program to *construct* a state highway system. It was not intended to *maintain* a system over time. Rather than sunsetting Act 51, the legislature continually renewed and amended it, directing further revenue into a distribution formula intended as a construction project. Road agencies responded by constructing more roads, implicitly assuming that additional funds would be provided for maintenance as needed. The legislature has typically obliged.

It has long been understood that PA 51 does not reflect current road funding needs. Yet there has been no appetite to repeal and replace the law, which has been described as the "third rail" of Michigan's pothole crisis.[26]

Michigan's road agencies typically oppose replacing PA 51 because they fear that a new formula will create 'winners and losers.' A needs-based road funding law would be so unlike PA 51, that it's impossible to predict how funding would be redistributed under a rational formula. Every road agency fears being a loser under a new formula. Thus, road agencies have instead advocated for more funding to be directed into the current system, under the theory that 'a rising tide lifts all boats.' But some boats are already swamped.

This 'winners and losers' dilemma could easily be addressed in legislation. It is common to adopt laws with 'hold harmless' provisions. In this case (assuming that some additional road funding is provided), a new road funding law could ensure that no agency would receive a drop in funding compared current levels. Additional revenue would be distributed by a rational needs-based formula.

> Road agencies oppose repealing and replacing PA 51 for fear of ending up with less funding. These concerns could be addressed through a 'hold harmless' provision that assures no agency experiences a funding decrease from current levels.

Legislation to repeal and replace PA 51 will require more thought and effort than a simple funding bill. However, it is a necessary prerequisite to fixing the damn roads. PA 51 is a primary source of Michigan's roads program underperformance (section 4.1, page 43).

The bottom line is that PA 51 is obsolete. Increasing Michigan's road funding without fundamental reform to how it is spent would be a disservice to citizens of the State.

6.2 Road User Cost Allocation and Impact of Commercial Vehicle Traffic

A primary factor in determining funding requirements for maintaining road infrastructure is the traffic demand of a particular segment of road. Several states have conducted a formal road user cost allocation study that estimates costs imposed by vehicle class.

Light vehicles impose costs primarily by taking up space. A high-volume roadway typically requires more pavement – additional lanes, turning lanes, paved shoulders, etc.

However, light vehicles impose essentially no pavement damage. MDOT does not even consider light vehicles (classes 1-3) in pavement design.[27] In most cases, essentially all traffic-related pavement damage is imposed by commercial vehicles (trucks, classes 4 and greater).

Although trucks are the most determining factor to predict pavement deterioration and related costs, Michigan's road funding distribution formula does not consider truck traffic. Furthermore, the omission of truck traffic in pavement condition forecasting is a potentially significant source of error and impedes effective project investment decisions.

Despite decades-long concerns over the impact of Michigan's unique truck weight laws, the state has never conducted a road user cost allocation study to quantify the pavement damage and costs imposed by commercial vehicle traffic. Michigan should conduct a study to determine the costs imposed by trucks, as well as to identify the routes and road agencies that are most burdened by commercial vehicle traffic. This study could inform the institution of a truck weight-distance fee, a revenue option used by five other states. Even if Michigan does not adopt such a fee, improved truck traffic data could improve pavement design, asset management, and funding distribution.[an][28]

6.3 State Limitations on Local Revenue Generation

Michigan's local road agencies frequently argue that local road systems are especially underfunded. This is specifically true for minor local routes that are not eligible for federal aid (non-FAE routes). Many local governments impose road funding millages or use general fund resources to manage and maintain these roads. However, most local road agencies are highly dependent on state shared revenue.

It is worth reconsidering what the role of the state should be regarding local roads with marginal state or regional value. If minor local roads continue to be reliant on state shared revenue, significant state funding increases are likely needed to bring these systems into acceptable condition. This would invite thorny problems such as identifying revenue sources, calculating equitable distribution, and ensuring accountability.

Another option is to provide local governments with more freedom to derive their own local road revenue for local purposes.[ao] Local governments in Michigan are currently restricted from using many tools that are available for local road funding in other states. For example:[29]

- Local-option fuel taxes
- Local-option vehicle registration fees (wheel taxes)
- Local-option income taxes (imposed at the county or regional level)
- Local-option sales taxes (imposed at the county or regional level)
- Local-option delivery/ride-hailing fees
- Local-option truck weight-distance fees (would require institution of a statewide weight-distance program)

In some ways, such an approach would represent shifting part of the road funding problem from the state to local governments. However, local governments may be in a better position to address local problems. Allowing more local-option revenue does not impose any requirements on local governments – it would simply give them more options. Additionally, if local governments assume more funding responsibility for their roads (more 'skin in the game'), it may encourage more effective asset management by local road agencies.[ap]

an Ideally such a study should be administered by an unbiased agency such as DTMB.

ao These options are not mutually exclusive.

ap Michigan's smallest local agencies are unlikely to benefit much from local-option revenue even if permitted. In these cases, policymakers might consider incentives for small local agencies to consolidate.

6.4 Statewide Pavement Management

Michigan's Transportation Asset Management Council has collected data on the statewide federal aid eligible network since 2004. TAMC was created by the legislature and tasked with creating and implementing a statewide transportation asset management program. To meet the challenge of implementing a pavement management system that could be used by all 615 road agencies in Michigan, TAMC adopted a largely subjective measure of pavement condition, MI-PASER, that is collected by road raters conducting a "windshield survey" and recording a score of 1-10 while driving the road.

The original PASER metric was introduced in 1987 and intended for local rural and small city pavements that lack the resources for a comprehensive pavement management system.[30] MI-PASER can be a valuable tool and may be appropriate for many of Michigan's small local road agencies. But MI-PASER is inadequate for complex urban systems and high-traffic roads. It just doesn't make sense to use the same metric for an expressway as a subdivision. Many of Michigan's road agencies supplement MI-PASER data with additional metrics and decision-support processes for their own use. However, when aggregated to the state level, the MI-PASER pavement condition data is of questionable reliability.

TAMC's asset management program is incapable of answering a simple question: Which of Michigan's road agencies are making the best use of funding?

As a subjective metric, PASER data is subject to myriad human biases and can provide only a vague idea of actual system conditions. Yet MI-PASER data has become the *de facto* measure of pavement quality in Michigan. Not only are statewide pavement conditions reported using MI-PASER, but conditions are forecasted into the future and become the basis for funding needs estimates. As shown in Chart 7 (page 22), TAMC has consistently forecasted higher rates of pavement decline than have subsequently been measured. It follows that funding needs estimates based on these forecasts are also overestimated.

An updated statewide transportation asset management program should be developed that is capable of assessing the performance of Michigan's road agencies. In its current form, TAMC's asset management program cannot provide answers to a simple question: Which of Michigan's road agencies are making the best use of funding?

Answering this question would require objective, reliable assessment of system conditions, and consideration of variable cost drivers and constraints (such as system size, number of bridges, traffic demands, and climate factors). An asset management system that cannot identify what good asset management looks like is not likely effective.

With 83 county and 531 municipal road agencies distributed across the state, it is certain that some are performing better than others. Identifying top performers would allow for the evaluation of successful approaches. The lessons-learned could then be shared statewide, facilitating road and bridge condition improvement across the state.[aq]

6.5 Trunkline Pavement Management

While MDOT reports MI-PASER data (as to comply with TAMC and legislative directives) MI-PASER does not factor into MDOT's own pavement management system. MDOT has historically conducted a distress survey to derive a unique metric called the Distress Index (DI). The DI was then converted into a measure of pavement remaining service life (RSL) – the number of years before a pavement reaches failure state.[31]

However, research shows that MDOT's DI does not reliably predict RSL.[32] Thus, MDOT's primary metric used to inform pavement investments is of questionable value.

MDOT last collected DI in 2019 and has since been in a transition period regarding pavement management. MDOT contracted with Michigan State University to develop a new metric called Pavement Distress Score (PDS).[33] MDOT is now collecting PDS on the trunkline network and is working to integrate this into a pavement management system to enable improved decision support. In the interim period from 2020 until now, MDOT has been extrapolating RSL data from 2019 combined with occasional manual adjustments based on engineering intuition and knowledge.

> MDOT has not collected the data used in its pavement management system since 2019. A new metric is now being collected but has not yet been integrated into the pavement management process.

MDOT's new Pavement Distress Score is based on widely used engineering-quality metrics that are objective and able to be collected by automated equipment through a variety of venders (IRI, cracking, rutting, faulting). This is likely to enable improved decision support and pavement management on state trunklines in future years. However, it must be noted that MDOT's previous DI metric, used since the early 1990s, may not have enabled effective decision support to-date.

Additional evidence suggests that MDOT's pavement management is lacking in Chart 8 (page 21). Chart 8 shows reported pavement conditions on the National Highway System as measured by the International Roughness Index (an objective, standardized engineering-quality metric) from 2004 to 2022. While 19 percent of Michigan's NHS network is owned by local agencies, 81 percent is MDOT trunkline, and thus the trends in Chart 8 largely reflect trunkline pavement condition.

Chart 8 shows that the percentage of routes in good condition on the NHS improved from 47 percent in 2004 to 62 percent in 2022. Over this

aq Policymakers should reconsider the wisdom of having the TAMC, which provides funding needs estimates, administered by employees of public road agencies.

period, pavement in poor condition remained relatively flat at around 12 percent. This is generally good improvement; however, this means that pavement maintained in fair condition declined (from 40 percent in 2004 to 22 percent in 2022). It stands to reason that a more effective pavement management strategy would bring more pavement out of poor condition by cost-effectively maintaining pavement in fair condition with routine scheduled maintenance.

The challenge for Michigan road agencies to maintain pavement in fair condition across its life cycle is also evident in comparison to other states. As shown in Table 2 (page 26), Michigan ranks 24th nationally in NHS pavement in good condition by IRI but ranks 33rd in pavement in poor condition. Michigan ranks 18th in Interstate pavement in good condition by PCM, but 44th in Interstate pavement in poor condition.

This all suggests that, compared to a typical state, Michigan struggles to maintain pavement in fair condition. Regardless of funding increases, Michigan could improve overall system conditions by adopting a pavement management strategy that is at least as effective as an average state. MDOT's pending adoption of PDS is a positive step in this direction.

6.6 Impact of Highway Construction Cost Inflation

As shown in Chart 3 (page 7), Michigan's nominal road funding levels were nearly flat from 2004 to 2016 ($2.6 billion to $2.8 billion). When converted to 2023-equivalent road funding dollars, this equates to $5.0 billion in 2004, declining to $3.8 billion in 2016. Following the 2015 road funding legislation and Rebuilding Michigan bond program, nominal funding more than doubled from $2.8 in 2016 to $6.1 billion in 2024. However, when adjusted for inflation, this represents only a 55 percent increase.

Critically, when nominal funding is flat, the purchasing power of Michigan's road program steadily declines due to inflation. Further, when funding increases, purchasing power does not increase as much as may be expected.

While the 2015 road funding legislation indexed the fuel tax to inflation, annual increases are capped at five percent and indexed to the Consumer Price Index (CPI-U). In most years, construction cost inflation increases faster than the CPI-U. Furthermore, the adoption of electrified and increasingly fuel-efficient vehicles is likely to reduce fuel consumption in coming years. Thus, the purchasing power of road revenue under current policy is likely to gradually decline.

Policymakers should prioritize road revenue formulas that increase relative to the rate of construction cost inflation. Knowing that the purchasing power of state revenue will be relatively consistent into the future would better enable road agencies with multi-year project planning and asset management. (This would also help future legislatures avoid emergent road funding discussions.)

Regional Variations

An additional feature of construction cost inflation is that it is not consistent across the state. As shown in Figure 1 (page 9), highway construction cost inflation varies significantly across Michigan's regions. From 2015 to 2023, cost inflation ranged from 34 percent in the Upper Peninsula to 63 percent in the Metro region.[ar]

While MDOT has the ability to shift resources between regions to account for variable costs, local road agencies are subject to these same inflation pressures and are largely funded through state shared revenue as determined by Public Act 51, which does not consider variable costs. Thus, local agencies in high-inflation regions such as Metro Detroit and the University Region are especially challenged to maintain their local systems with their given funding allocations.

> Local agencies in high-inflation regions are especially challenged to maintain their system. Local agencies are highly reliant on state revenue sharing through the PA 51 distribution formula, which does not consider variable construction costs.

Michigan is one of only a handful of states that calculates a state Highway Construction Cost Index (e.g., the MHCCI). This is a valuable effort,[as] but is currently underutilized.

The legislature should require MDOT to submit a formal quarterly report including MHCCI data, as well as the most recent average unit bid prices across Michigan's regions.[at]

This data could provide valuable policy insight regarding road funding needs across Michigan. Ideally, this data would be considered in a distribution formula that adjusts allocations of state road revenue sharing to local agencies based on local costs.

6.7 Aggregate Mining Permitting Reform

Road agencies and construction interests often highlight regulatory costs and permitting requirements as a factor driving up construction costs. One of the most frequently cited regulatory costs is related to local barriers to permitting new aggregate mines that produce sand, gravel, and crushed stone for construction.[34]

Michigan's Zoning Enabling Act prevents local governments from completely prohibiting the siting of a new aggregate mine. However, local governments may deny permits for mining operations if "very serious consequences would result." If a local government denies a permit appli-

ar Regional inflation data is also available from 2010 to 2023, ranging from 61 percent inflation in the Upper Peninsula to 110 percent in the University region.

as For example, the inflation-adjustment analysis included in this report (Chart 3, page 7) would not have been possible if MDOT had not generously shared their Michigan Highway Construction Cost Index data. An attempt to determine Michigan's historical purchasing power using alternative methods such as by reference to the National Highway Construction Cost Index or Consumer Price Index would have reached very inaccurate results.

at MDOT initiated the MHCCI in response to proposed legislation that would require MDOT to create a highway construction cost index to measure inflation in highway construction costs for road and bridge projects in the State and submit quarterly reports to the House and Senate Transportation subcommittees (SB 515 of 2019). This legislation was not adopted, but MDOT continues to calculate the MHCCI for internal use.

cation for mining operations, it becomes the burden of the permit applicant to demonstrate that "there is a need for the [mine], and that no very serious consequences would result from the extraction, by mining, of the natural resources."[35] This requirement frequently leads to lengthy and costly lawsuits, often with the court supporting the local governments' right to deny a mining permit.

Neither road agencies nor the construction industry have offered an estimate for cost increases resulting from barriers to opening new aggregate mines. However, there is evidence to suggest that lack of aggregate availability is contributing to construction cost inflation.

The Michigan Highway Construction Cost Inflation Index breaks down cost inflation by various components. From 2010 to 2023, the category of bases (sand, gravel, and crushed stone) shows cost inflation of 165 percent. This is the largest inflation rate of any construction cost category tracked by the MHCCI, and twice the overall construction cost inflation rate of 82 percent over this period. That said, base material accounts for only about six percent of construction costs overall. Considering that total project costs include planning, engineering, administration and other non-construction costs, a reasonable estimate for road construction cost increases due to rising costs of aggregates is likely about one or two percent on average. This may seem minor, but adding $1-$2 million to the cost of a $100 million project is an issue worth evaluating.

> Rising costs of aggregates (sand, gravel, and crushed stone) are increasing construction costs by an estimated one to two percent on average. Challenges in sourcing aggregates is likely a highly localized problem best addressed with targeted policy intervention.

Per U.S. Geological Survey (USGS) data, in 2022, Michigan produced 41.5 million metric tons of sand and gravel for construction aggregate. This is down from 44.9 million metric tons in 2019. But going further back in history provides a more complicated picture. Michigan's sand and gravel production has varied over the decades. In 2011, Michigan produced only 31.9 million metric tons. However, from 1999 to 2003, Michigan produced over 70 million metric tons of sand and gravel construction aggregate per year.[36]

The USGS tracks crushed stone construction aggregate as a separate category, which tells a different story. In 2022, Michigan produced 38.2 million metric tons of crushed stone for construction aggregate. This is the highest production of any year since 2002. Michigan peak production of crushed stone was 43.4 million metric tons in 2001.

As of 2022, Michigan's overall aggregate production was neither at historic highs nor historic lows, going back 25 years. In 2021, MDOT listed 613 aggregate suppliers.[37]

None of this data individually or combined provides enough information for an informed policy intervention. More information is required to determine the extent to which aggregate availability is a problem. This high-level data does not provide information about where aggregate mines are located in relation to construction demands, nor the quality of aggregates at a given mine in relation to aggregate specifications required by road agencies.

Lack of aggregate availability is likely a localized problem. Policymakers should delve beneath available anecdotes to better determine the extent to which new mines are needed, for what materials, and in what locations before imposing a statewide solution.[au]

6.8 Costs and Resource Demands of Speculative Projects

As the historical home of the U.S. auto industry, Michigan policymakers often seek to leverage the state's automotive history and expertise to promote speculative technologies and new 'mobility' solutions.[38] The objective is to establish Michigan as a leader in emerging markets to promote economic development, as well as improved quality of life. Michigan's road agencies are frequently directed, or at least encouraged, to support these projects.

These speculative projects rarely amount to significant budget expenditures.[av] However, they often require resource expenditure from high-level public servants whose time may be better spent focusing on their core jobs. It is difficult to identify any state-government-led effort to develop new mobility technologies that has lived up to expectations.

Michigan's efforts in mobility innovation date back to at least 2004. In a 2017 comment on a USDOT rulemaking docket, MDOT stated that the department had invested $40 million since 2004 deploying infrastructure to support a connected vehicle technology called dedicated short-range communication (DSRC).[39]

DSRC is now a dead technology. The Federal Communications Commission rescinded the radio communications license, stating, "DSRC has barely been deployed."[40] A handful of other state DOTs invested in DSRC infrastructure, but Michigan was the main proponent.

While commercial deployment of DSRC technology was always questionable,[41] MDOT funded the development of an entire data platform based on the technology called Data Use Analysis and Processing (DUAP). A final report on the project stated, "DUAP research has been constrained by the relative unavailability of connected vehicle data."[42] MDOT's DUAP program is now defunct.

MDOT was not the only Michigan road agency to invest in DSRC. Many local road agencies followed MDOT's lead to pilot and deploy DSRC technology, including Detroit, Ann Arbor, and the Road Commission of Oakland County.

au Such research should be administered by an unbiased agency such as DTMB.
av It is not always clear how much is spent on such projects or where funding comes from.

As industry and investor hype shifted from connected to autonomous vehicle technology, Michigan policymakers shifted focus to a concept of 'connected and automated vehicles' (CAVs). In 2017, MDOT published a CAV Strategic Plan elaborating how a combination of DSRC and automated vehicle technology would promote the Department's Towards Zero Deaths (TZD) efforts. [43]

Michigan's CAV efforts included plans to reconstruct Michigan Avenue through Detroit's Corktown neighborhood with a dedicated automated vehicle lane.[44aw] This plan fizzled out, but evolved into the Cavnue express lane that has been constructed on I-94.[45] It remains unclear how this project will move forward or provide value.[46]

Another foray into speculative autonomous vehicle development is the Automated Bus Consortium (ABC), a program intended to develop and deploy full-size, fully autonomous transit buses. MDOT is acting as the procurement agency for the ABC, and about half of funding members are Michigan entities. The ABC released an initial RFP to procure autonomous buses in 2021. Lacking responses, a revised request for services (RFS) was released in 2022. The 2022 RFS also was unsuccessful. Another revised RFS was released in 2024. The latest effort is also likely to be unsuccessful, considering ABC is requesting venders to develop and integrate automation technology for full-sized buses that has yet to be achieved for any veh[47]icle.[ax]

Unrelated to connected and/or automated vehicle technology, MDOT has led a pilot project for a dynamic-inductive electric vehicle charging roadway.[48] Similar to Michigan's CAV efforts, there is little indication that this technology has much potential for success. No automaker has shown any interest in installing the on-board equipment to enable this wireless inductive charging system.

Further research would likely identify many similar efforts with questionable value. A focus on innovation is admirable, but Michigan's mobility investment track-record appears poor. These efforts typically constitute relatively minor budget expenditures but require substantial time and attention from high-level public officials. Considering that Michigan's road agencies appear to have room to improve performance of their core function of managing and maintaining the road network and public transportation system, it may be advisable to pull-back on speculative technology projects and pilots.

aw The MDOT Michigan Avenue Planning and Environmental Linkages (PEL) study report states that "transit/autonomous vehicle (AV) alternative [was] most popular among stakeholders." However, in the related survey, stakeholders were not given an option to select dedicated transit lanes that were not also AV lanes. In public meetings, stakeholders expressed a desire for Bus Rapid Transit; the AV element was imposed upon them.

ax Waymo, the global leader in automated technology, has deployed a similar technology on light passenger vehicles but these vehicles still make regular errors and require frequent remote and manual intervention.

6.9 Efficiencies Available Through Multi-agency Project Coordination

Public infrastructure management in the United States is a result of a long evolution of compromises between public and private agencies. Public roads are typically owned and operated by state, county, or municipal road agencies. However, a road is not only a road, but a public right-of-way (ROW) that is permitted for use by various other infrastructure and utility providers, such as water, sewer, electric power, natural gas, and telecommunications. ROWs are rarely designed to accommodate these utilities in a rational manner. Each infrastructure provider conducts planning and construction work with minimal coordination with other ROW users, often leading to inefficient use of time and money.

This problem is widely understood. The most common example is when, soon after a road is re-paved, a utility company will excavate the new pavement to replace underground infrastructure such as water mains or gas lines. The replacement pavement patch cannot possibly be as robust as the original pavement and usually manifests potholes or other failures within a few years.

Michigan has made progress to address such inefficiencies. In addition to various local and regional 'dig once' efforts across the state, the Michigan Infrastructure Council (MIC) has created a "Dig Once Project Portal" (MiDIG).[49] MiDIG provides a platform for public and private infrastructure owners to share project plans in a standardized format. The idea is that agencies will use the portal to voluntarily coordinate construction projects.

Most utilities and road agencies understand the potential benefits of cooperation and coordination, such as dig-once construction. However, there are practical barriers to putting such ideas into action.

Each individual agency must be responsive to individual incentives and unique regulatory requirements. Coordination on complex projects often requires sacrifice or extra work by one or more agencies. Consequently, meaningful coordination and successful dig-once projects have been sporadic, usually requiring extra efforts by dedicated agency staff going above and beyond their job description. Most potential cost-saving multi-agency projects never move forward.

It is unlikely that a platform that relies entirely on voluntary inter-agency collaboration will achieve a fraction of the cost efficiencies that are possible. This is a collective action problem that will require state legislation to sufficiently address.

Michigan could become a national leader in infrastructure management by adopting legislation that envisions infrastructure assets within public ROWs as a coherent engineered system within a statewide framework. Legislative directives should include three interrelated concepts:

1. **Dig-once legislation** that enables, supports, and coordinates multi-agency construction projects.
2. **Subsurface Utility Engineering (SUE) legislation** that establishes standards and expectations for data-sharing by owners of underground infrastructure within the public ROW.
3. **Building Information Modeling (BIM) for infrastructure legislation** that establishes a goal to adopt a statewide BIM for infrastructure framework, and establishes an official commission tasked with further advising the legislature on how to achieve that goal.

It should be emphasized that such an effort would not be trivial, and would involve meaningful near-term investments and long-term commitments to the program. The development of a statewide approach to infrastructure life-cycle management would require earnest participation by hundreds, if not thousands of individual organizations that are stakeholders within public ROWs. This would represent a paradigm shift in infrastructure management, yet a necessary investment to modernize Michigan's infrastructure and ensure long-term fiscal sustainability.[50]

6.10 Concluding Remarks

Typically, when policymakers discuss large budget items (e.g., education and public health), the allocation of resources and efficacy of programs is evaluated along with funding levels. Michigan's road and bridge programs rarely receive such scrutiny.

Recent policy discussions regarding the public road network focus entirely on the need for more revenue. Michigan's legislature has even funded multi-million-dollar studies investigating new revenue sources.[51,52]

Evaluating new sources of road revenue is likely appropriate as fuel tax revenues are forecast to slowly decline in future years. However, there should be more research and analysis of how existing road funding is spent.

Evidence suggests there are multiple inefficiencies in our current system. Allocating more funding to roads without addressing these inefficiencies may reinforce systemic problems without making much progress in fixing the roads.

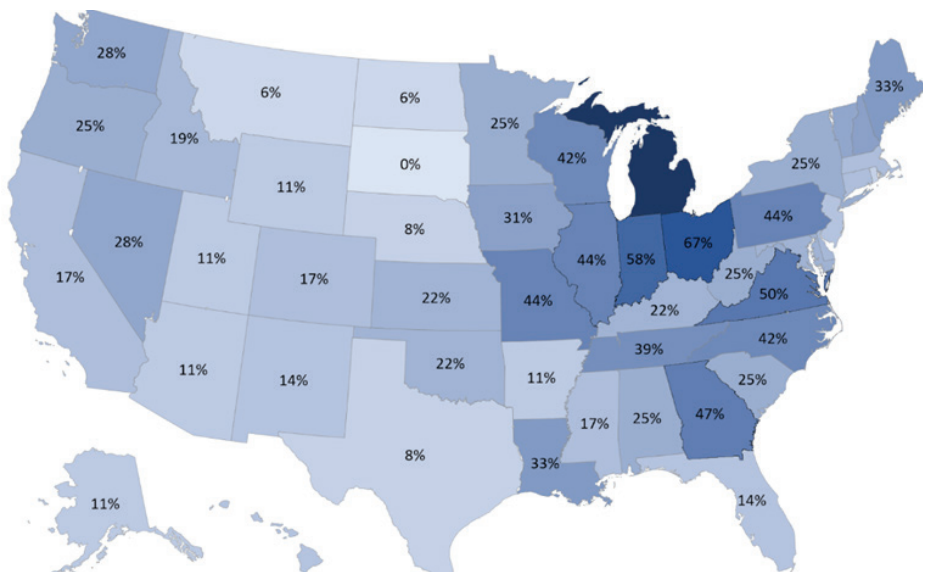
Michigan's citizens and taxpayers deserve a thorough evaluation of transportation funding policy before being subjected to substantial tax increases or losing public services through a redirection of general fund revenue.

Appendix A: Peer State Selection Process

In public policy analysis, it is difficult to point to any public policy as a best practice. In thinking about state and local governments as "laboratories of democracy," it is often useful to identify opportunities for reform by examining the practices of others. These exercises are most useful if the comparison governments look like the government in question.

With 50 states, all unique in their own way, it can be useful to select a specific subset of peer states to use as a basis of comparison for Michigan's road program. With this in mind, a transportation infrastructure peer state index was constructed to determine which states are most similar to Michigan for purposes of examining infrastructure policy and planning (map below).

Figure 3
States with Percentage Labels Reflecting Similarity to Michigan for Road Program Comparison



Component Metrics

Any approach to selecting peer states requires informed creativity. Numerous statistics might be important and there are practically infinite ways of combining them into a final result. This approach uses data from the Federal Highway Administration's 2020 Highway Statistics Series[53] combined with additional Census data and other metrics. These metrics are most pertinent to transportation infrastructure policy, but many are relevant to other infrastructure types as well.

For each of 12 individual categories, raw data was ranked as most similar to Michigan and scored with up to three 'similarity points.' Unless stated otherwise, the five closest states are awarded 3 points each, the next five are awarded 2 points, and the next ten are awarded one point. The final index is the sum of points awarded across all categories expressed as a percentage of all possible points (36).

The 12 individual components are:

1. Population (2020 Census)

The 2020 statewide population provides a rough idea of the demands placed on public infrastructure and resources available. Michigan is the tenth largest state with a population of just over ten million people. The mean U.S. state population is about 6.2 million, and the median is only 4.4 million.

2. Population Change (2010 - 2020)

Infrastructure issues and related policies can vary depending on if a state is growing, and how fast. Michigan grew 2.0 percent from 2010 to 2020, one of nine states with population growth between zero and three percent. When scoring this category, these states were given three similarity points. Three states - West Virginia, Mississippi, and Illinois - lost population and were scored two points each. Additionally, ten states grew between three percent and five percent, not too dissimilar from Michigan's two percent growth; these were scored one point.

3. Network Miles (public road centerline length)

The geographical size of a state factors into the demands placed on road agencies to provide access to sparsely populated rural areas. However, many large states are so sparsely populated that the public road network has gaps of tens or hundreds of miles. Alaska is the best example of this– while it is the largest state by land area, it ranks 45th in miles of public road. Rather than using the area of a state as a basis for comparison, it is more relevant to consider the size of the public road network in centerline miles, which reflects the size of the state but more directly defines the demands placed on road agencies. Michigan is the 22nd largest state in land area but has the 10th most extensive public road network.

4. Urban Land Area Percentage

The percentage of a state's land area that is defined as "urban" helps define the demands placed on infrastructure, and the efficiency with which infrastructure can be constructed and maintained. States with similar urban land percentages share similar priorities and constraints in allocating resources between urban and rural areas. Michigan is the 15th most urbanized state by land area with 6.4 percent of its area designated as urban. This is below the U.S. mean of 7.4 percent but above the median state, which has only 3.5 percent urban area.

5. Urban Population Percentage

The percentage of a state's population living in urban areas does not always correlate closely with percent-urban by land area. For example, California is the nation's most urbanized state with a population that is 95 percent urban, yet California is the 21st most urbanized state by land area with 5.3 percent, a slightly lesser percentage than Michigan. States with higher percentages of urban population are often better positioned to provide infrastructure efficiently. Michigan's urban population is 24th at 74.6 percent, very near the median state with 73.7 percent and the U.S. mean of 73.6 percent urbanized.

6. Overall Density of Population

A third way of quantifying population distribution within a state is overall density (i.e., in residents per square mile). By this measure, Michigan is the 17th densest state with 175 persons per square mile. Michigan is less dense than the U.S. average of 195, but denser than the median state of 99 persons per square mile. Combined with the above metrics reflecting urban area and population, this metric can help identify states with similar overall land use to Michigan.

7. Per Capita Income

Per capita income is a useful way to broadly reflect a state's economic activity and potential funding resources, as well as vehicle trips generated by economic activity. Michigan's per capita income of $51,971 in 2020 ranked 34th. This was below both the U.S. average of $56,868 and the median state of $55,403.

8. Vehicle Miles Traveled per Capita

Annual vehicle miles traveled (VMT) per capita is simply the estimated total annual VMT in a state divided by the number of residents. Michigan ranked 37th for most VMT per capita, indicating the state has relatively less traffic than the U.S. average of 10,054 VMT/cap and the median state of 8,909 VMT/cap. The states with high VMT per capita tend to be states with a low percentage urban population and/or that are situated along high-traffic interstate routes.

9. Urban Percentage Truck Vehicle Miles Traveled

Truck traffic imposes a disproportionate amount of damage on road pavement. Cars and light trucks impose demands on the road system that can lead to congestion and safety issues but have negligible impact on roadway pavement. Thus, the percentage of VMT associated with trucks and heavy vehicles correlates closely with the costs of constructing sufficient roadway pavement and maintaining it in good condition. Urban areas with heavy truck traffic also have unique issues related to congestion, safety, and traffic control. Typically, states with high VMT and a high percentage of trucks may require substantial resources to accommodate such demands. Fortunately, not only is Michigan a low VMT per capita state, but it is a very low truck traffic state. Michigan ranks 46th among states with an urban percentage truck VMT of 5.6 percent.

10. Average Daily Traffic (ADT) per Lane (All Arterials)

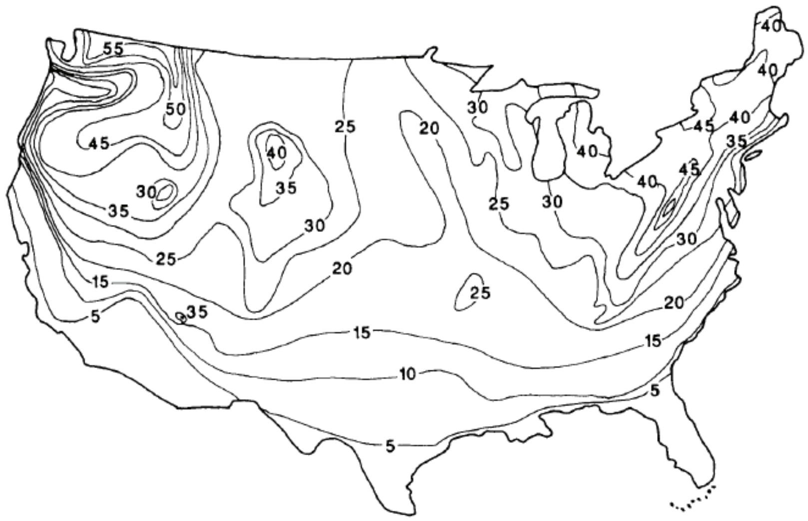
Average daily traffic per lane across the state broadly reflects traffic density, which then reflects the likelihood of congestion. This metric is influenced both by traffic demand (ADT) and capacity to accommodate that demand (number of lanes). States that are similar in this regard are likely to have similar concerns regarding traffic management, congestion mitigation, and capacity constraints. Michigan ranks 22nd for highest trafficked arterial lanes with 6,027 vehicles per lane per day. This is slightly higher than the U.S. state average of 5,571 and the median state 5,764.

11. Climate

Although heavy trucks do the most damage to roadway pavement, the local climate can also significantly factor into pavement failure. For example, pavement can be rapidly damaged during freeze/thaw cycles, especially in regions where soils are likely to be saturated in the spring. Climate also has implications for the design, maintenance, and operations of water and energy infrastructure.

A study by Michigan Technological University found that Michigan's climate was closest to Iowa, Wisconsin, Illinois, and Ohio.[54] Michigan and these four states are all within the wet-freeze climate zone as defined by FHWA, experiencing seasonal freeze/thaw cycling and saturated soils.[55] Another way of estimating freeze-thaw activity is the Lienhart freeze-thaw index, which combines seasonal temperature and precipitation into a single metric.[56] As shown in Figure 4, Michigan's average Leinhart freeze-thaw index is about 40. This is towards the higher end of the range but not dissimilar from many areas in the U.S. northeast and northwest.

Figure 4: Isoline Map of the Lienhart Moist Freeze-Thaw Index



Source: David Lienhart. The Geographic Distribution of Intensity and Frequency of Freeze-Thaw Cycles. July 2015.

In scoring the climate factor, three points were awarded to the four states identified by MTU as most climatically similar to Michigan. Two points were awarded to all other states within the FHWA wet-freeze region that also have a similar Lienhart freeze-thaw index as Michigan. One point was awarded to the remainder of the states within the FHWA wet-freeze region. Finally, one point was also awarded to states in the FHWA dry-freeze region that have a similar Leinhart freeze-thaw index as Michigan.

12. Consistency Bonus

The final metric reflects the number of previous categories in which states matched up with Michigan. This was done because states that are consistently grouped with Michigan are more likely to have similar infrastructure issues than states that match fewer categories more closely. This consistency bonus amplifies the results of previous categories, helping to make the most appropriate peer states more obvious. States that matched in eight or more of the eleven categories (IN, MO, OH, and WI) were awarded an additional three points. States matching seven categories were awarded two points. Finally, one consistency point was given to states matching five or six categories.

Results: Michigan's Infrastructure Peer States

Table 9 shows the full scoring that determined Michigan's infrastructure peer states. The results are further divided into first- and second-tier peer states.

Table 9
Michigan Peer State Ranking

Group	State	Population (2020)	Pop. Change	Network Miles	Urban Land %	Urban Pop %	Overall Density	Per Cap Income	VMT per Cap.	Urban % Truck	ADT/Lane	Climate	Consistency	Total Score /36	Michigan-like
Michigan		3	3	3	3	3	3	3	3	3	3	3	3	36	100%
1st-tier Peer States	Ohio	3	3	3		2	1	2	3		1	3	3	24	67%
	Indiana	1	1	1	3	2	3	3		2	1	1	3	21	58%
	Virginia	3			3	3	2		1	3		1	2	18	50%
	Georgia	3		2	2	3	3	3					1	17	47%
2nd-tier Peer States	Illinois	2	2	1	3		2			1		3	2	16	44%
	Missouri	1	3	2	1	1	1	3				1	3	16	44%
	Pennsylvania	2	3	3		1				1	2	2	2	16	44%
	Wisconsin	1	1	3	1	1	1	1				3	3	15	42%
	North Carolina	3		2	1	1	3	1			2		2	15	42%
	Tennessee	1		1	3	1	3	2			1		2	14	39%
Non-peer States	Maine		3					2	1	3		2	1	12	33%
	Louisiana		3		2	3	1	1			1		1	12	33%
	Iowa		1	2				2	1	1		3	1	11	31%
	New Hampshire		1		2		2		3			2	1	11	31%
	Vermont		3				1		1	2		2	1	10	28%
	Washington	2			1		1		1		3	1	1	10	28%
	Nevada							3	2	2	3			10	28%
	Minnesota	1		1		3			1		1	1	1	9	25%
	Alabama	1		1	1		1			2	2		1	9	25%
	Oregon					1		1	3		2	1	1	9	25%
	West Virginia		2		1		1		3			2		9	25%
	New York		1	3	1						1	2	1	9	25%
	South Carolina	1			2	1	3				1		1	9	25%
	Kansas		1	1		3			1	1			1	8	22%
	Maryland	1							3	3		1		8	22%
	Oklahoma			3		1		1			3			8	22%
	Kentucky		1		1		1				3	1	1	8	22%
	Idaho					2		1		3		1		7	19%
	Delaware							1	2	1	1	1	1	7	19%
	Massachusetts	2							2			2		6	17%
	California				2		2		2					6	17%
	Colorado	1		1					1	1	1		1	6	17%
	Connecticut		3						2			1		6	17%
	Mississippi		2		1					3				6	17%
	New Jersey	3							1			1		5	14%
	Hawaii				3		2							5	14%
	New Mexico		3			2								5	14%
	Florida			2				1			2			5	14%
	Alaska		1			1			1	1				4	11%
	Arizona	2						1			1			4	11%
	Arkansas		1	1						2				4	11%
	Wyoming		3									1		4	11%
	Utah							3			1			4	11%
	Nebraska			1		2								3	8%
	Rhode Island		1							1		1		3	8%
	Texas				1		1	1						3	8%
	North Dakota			1						1				2	6%
	Montana							2						2	6%
	South Dakota													0	0%

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