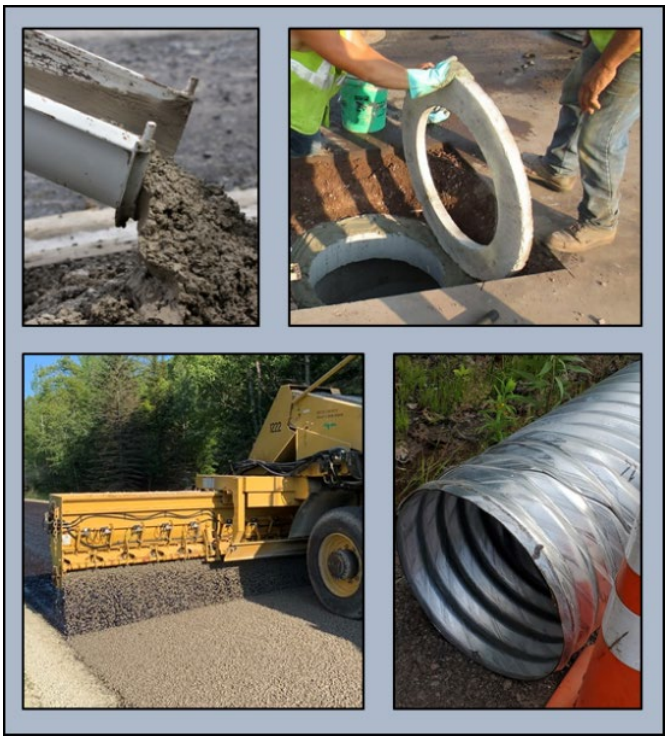
Evaluation of Michigan's 2020-2022 Local Agency Transportation Asset Management Plans



Peter Torola, Research Engineer

Center for Technology & Training
Michigan Technological University
309 Dillman Hall
1400 Townsend Drive
Houghton MI 49931

December 31, 2023

Michigan Transportation Asset Management Council

Michigan Technological University

ACKNOWLEDGEMENTS

I would like to thank Reagan May for her assistance with data gathering. I would also like to thank the Michigan road-owning agencies who submitted transportation asset management plans for approval to the Transportation Asset Management Council. This report would not have been possible without the time and resources they spent in creating the transportation asset management plans over the last few years and in collecting data that spans over the last 20 years on Michigan's road and bridge network.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Michigan has long been a leader in providing tools and trainings to local agencies for transportation asset management due to the efforts of the Transportation Asset Management Council (TAMC). Most recently, the TAMC has supported local agencies by creating and providing tools and trainings that assist local agencies in creating their own transportation asset management plan, which became required by the Michigan Legislature through the passing of Public Act 325 of 2018. This study reviewed all the local agency transportation asset management plans that had been submitted to the TAMC prior to August 3, 2023 to compile aggregate statistics on the plans and identify improvements for the tools and training.

Local agencies were required to submit a transportation asset management plan that included all the components required by legislation and also a separate plan specific to pavements and a separate plan specific to bridges. There were four data items collected on the transportation asset management plans, seventeen on the pavement plans, and thirteen on the bridge plans. These collected data items provided aggregate statistics on the state of the local-agency-owned roads and bridges in Michigan from the perspective of the individual agency.

The pavement plan goals set by local agencies were found to lean towards aspirational because the majority wanted to improve the current asset conditions or at least maintain the current asset conditions although they had forecast to meet these goals only 46 percent of the time. There was a lowering of pavement goal expectations when moving from the paved primary/major network to the paved local network, and a further lowering of goals when moving from the paved local network to the unpaved network. The Roadsoft pavement condition forecast model was used in 75 percent of the plans that contained a pavement predictive method. This model is more detailed and takes more time than the National Center for Pavement Preservation quick check method. This shows local agencies have at least a baseline of the data that is required and are willing to devote the time needed to perform the more complicated modeling.

The need for additional funding for roads in Michigan has been well documented in past Michigan studies. This review of local agency plans provides a summary of the statewide local agency funding need. The 2020-2022 local agency road and bridge average annual funding gap was estimated to be $1.07 billion. Each network is summarized below.

Statewide County and Large City Assets	2020-2022 Average Annual Funding Gap
Paved Primary/Major Roads	$ 257,700,000
Paved Local Roads	$ 370,300,000
Unpaved Roads	$ 240,200,000
Bridges	$ 199,400,000
Total	**$ 1,067,600,000**

It is estimated that all Michigan local agencies have condition data on the paved primary/major network and well over 90 percent of the paved local network. It is also estimated through this study that local agencies have condition data on 20 to 30 percent of the unpaved network. However, it is not clear how current the local paved and unpaved data is. Therefore, it would be beneficial for local agencies in updating their plans to have a dedicated funding source for updating the local paved and unpaved network condition data.

On average agencies that submitted plans in 2020, 2021, and 2022 had an increase in the paved local network that contained data from 83 percent to 90 percent to 99 percent and the percentage of culverts inventoried when from 32 percent to 40 percent to 57 percent. Another interesting correlation was the average percent of culverts that agencies inventoried dropped from 56 percent for plans that used only Roadsoft as a predictive model on the paved local network to 16 percent for plans that used only NCPP as a predictive model on the paved local network. Agencies that forecast a decline in paved local condition were also much more likely to use the National Center for Pavement Preservation (NCPP) predictive model than the Roadsoft predictive model.

It was found that there are an estimated 198,600 culverts statewide for the county-owned and large city-owned culverts. It was also estimated that there are 8,900 signals owned by county and large city agencies; however, there was less confidence in the signal total than with the culvert total.

County and large city agencies performed an estimated 3,870 centerline miles of light capital preventative maintenance treatments every year on average from 2020 through 2022. In addition, they performed 4,570 centerline miles of heavy capital preventative maintenance, 720 centerline miles of rehabilitation, and 250 centerline miles of reconstruction every year on average during this plan reporting period.

The statewide average planned bridge spending estimate for all county and large city agencies was found to be $133,100,000. Eighty-eight percent of this spending estimate is accounted to county agencies who own 94 percent of the bridges in this study.

Template improvement opportunities stemmed from local agencies not having a history of consistent data collection. This produced automatically generated plan template charts that conflicted with agency institutional knowledge and visual observations if not corrected. Having a checklist could assist local agencies perform a final review prior to submitting their plans to the TAMC. A possible solution that could help with simplifying forecasting surplus/shortfall needs is to develop a roadway network needs assessment tool in Roadsoft. This would take the foundation of the current strategy module and add user input goals to determine the cost needed to reach their set goals.

BACKGROUND

Creating and updating a written transportation asset management plan is a significant phase of the asset management process. A transportation asset management plan documents items such as asset inventory, future condition expectations based on funding levels, critical assets, and performance goals. The focus of a transportation asset management plan can be either internal—that is, used as a guide for internal staff such as managers and technicians—or external–that is, used to explain the process of how decisions are made to constituents and users.

The foundation of a transportation asset management plan is synthesizing basic inventory and asset condition data into actionable information. Michigan's local agencies have no-cost access to software for synthesizing condition data: Roadsoft, a GIS mapping database for collecting, storing, and evaluating data associated with transportation assets. Roadsoft is an approved tool used for the road condition data collection and reporting sponsored by the Transportation Asset Management Council (TAMC). This consistent platform has made it easier for agencies to adopt best practices in managing their assets because each agency does not have to create their own asset management process and system.

Michigan road-owning agencies with 100 or more certified centerline miles of public roads were required by Public Act 325 of 2018 to submit transportation asset management plans to the TAMC every three years. The legislature required that transportation asset management plans have an asset inventory, performance goals, risk of failure analysis, anticipated revenues and expenses, performance outcomes, a description of any plans of coordination with other agencies, and proof of acceptance. Public Act 325 required that one third of the local agencies submit their transportation asset management plans every year starting on October 1st, 2020 and repeating with a new third every year thereafter.

Prior to the passing of Public Act 325 of 2018. local agency transportation asset management plans were relatively common. The TAMC first published transportation asset management plan templates in 2011 that were developed on their behalf by the consulting firm Opus. The TAMC also sponsored the development of the *Asset Management Guide for Local Agency Bridges in Michigan* and the *Local Agency Guidelines for Developing an Asset Management Process and Plan* in 2011. The use of these templates and submittal of a pavement or bridge asset management plan was voluntary; however, Michigan cities and villages had been allowed more flexibility in how they fund major streets and local streets if they had an adopted "asset management plan". Early transportation asset management plan submission was not a requirement but was deemed discretionary by the Michigan Legislature according to Public Act 338 of 2006. In 2016 and 2017, the TAMC directed the Center for Technology & Training (CTT) to develop a new set of templates, training materials, and data-parsing tools for local agencies to create bridge asset management plans and pavement asset management plans, respectively.

In order to ease the burden of agencies meeting the plan requirements established by Public Act 325 of 2018, the TAMC contracted with the CTT to update the 2016 and 2017 templates. The TAMC decided to keep separate bridge and pavement asset management plans that local agencies could customize for their use as they see fit, while requiring a strictly formatted transportation asset management plan be submitted to meet PA 325 of 2018 requirements. The transportation asset management plan summarizes the most important details of pavement and bridge plans. This arrangement allowed local agencies maximum flexibility to make their road and bridge plans meet their needs while separating a purely reporting and compliance function to the transportation asset management plan. The templates developed by CTT work together to send data from the completed bridge and pavement plans to auto fill the transportation asset management plan, significantly reducing administrative burdens. There were 122 county and large city agencies that were required by Public Act 325 of 2018 to submit transportation asset management plans.

METHODS

This study reviewed all of the Michigan local agency transportation asset management plans that were submitted to the Transportation Asset Management Council (TAMC) before August 3, 2023. Elements of the transportation asset management plan, bridge asset management plan, and pavement asset management plan were evaluated. Aggregate statistics were calculated based on data collected in the review process of this study. Transportation asset management plan limitations and lessons learned were identified that could be used to improve the templates and training.

Data Items

Each transportation asset management plan that was submitted to the TAMC was to contain the following legislatively-required components: asset inventory, performance goals, performance outcomes, anticipated revenues and expenses, risk of failure analysis, a description of any plans of coordination with other agencies, and proof of acceptance. Data was collected by the Center for Technology & Training (CTT) staff in a spreadsheet and analyzed using pivot tables and summarized using spreadsheet formulas. The data items collected consisted of:

Pavement asset management plan data items

1. What year was the plan submitted?
2. How often was the pavement plan to be updated? (years)
3. What type of agency submitted the pavement plan? (county, large city, small city not required to submit a plan)
4. Did the pavement plan use the TAMC template? (yes, no)
5. How many pages including the appendix were in the pavement plan?
6. What method of predictive modeling was used? (Roadsoft, NCPP, other)
7. What networks did the plan include? (paved primary/major, paved local, unpaved)
8. What was the condition of each network?
9. What was the goal for each network? (improve, remain the same, manage decline)
10. Did their condition trend indicate they would accomplish their goal for each network? (yes, no)
11. What was the outcome of the condition forecast for each network? (improve, maintain same, decline)
12. What was the surplus and shortfall for each network relative to the goal?
13. What was the dollar volume of planned pavement projects and total spending per year for each network?
14. What type of coordination with other assets was included?
15. What type of critical pavement assets were included?
16. What was the degree of customization of the plan? (percent of template duplicated)

17. Who was author of the pavement plan? (internal staff, consultant, both)

Bridge asset management plan data items

1. What year was the plan submitted?
2. How often was the plan to be updated? (years)
3. What type of agency submitted the bridge plan? (county, large city, small city not required to submit a plan)
4. Did the bridge plan use the TAMC template? (yes, no)
5. How many pages including the appendix were in the bridge plan?
6. What was the goal for the bridge network? (improve, remain the same, manage decline)
7. Did their condition trend indicate they would accomplish their goal? (yes, no)
8. What was the dollar volume and type of unfunded (gap) bridge projects?
9. Did they include a revenue and expenses summary? (yes, no)
10. What was the degree of customization of the plan? (percent of template duplicated)
11. Who was author of the bridge plan? (internal staff, consultant, both)
12. What was the condition of bridges?
13. What type of critical bridge assets were included?

Transportation asset management plan data items

1. What was the status of the culvert inventory? (rated, inventoried, total)
2. What was the status of the signal inventory? (inventoried, total)
3. Did the transportation asset management plan use the TAMC template? (yes, no)
4. Who was author of the transportation asset management plan? (internal staff, consultant, both)

Quality control was performed by having the lead researcher go back and review ten percent of each data item. If a discrepancy was found in a data item, all the plans were rechecked for that data item.

In order to contextualize the collected data items in each plan, the amount of centerline miles of each agency's primary/major, local, and unpaved network was collected as well. This data was collected from the transportation asset management plans if available, from the *County Road Association of Michigan 2023-2024 Member Directory* (County Road Association of Michigan, 2023) for county agencies, and from the Act 51 Mileage Certification Maps (Michigan Department of Transportation, 2019) for city and village agencies.

Most transportation asset management plan data items were straight forward and simple to directly evaluate by searching for the keyword(s) based on the data item question. For example, the data item "How often was the plan to be updated?" could be identified quickly by searching for "update".

The data elements that were not as straight forward to assess required the use of tools and metrics to evaluate them. A two-step process was used to determine if a plan used the TAMC template. First, the plan was visually reviewed to see if it had the same format, sections, and text as the plan template. If the plan did not appear to have used the plan template, it was further reviewed by searching to locate any blocks of text that were the same as the plan template. This helped identify the plans that used the plan template but did not look similar at all in appearance. The surplus or shortfall of each network and the degree of plan customization data items were also more complex than searching the plan manually and are explained below.

Pavement Plan Surplus or Shortfall Data Item

One of the requirements of a pavement asset management plan was to identify a pavement condition goal and then determine if they had the resources to meet this goal. The pavement plan surplus or shortfall data item should depict the improvement needed to reach each agency network goal if there was a shortfall, or the surplus the agency had if it was able to reach their network goal. Some agencies reported their surplus or shortfall in dollars and some reported them in mile-years. The term mile-year was used in the National Center for Pavement Preservation method of network-level modeling. Roadway treatments in this method were converted to mile-years, which is a product of how many miles of a specific improvement were performed each year and the length of time of extended service life the treatment was expected to achieve. This depicted the amount of roadwork that was needed each year and how much life extension was expected, which is simpler to model than determining the roadwork need in dollars.

Determining the pavement plan surplus or shortfall relative to each network goal was determined by calculating the surplus or shortfall as a percentage of the reported network metric so they were comparable to each other. If an agency used dollars to show their surplus or shortfall, then this was divided by their annual spending on each network type. If an agency used mile-years to show their surplus or shortfall, then this was divided by the total amount of centerline miles in each network type.

Pavement and Bridge Plan Degree of Customization Data Item

A quantitative measure was developed to determine how much an agency customized the plan templates. The pavement and bridge plans were compared to the pavement and bridge plan templates by use of spreadsheet tools. The template and plans were copied and pasted into a spreadsheet so that each line of text was placed in a single column of cells. For example, the pavement template resulted in an array that was one column wide by 1697 rows tall before removing the common text. The common text not counted was: cells that contained blank rows, single numbers, single roman numerals, “years”, “lane miles”, “miles”, “brick”, “gravel”, “asphalt”, “concrete”, and “executive summary”. These were not counted because they were common to all transportation asset management plans whether the plan template was used or not. Each agency’s plan text lines were compared to the template array and all the matching

lines were counted. The number of matching lines was summarized as a percentage of the template that was duplicated by dividing the duplicate row count by the number of template rows (1488 for pavement and 885 for bridge).

Dealing with Plan Inconsistencies

Most Michigan local agencies had historically used Roadsoft for their roadway data storage and the MiBRIDGE system for storing their bridge data. The CTT created data parsing tools that automatically inserted data exports from these sources into a word processor after users added additional data. This helped speed up the process for local agencies to create their transportation asset management plans. However, this automation had the potential to introduce inconsistencies in the message conveyed to the completed plan audience. During the review of plans there were instances where the written text of the plan did not correspond exactly to similar data shown in charts and graphs. The disagreement between these two elements can be from not completing the final step of reading through and editing the *customized template* generated for an agency's asset management plan, thus manifesting itself as poor formatting, oversights, or incomplete edits. In cases where there was an inconsistency between charts and tables and written text, reviewers gave precedence to written text as the final word.

Dealing with Network Inconsistencies

Public Act 325 of 2018 required that local agency transportation asset management plans at least include the federal-aid-eligible county paved primary road system or the large city paved major street system. Local agencies had the option to include paved local roads and unpaved roads in their transportation asset management plan. This freedom allowed local agencies to create plans that fit their reporting needs. For the purposes of this study, project spending and surplus/shortfall data that combined the paved primary and paved local networks were not included in the individual network breakdowns. This was done to collect accurate data on the individual networks of paved primary/major, paved local, and unpaved.

RESULTS

There were 88 total transportation asset management plans submitted by August 3, 2023 that were reviewed and evaluated for this study for a total of 12,398 pages, which includes all pavement and bridge specific plan appendices.

The transportation asset management plan is the basis for meeting Public Act 325 of 2018 requirements. The submitted and reviewed plans represented 86 agencies that were required and 2 agencies that were not required to submit plans according to the measure of having 100 or more certified miles of road. These 86 required agencies with submitted plans made up 70 percent of the total 122 local agencies that were required to submit transportation asset management plans per Public Act 325 of 2018.

Of the 88 transportation asset management plans, 2 plans were submitted in 2019, 29 plans in 2020, 27 plans in 2021, 29 plans in 2022, and 1 (one) plan in 2023.

The transportation asset management plan review was summarized by each individual data item. The data was also filtered and segmented by other data items to pull out additional details and insight from the collected data items. The collected data items are summarized in Appendix A – Pavement Plan Data, Appendix B – Bridge Plan Data, and Appendix C – Transportation Asset Management Plan Data.

In the transportation asset management plans, the paved primary/major network was included in 87. The only plan that did not include the paved primary/major network was a small city agency that was not required to submit a plan and did not own any primary/major roads. The paved local network was included as a separate discussion in 86 of the transportation asset management plans; 1 (one) county agency plan and 1 (one) large city agency plan did not include a discussion of the paved local network beyond the number of miles of paved local roads they had. The unpaved network was included as a separate discussion in 73 of the transportation asset management plans. Unpaved roads were not included as a separate discussion by 2 county agencies, 12 large city agencies, and 1 (one) small city agency not required to submit a transportation asset management plan. The complete breakdown of included networks is summarized in Appendix A – Pavement Plan Data.

The bridge network was included in 82 transportation asset management plans. The remaining 6 plans had no bridges.

Transportation asset management plans were required to have pavement and bridge specific plans attached in their appendix. The following sub-sections detail the results of transportation asset management plans inclusive of their attached pavement- and bridge-specific asset management plans; these sub-sections are followed by evaluation results of just the attached pavement- and bridge-specific plans.

Planned Spending Findings

Pavement Planned Spending

Project spending is an important part of a transportation asset management plan as it helps provide context between current spending levels and the projected spending required to meet set goals. Annual "planned spending per centerline mile" is a measure that shows how much money could be devoted to each centerline mile every year, *not* how much a project costs per centerline mile. For this study, the annual pavement costs were the spending in the first year of the plan if it was provided. If the plan only identified total spending across all plan years, then total spending was divided by the number of years of the plan to determine an annual average.

Of the 88 reviewed plans, 75 transportation asset management plans contained annual costs of planned pavement projects specific to the paved primary/major network, which totaled to $376,250,957. Included in this data set was one small city agency with an annual planned project cost of $4,000 on a 1.0 centerline-mile paved city major network. The total planned annual project spending for the paved county primary and paved large city major networks are shown in Table 1.

For the paved county primary network, 48 county agency plans (83 are required to submit a plan) identified planned spending. Their 2020-2022 average annual planned spending per centerline mile was $17,527 covering 15,750.2 (of 24,595.5 statewide) centerline miles of the county paved primary network. For the paved large city major network, 26 large city agency plans (39 are required to submit a plan) identified planned spending. Their 2020-2022 average annual planned spending per centerline mile was $55,286 covering 1,812.2 (of 3,299.5 statewide) centerline miles of the paved large city major network.

Of the 88 reviewed plans, 67 transportation asset management plans contained annual costs of planned pavement projects that were specific to the paved local network, which totaled to $203,581,538. This includes one small city agency type with an annual project cost of $300,000 on a 7.5 centerline-mile paved local network. The total planned annual project spending, network size, and 2020-2022 average annual planned spending per centerline mile for the county and large city paved local networks are shown in Table 1.

For the county paved local network, 41 county agency plans identified planned spending. Their 2020-2022 average annual planned spending (*not* project cost) per centerline mile was $5,878 covering 17,732.0 (of 28,352.0 statewide) centerline miles of the county paved local network. For the large city paved local network, 25 large city agency plans identified planned spending. Their 2020-2022 average annual planned spending per centerline mile was $21,907 covering 4,521.9 (of 8,459.5 statewide) centerline miles of the large city paved local network.

Table 1: Annual Planned Project Spending by Road Network Type

Paved Network	Total Annual Spending from Plans	Total Network Size of the Plans (CL-mile)	2020-2022 Average Annual Spending per Network CL-mile	Number of Agency Plans
County Primary	$ 276,059,966	15,750.2	$17,527	48
Large City Major	$ 100,186,991	1,812.2	$ 55,286	26
County Local	$ 104,220,628	17,732.0	$ 5,878	41
Large City Local	$ 99,060,910	4,521.9	$ 21,907	25

For the unpaved network, agencies did not always distinguish between the unpaved network and the paved primary/major and paved local networks; those plans with combined network costs were not included in the collected spending per network centerline mile data item. For county unpaved networks, 6 county agency plans identified planned spending totaling $4,305,000. Their 2020-2022 average annual planned spending per centerline mile was $1,456 covering 2,957 centerline miles. There were no large city agency plans that listed out projects on their unpaved network. The large city agency plans contained 125.5 centerline miles of unpaved roads, which was 2 percent of their entire road network.

The average annual planned spending per centerline mile was used to extrapolate a statewide spending estimate and is shown in Table 2. The submitted transportation asset management plans reflected over 60 percent of the statewide paved network miles and were used to estimate the remaining 40 percent. The estimated statewide 2020-2022 average annual planned spending for the paved primary/major network was $613,500,000 and for the paved local network was $351,900,000.

Table 2: Statewide Annual Planned Projects Estimate by Road Network Type

Road Network	Statewide Network Size (CL-mile)	Estimated Statewide 2020-2022 Average Annual Planned Spending
County Paved Primary	24,595.5	$ 431,100,000
Large City Paved Major	3,299.5	$ 182,400,000
County Paved Local	28,352.0	$ 166,600,000
Large City Paved Local	8,459.4	$ 185,300,000
County Unpaved	37,823.5	$ 55,100,000

The total annual spending on unpaved road projects was estimated from the six county transportation asset management plans that included data on unpaved roads. There were no large city agencies that listed out project spending on their unpaved network. The county primary unpaved and county local unpaved centerline mile totals were used to estimate the annual planned spending of $55,100,000. This was calculated from the statewide 37,823.5 centerline miles of county unpaved network and the 2020-2022 average project spending of

$1,456 per centerline mile per year. This was derived from a small sample size of six county agencies and their 2,957.0 unpaved centerline miles.

Altogether, the 2020-2022 average statewide planned annual spending on the paved primary/major, paved local, and unpaved networks was $1.02 billion.

Pavement asset management plans typically included a total spending amount along with a list of the type of projects that were planned. Appendix A – Pavement Plan Data lists out the dollar amount totals for the specific types of planned projects; however, most agencies listed various mix-of-fixes with a total dollar amount planned and not anticipated spending estimates for specific treatment types. The various mix-of-fixes description often included reconstruction and is designated as "Various M-of-F (incl. Recon)" in Appendix A – Pavement Plan Data.

Another method of assessing project spending was looking at the annual miles of treatments used in the pavement plan models. There were 45 county agencies, 19 large city agencies, and 1 small city agency who provided average annual centerline miles of treatments performed, and there were two agencies—one county and one large city–who reported their treatments in lane miles that were roughly converted to centerline miles so they could be included (see Table 3). The average annual centerline miles of treatment per agency was used to determine an estimated annual centerline miles of treatments performed statewide from 2020 through 2022. Every year, county and large city agencies performed an estimated 3,870 centerline miles of light capital preventative maintenance (CPM), 4,570 centerline miles of heavy capital preventative maintenance, 720 centerline miles of rehabilitation, and 250 centerline miles of reconstruction (see Table 4).

Table 3: 2020-2022 Average Annual Centerline Miles of Treatments Performed per Agency

Paved Network	Light CPM	Heavy CPM	Rehab	Recon
County Primary	24.3	31.9	4.1	1.5
Large City Major	11.3	3.2	2.0	1.4
County Local	12.4	19.6	1.9	0.7
Large City Local	9.7	4.5	3.8	0.9

Table 4: 2020-2022 Statewide Average Annual Treatment Estimate by Network Centerline Miles

Paved Network	Light CPM	Heavy CPM	Rehab	Recon
County Primary	2,020	2,650	340	120
Large City Major	440	120	80	50
County Local	1,030	1,630	150	50
Large City Local	380	170	150	30
Total	**3,870**	**4,570**	**720**	**250**

There was one small city agency that submitted a plan with project spending details that was not required to submit a plan according to Public Act 325 of 2018; this data was a very small sample size. This small city's planned project spending details can be found in Appendix A – Pavement Plan Data.

Bridge Planned Spending

Local agency-owned bridges have a dedicated funding source of federal funds administered by the Michigan Department of Transportation on behalf of the Federal Highway Administration. This is not the sole source of funding for Michigan local-agency-owned bridges nor has it traditionally been enough to fund all project funding requests. For example, for fiscal year 2026 bridge projects, Michigan Local Agency Program Bridge Unit had received $469,698,345 in funding applications (MDOT LAP Bridge Unit, 2023) and was able to select only $126,672,345 in projects (MDOT LAP Bridge Unit, 2023).

Of the 88 submitted transportation asset management plans, 78 plans included planned annual project spending and 10 did not. These 78 plans encompass 4,341 local-agency-owned bridges of which 4,071 are owned by county agencies and 270 are owned by large city agencies. The planned annual project spending used from the plans ranged from two to nine years into the future. The total planned spending in each project category type was converted to an annual planned spending amount and is summarized in Table 5 by agency type. The overall planned annual spending on bridges for the submitted county and large city agency plans was $92,901,056 and does not include unfunded (gap) projects.

Table 5: Planned Annual Bridge Spending from Plans

Bridge Owner	Replacement Only	Replacement and Rehabilitation	Rehab Only	Scheduled Maintenance	Preventive Maintenance	Total Bridges from Plans
County	$ 55,459,105	$ 4,836,750	$ 13,046,030	$ 597,970	$ 7,489,207	4,071
Large City	$ 3,444,711	$ 0	$ 5,211,393	$ 370,000	$ 2,445,890	270
Total	$ 58,903,816	$ 4,836,750	$ 18,257,423	$ 967,970	$ 9,935,097	4,341

The planned annual spending per bridge was calculated by dividing the overall planned annual spending by the total bridges from the plans. This annual planned spending measure shows how much money could be devoted to each bridge, *not* how much each bridge project costs. The planned annual spending per bridge is shown in Table 6 by agency type and was used to determine the statewide planned annual spending estimate.

Table 6: Planned Annual Spending per Bridge

Bridge Owner	Replacement Only	Replacement and Rehabilitation	Rehab Only	Scheduled Maintenance	Preventive Maintenance
County	$ 13,623	$ 1,188	$ 3,205	$ 147	$ 1,840
Large City	$ 12,758	$0	$ 19,301	$ 1,370	$ 9,059
All Bridges	**$ 13,569**	**$ 1,114**	**$ 4,206**	**$ 223**	**$ 2,289**

The statewide average planned bridge spending estimate for all 83 county agencies and the 39 large city agencies was found to be $133,100,000 and is summarized in Table 7 by agency type and project category type. The number of bridges that each agency owned was taken from the submitted plans. The number of bridges owned by agencies that did *not* submit a plan was determined from the Michigan Department of Transportation National Bridge Inventory database (MDOT, 2023). There are a total of 6,228 county and large city agency owned bridges included in this statewide annual planned spending estimate.

Table 7: Statewide Average Annual Planned Bridge Spending Estimate by Network Type

Bridge Owner	Replacement Only	Replacement and Rehabilitation	Rehab Only	Scheduled Maintenance	Preventive Maintenance	Statewide Network Size
County	$ 79,600,000	$ 6,900,000	$ 18,700,000	$ 900,000	$ 10,700,000	5,843
Large City	$ 4,900,000	$ 0	$ 7,400,000	$ 500,000	$ 3,500,000	385
Total	**$ 84,500,000**	**$ 6,900,000**	**$ 26,100,000**	**$ 1,400,000**	**$ 14,200,000**	**6,228**

Asset Inventory and Condition Findings

Knowing inventory and condition data is a critical first step in maintaining any asset. Condition data can be used to assist with goal setting, network modeling, and project planning.

Pavement Assets

Michigan local agencies were required to collect and report condition data on the federal-aid network, and there was limited funding available to collect data on the non-federal-aid network. The federal-aid classification is based on different criteria than the primary/major classification, however both classifications contain many of the same roads. Condition data collection funding was administered through the TAMC to collect data annually using the Pavement Surface Evaluation and Rating (PASER) system for paved roads and the Inventory-based Rating (IBR) System™ for unpaved roads. The TAMC defines “good” as a rating of 8 to 10, “fair” as a rating of 5 to 7, and a “poor” rating as 1 to 4.

Of the 88 submitted transportation asset management plans, 86 plans reported centerline miles by condition on the paved primary/major network, 85 plans reported centerline miles by condition on the paved local network category, and 56 plans reported centerline miles by condition on the unpaved network category. The percentage of miles in the TAMC good, fair, and poor categories are shown below in Table 8 for the county agency plans and large city agency plans. The plans that reported condition summaries in lane miles were converted to centerline miles. The small city agencies that were not required to submit plans are not included in Table 8 but can be found in Appendix A – Pavement Plan Data. The plans that used their own rating definitions of good-fair-poor were not included in the good, fair, and poor summary. The total centerline miles breakdown by agency type is summarized in Appendix A – Pavement Plan Data.

Table 8: 2020-2022 Road Condition Data Summary by Network Type

Road Network[1]	Good	Fair	Poor	Percent of Network Rated in Submitted Plans	Percent of Statewide Network Rated in Submitted Plans
County Paved Primary	27%	35%	38%	99.9%	71.3%
Large City Paved Major	24%	37%	39%	94.7%	62.9%
County Paved Local	20%	30%	50%	95.8%	70.2%
Large City Paved Local	14%	41%	46%	91.7%	61.3%
County Unpaved	28%	44%	27%	28.6%	19.1%
Large City Unpaved	17%	59%	24%	51.0%	51.0%

All plans had their entire or almost-entire paved primary/major network condition data in their plans. Five plans (four county agencies and one large city agency) did not include condition data for the *entire* paved local network. Ten plans (five county agencies and five large city agencies) included their *entire* unpaved network condition data. Collectively, in terms of the paved primary/major network, this condition data represented 71.3 percent for statewide county agency networks and 62.9 percent for statewide large city agency networks. Similarly, in terms of the paved local network, this condition data represented 70.2 percent for statewide county agency networks and 61.3 for statewide large city networks. For the unpaved network, this condition data represented 19.1 percent of statewide county agency networks, and 51.0 percent for large city agency networks.

Bridge Assets

It is a Federal Highway Administration requirement that *all* bridges on public roads be inspected using the National Bridge Inventory Standards (United States, Federal Highway Administration,

[1] The network good-fair-poor percentage totals may not add up to 100% due to rounding.

2022). The National Bridge Inventory Standards define “good” as a rating of 7 to 9, “fair” as a rating of 5 to 6, and a “poor” rating as 0 (zero) to 4. Through this effort local agencies have condition data on nearly all of the bridges that they own. There was one agency that did not have condition data on two of their bridges that they owned. Over 94 percent of the local-agency-owned bridges from the plans are owned by county agencies. The condition data is summarized by agency type in Table 9 and in Appendix B – Bridge Plan Data.

Table 9: 2020-2022 Bridge Condition Summary by Network Type

Bridge Network	Good	Fair	Poor	Structural Deficient	Load Posted	Closed
County	43%	42%	15%	554	615	39
Large City	50%	39%	11%	20	26	4

Culvert Assets

Culverts and traffic signals (see below) were identified in Public Act 325 of 2018 as additional assets that the legislature shall be advised on. The Michigan TAMC *Policy for Submittal and Review of Asset Management Plans for Roads, Bridges and Transportation Infrastructure* stated that “road agencies were only required to include a short description of the current status of these two assets within the agency” (Michigan Transportation Asset Managment Council, 2023). The TAMC template provided placeholders for basic inventory and condition fields that could be filled out by local agencies. The number of culverts that were inventoried, the number of culverts that were rated, and the total culverts owned were collected from the plans.

Of the 88 submitted transportation asset management plans, 64 plans listed the total count of culverts they owned. The 45 county agency plans reported a total of 104,552 culverts, the 19 large city agency plans reported a total of 2,837 culverts, and the small city agency plans reported no culverts.

There were 80 plans that included at least an estimated total of culverts owned, so a percentage of their culverts inventoried could be determined along with a percentage of culverts inventoried and rated. These plans include the 19 plans that stated they owned culverts but did not inventory any yet so their inventoried percentage was zero. These plans do *not* include the three plans that stated they did not own any culverts.

Of the plans that had inventoried their culverts, the average percentage of total culverts inventoried was 58 percent and the median value was 84 percent. These plans included 32 plans with all of their culverts inventoried, 24 with a portion of their culverts inventoried, and 24 plans with no culverts inventoried.

Of the plans that had inventoried and rated their culverts the average percentage of total culverts inventoried and rated was 34 percent and the median value was zero percent. These plans included 16 plans with all of their culverts inventoried and rated, 18 plans with a portion of their culverts inventoried and rated, and 46 plans with no culverts inventoried and rated. The remaining results are broken down by agency type and shown in Figure 1, Figure 2, and Appendix C – Transportation Asset Management Plan Data.

The average of the percent of culverts inventoried by plan submission year increased from 2020 to 2022 each year as shown in Table 10. The plans submitted in 2019 and 2023 have a small sample size of two plans and one plan respectively, with an average percent of culverts inventoried of 100 percent and zero percent respectively.

Table 10: Percent of Culverts Inventoried by Plan Year

Plan Submission Year	Plan Count	Average Percent of Culverts Inventoried
2020	29	32%
2021	27	40%
2022	29	57%

A statewide estimate was determined by extrapolating the total reported number of culverts from the plans for the rest of the agencies that did not submit a plan or did not have an estimated culvert total. The statewide estimate of total culverts was 198,600 for the 83 counties and 39 large cities. The total county agency culvert estimate was 192,800 and the total large city agency culvert estimate was 5,800. This statewide estimate was derived from 64 agencies, which includes the three large city agencies that did not own any culverts. It should be noted that the T-shaped outlier lines on all the scatter box plots in this report are drawn at the last data point that was inside the outlier distance. The outlier distance was defined as 1.5 times the distance between the first and third quartile lines on these plots.

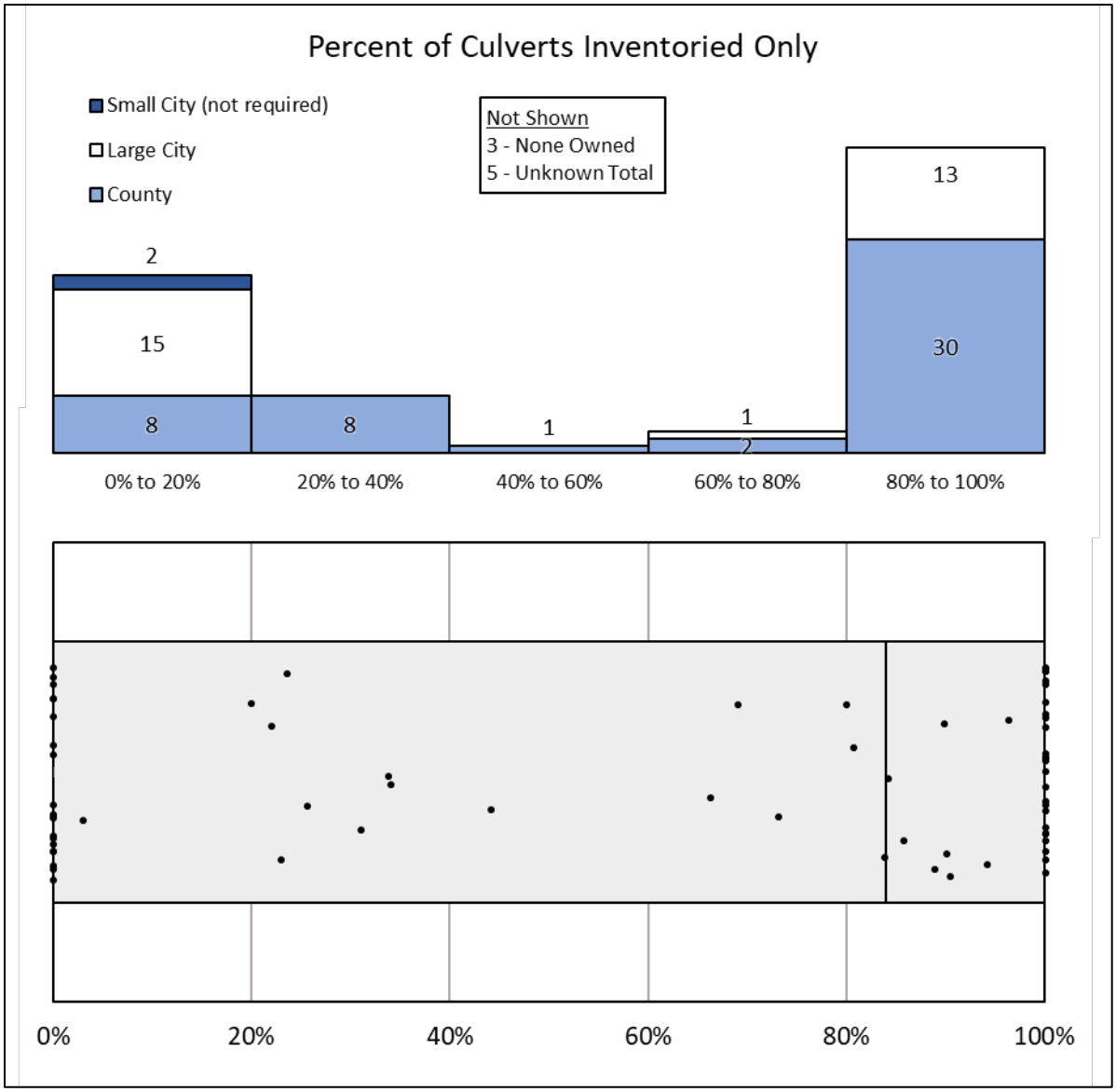


Figure 1: What percentage of culverts are inventoried?

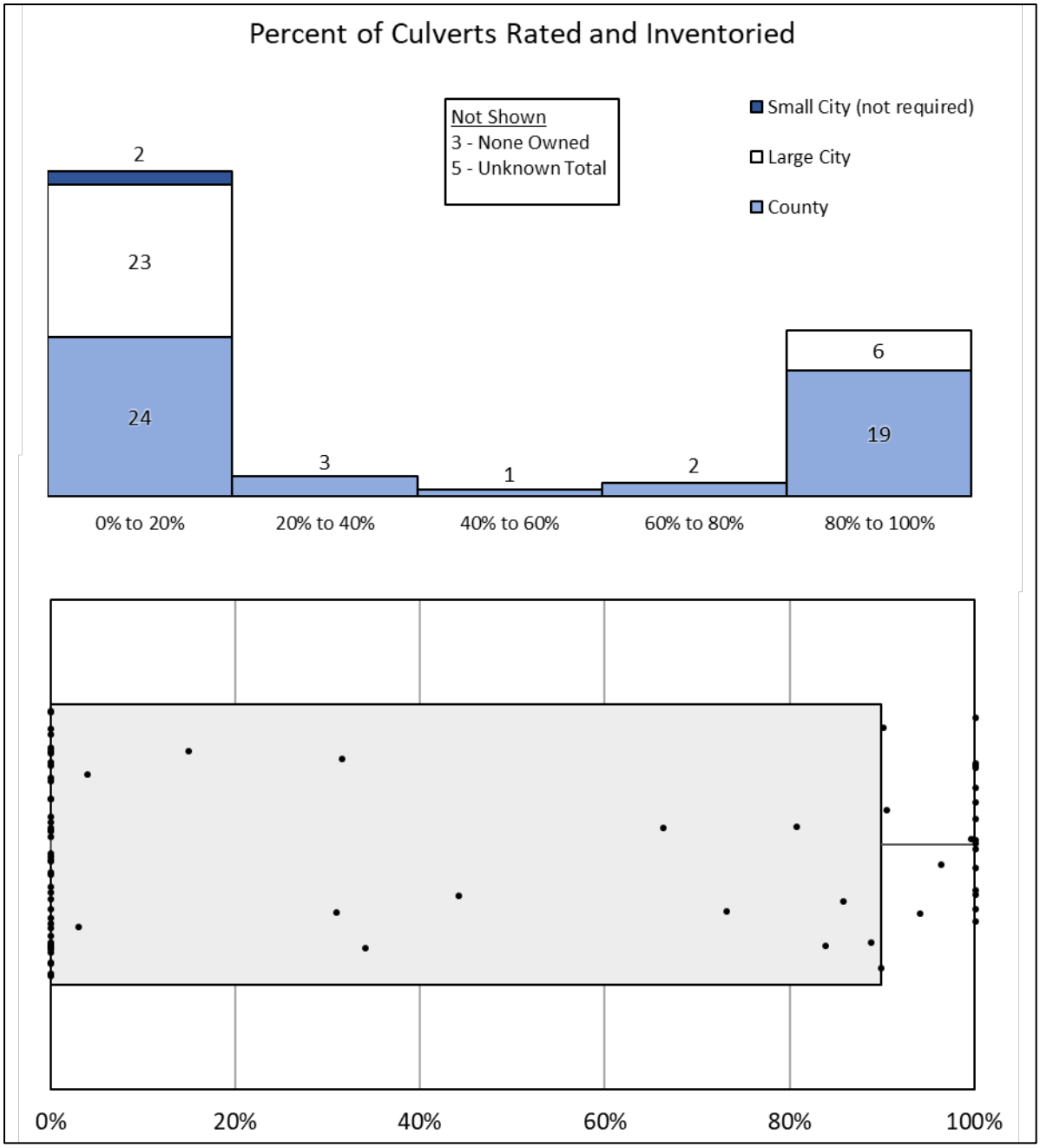


Figure 2: What percentage of culverts are rated and inventoried?

Signal Assets

Like culverts, the TAMC template provided placeholders for basic inventory fields for signals to be filled out by local agencies. Of the 88 submitted transportation asset management plans, 76 plans provided a total number of signals, either inventoried or not inventoried. The 51 county agency plans reported 4,147 signals, the 24 large city agency plans reported 1,857 signals, and

the 1 (one) small city agency plan reported no signals. There was 1 (one) county agency that owned 12 signals but did not inventory them because they were maintained by another agency. The average number of signals owned was 91 with 31 agencies not owning any signals and 1 (one) agency owning the highest amount at 1,490 signals. The results are summarized by agency type in Figure 3 and Appendix C – Transportation Asset Management Plan Data.

Using the number of signals owned from these 76 plans, a statewide estimate was determined by extrapolating the totals for the rest of the agencies that did not submit a plan or did not have a signal total. The statewide estimate of total signals was 8,900 for the 83 counties and 39 large cities.

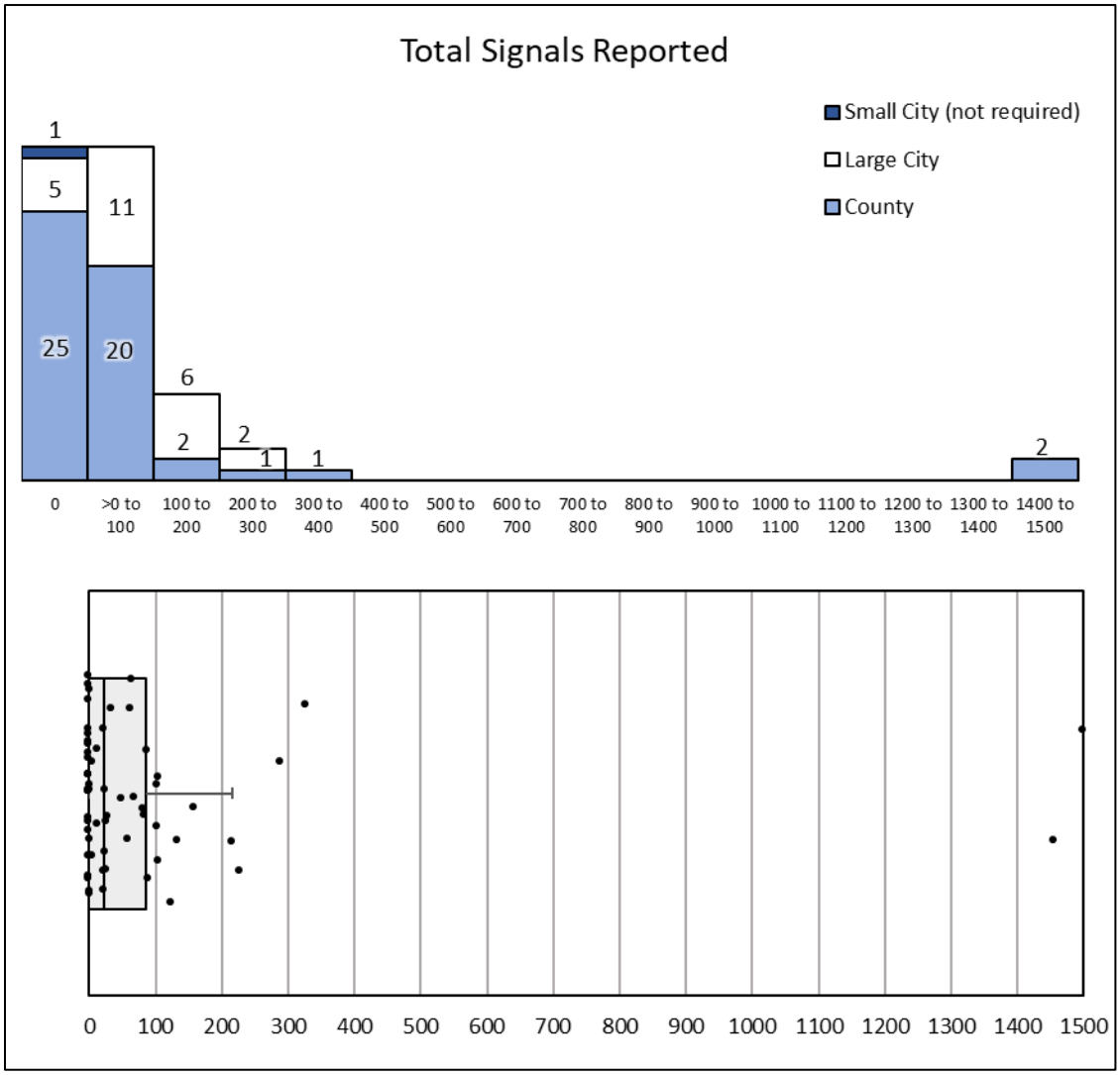


Figure 3: How many total signals are reported?

Modeling Findings

Pavement

Modeling is a key part of identifying the future spending needs for a road network. The asset management plan templates had options for modeling pavement trends using the National Center for Pavement Preservation (NCPP) quick check method and the Roadsoft pavement condition forecast method. Roadsoft was the most common method of predictive modeling used in the pavement asset management plan. Of the 88 plans that were reviewed, 54 percent used only Roadsoft, 23 percent used only the NCPP method, 15 percent used Roadsoft along with the NCPP method, 7 percent did not identify the method of predictive modeling they used, and 1 (one) percent did not perform predictive modeling. Notably, the county agency that did not perform predictive modeling had set a goal to use Roadsoft to perform their modeling in the future. The results of the methods of predictive modeling is shown in Figure 4. Nonetheless, it was found that 86 plans mentioned using Roadsoft in some capacity at their agency while 2 plans did not specifically list the pavement management software they use.

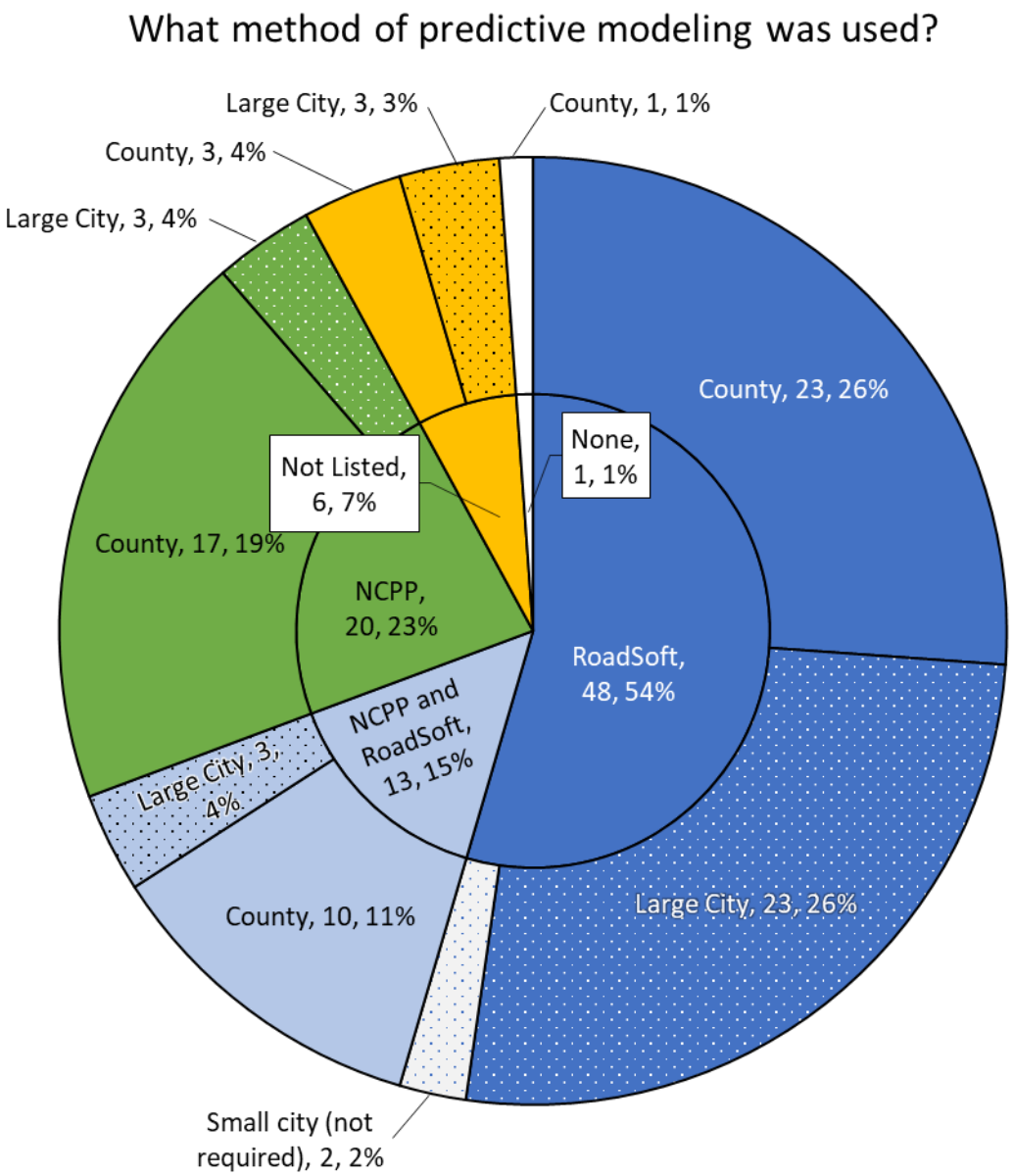


Figure 4: What method of predictive modeling was used?

Performance Goals and Outcomes Findings

It is a requirement of Public Act 325 of 2018 to have performance goals, performance outcomes, and an explanation of any funding shortfalls or gaps in reaching performance goals. The condition forecasts were based on the goals that the local agencies set in their plans and

were not necessarily based on the funding levels they actually had available. Guidance in the training was given to set goals as aspirational yet attainable. Local agencies were to set goals to meet their needs.

Pavement Performance Goals and Outcomes

Of the 88 submitted and reviewed plans, the goals for the paved primary/major network consisted of 24 plans to "improve" conditions, 52 plans to "improve or maintain" the current conditions, 10 plans to "maintain" the current conditions, 1 (one) plan with no condition goal, and 1 (one) plan with no major roads in the road network (this was for a small city agency not required to submit a plan). The goals for the paved local network consisted of 19 plans to "improve" conditions, 51 plans to "improve or maintain" the current conditions, and 8 plans to "maintain" the current conditions. The goals for the unpaved network consisted of 4 plans to "improve" the conditions, 37 plans to "improve or maintain" the current conditions, and 21 plans to "maintain" the current conditions.

The county agency and large city agency networks are summarized in Table 11. The remaining goals along with the breakdown by agency type is listed in Appendix A – Pavement Plan Data. The plans that did not have a stated goal were marked as "not listed", and the plans that did not include the network type were marked as "not-applicable" (or "N/A").

Table 11: Pavement Condition Goals by Network Type

Road Network	Improve	Improve or Maintain	Maintain Current Condition	Other	Not Listed	N/A
County Paved Primary	10	36	8	0	0	0
Large City Paved Major	14	16	1	0	1	0
County Paved Local	8	33	7	2	3	1
Large City Paved Local	11	18	1	0	1	1
County Unpaved	2	28	17	1	4	2
Large City Unpaved	2	9	4	2	3	12

The county agencies had plans showing they would be able to meet 37 of their goals and not meet 66 of their goals. The large city agencies had plans showing they would be able to meet 37 of their goals and not meet 17 of their goals. The remaining plans either did not provide a condition trend or did not set goals for that network type. The condition trend indication on whether the county and large city agencies would accomplish their network goals are summarized in Table 12. For small city agencies not required to submit plans, the condition trend indications on if they would accomplish their goals are included in Appendix A – Pavement Plan Data.

Table 12: Pavement Condition Trends Indicate Accomplishing Goal

Road Network	Goals Met	Goals Not Met	Not Listed	N/A
County Paved Primary	26	26	2	0
Large City Paved Major	22	6	4	0
County Paved Local	9	35	9	1
Large City Paved Local	15	11	5	1
County Unpaved	2	5	45	2
Large City Unpaved	0	0	20	12

The overall condition forecasting for the paved primary/major network had a more positive trend then the paved local condition trend forecast. Of the 76 plans that provided a forecast of the future condition of their paved primary/major network, there were 62 percent showing the condition improving, 18 percent showing the condition staying the same, and 20 percent showing the condition declining. Of the 70 plans that provided a forecast of the future condition of their paved local network, there were 47 percent showing the condition improving, 11 percent showing the condition staying the same, and 41 percent showing the condition declining. Only one plan included a forecast of their unpaved network condition.

The plan count breakdown of condition forecast outcome by agency type is shown in Table 13 and is listed in Appendix A – Pavement Plan Data.

Table 13: Pavement Condition Forecast Outcome Plan Count

Road Network	Improve	Maintain	Decline	Not Listed	N/A
Paved Primary/Major	47	14	15	10	2
Paved Local	33	8	29	9	9
Unpaved	1	0	0	72	15

Plans did not always provide a surplus or shortfall for each network relative to their goals. Of the 81 plans with a stated performance outcome for the paved primary/major network, 20 percent showed a surplus, 23 percent showed they met their goal, and 57 percent showed a deficit. Of the 71 plans with a stated performance outcome for the paved local network, 6 percent showed a surplus, 18 percent showed they met their goal, and 76 percent showed a deficit. All 7 plans with a stated performance outcome for the unpaved network showed a deficit. The performance outcomes in the submitted and reviewed plans are shown in Table 14 by network type and in Appendix A – Pavement Plan Data by agency type.

Table 14: Surplus or Shortfall Count for Each Road Network Relative to the Goal

Road Network	Surplus	Met Goal	Deficit	Not Listed	N/A
Paved Primary/Major	16	19	46	6	1
Paved Local	4	13	54	8	9
Unpaved	0	0	7	46	35

In terms of reporting surplus/shortfall, 29 plans provided their surplus/shortfall in dollars and 26 provided it in mile-years. The plans that used dollars were equalized by comparing to their annual planned project spending, and the plans that used mile-years were equalized by comparing to the amount of centerline miles in each network type. The results are shown in Figure 5 by agency type and network type for the county and large city agencies. The unpaved network was removed from Figure 5 and the vertical axis was zoomed in for readability, however some outlier data points are outside the axis limits and are not shown. A chart of the complete data set can be seen in Appendix A – Pavement Plan Data.

The overall average surplus/shortfall for the paved primary/major network was a shortfall of 40 percent, the paved local network was a shortfall of 150 percent, and the unpaved network was a shortfall of 436 percent. There was 1 (one) small city agency that had a shortfall of 631 percent for their paved local network which is not shown in Figure 5. The average surplus/shortfall for each network and agency type is shown in Table 15 along with an estimated annual statewide funding gap.

Table 15: Average Surplus/Shortfall by Road Network

	Paved Primary/Major	Paved Local	Unpaved
County*	-53%	-210%	-436%
Large City*	-16%	-11%	N/A
Small City (not required)*	N/A	-631%	N/A
Avg Surplus/Shortfall	-40%	-150%	-436%
2020-2022 Statewide Average Annual Planned Project Estimate	$ 613,500,000	$ 351,900,000	$ 55,100,000
Plans with Gap Listed	19	32	2
Plans with No Gap	36	16	0
Percent of Plans with a Gap	34%	67%	100%
2020-2022 Statewide Average Annual Gap Estimate**	$ 257,700,000	$ 370,300,000	$ 240,200,000

**Only includes plans that contain surplus/shortfalls with dollar or lane-mile amounts*

***See Table 27 for summary by agency type*

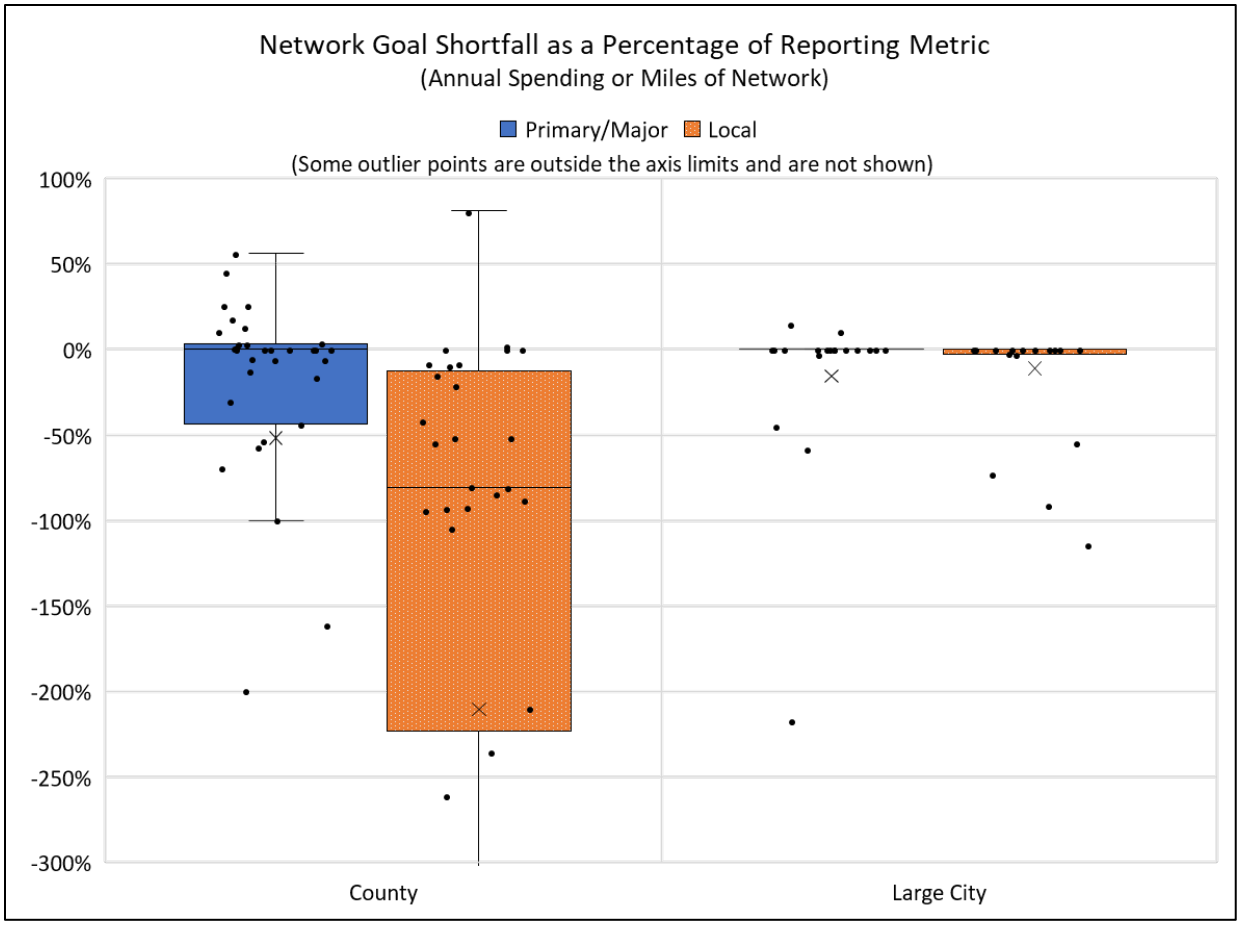


Figure 5: Network Goal Shortfall as a Percentage of Reporting Metric

Bridge Performance Goals and Outcomes

Bridge condition is traditionally much more stable than road condition just due to the fact that bridges are generally built to last five to ten times longer than roads. This makes goal setting for bridges a bit more simplified because the condition is much more stable over time. The bridge network goal to “improve” the network condition was found in 41 plans, “maintain or improve” the existing conditions in 1 (one) plan, and “maintain” the existing conditions in 39 plans; 1 (one) plan had no goal. The results are shown in Table 16 and Figure 6, and is summarized by agency type in Appendix B – Bridge Plan Data. The county agencies had a goal to “improve” their bridge network in 61 percent of their plans. Large city agencies that had a goal to “improve” their bridge network in 33 percent of their plans.

Table 16: Bridge Condition Goal Count by Network Type

Agency Type	Improve	Improve or Maintain	Maintain Current Condition	Not Listed	Nothing Submitted
County	32	1	21	0	29
Large City	9	0	18	1	11
Small City (not required)	0	0	0	0	2

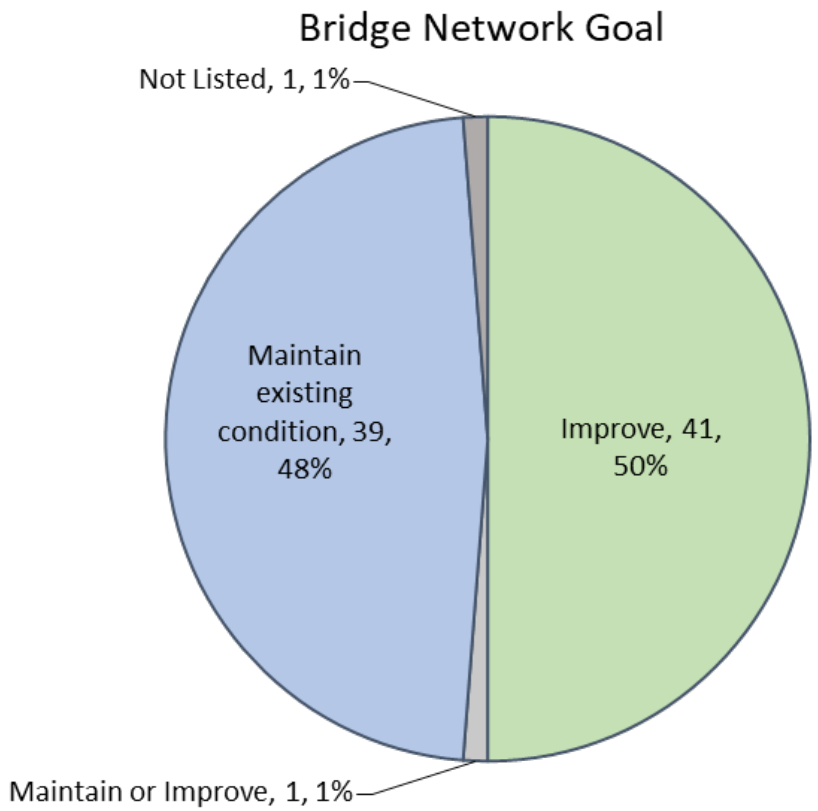


Figure 6: What was the goal for the bridge network?

In terms of performance outcomes, 38 plans showed their condition trend would accomplish their goals, 8 plans showed they would accomplish most of their goals, 12 plans showed they would accomplish some of their goals, 5 plans showed they would not accomplish their goals, 9 plans were uncertain, and 10 plans did not list their condition trends. The results are summarized by agency type in Table 17 and Appendix B – Bridge Plan Data. Of the county agency plans with condition trends, 51 percent indicated they would accomplish all of their goals and 77 percent of the large city agency plans indicated they would accomplish all of their goals.

Table 17: Bridge Performance Outcome Count—Indication of Whether Goal Would Be Accomplished

Agency Type	Yes	Most	Some	No	Uncertain	Not Listed	Nothing Submitted
County	21	6	10	4	9	4	29
Large City	17	2	2	1	0	6	11

Of the 88 submitted transportation asset management plans, 59 plans included an annual bridge revenue and expense summary and 24 plans did not. Of the 59 plans with an annual bridge revenue and expense summary, 24 plans had a dollar volume of unfunded (gap) projects listed while 35 plans had no gap in funding needs. The unfunded dollar volume is listed in Table 18 and the unfunded project types are listed in Table 19, and in Appendix B – Bridge Plan Data.

For the 24 plans with unfunded (gap) projects, the 2020-2022 average annual planned spending gap (or need) was $3,670,125 per plan. This gap was extrapolated to estimate a 2020-2022 statewide average annual planned spending gap of $199,400,000 for local-agency-owned bridges. For county agencies with a funding gap (56 percent of the county agencies), the average annual funding gap was $4,108,050. For large city agencies with a funding gap (17 percent of the large city agencies), the average annual funding gap was $1,480,500.

Table 18: Unfunded (Gap) Dollar Volume Estimate for Bridges

	County Bridges	Large City Bridges	Overall Bridges
2020-2022 Avg Annual Funding Gap of Plans with Gap Listed	$ 4,108,050	$ 1,480,500	$ 3,670,125
Plans with Gap Listed	20	4	24
Plans with No Gap	16	19	35
Percent of Plans with a Gap	56%	17%	41%
2020-2022 Statewide Average Annual Gap Estimate	$ 189,400,000	$ 10,000,000	$ 199,400,000

Table 19: Unfunded (Gap) Bridge Project Types

Unfunded Bridge Project	County	Large City	Total
Scheduled Maintenance	1	0	1
Preventive Maintenance	8	2	10
Rehabilitation	8	1	9
Replacement	17	1	18
Removal	0	1	1
Not listed	18	6	24
No Gap	16	19	35

Risk of Failure Analysis Findings

Including a risk of failure analysis in the transportation asset management plan was a requirement of Public Act 325 of 2018.

Pavement Critical Assets

Of the 88 submitted transportation asset management plans, 9 plans stated that they did not have any critical roads in their network, 53 plans provided a list of critical road assets in their network but provided no explanations, 8 plans did not list any critical assets in their risk section, 2 plans had no risk section, and 2 plans stated that all their roads were critical. The remaining 22 plans indicated critical assets with the following explanations: roadway category, geographic divides, emergency alternate routes, limited access areas, main access to key districts, and roads in poor condition. These results can be found in Appendix A – Pavement Plan Data.

Bridge Critical Assets

Of the 88 submitted transportation asset management plans, 9 plans stated that they did not have any critical bridge assets in their network, 21 plans provided a list of critical bridge assets but provided no explanations, and 26 plans had no list of critical bridge assets in their risk of failure section. The remaining plans indicated critical bridge assets with the following explanations: specific bridge category (e.g., primary, high traffic, large, historic), geographic divide, limited access area, main access to key districts, poor condition, and scour critical. These results can be found in Appendix B – Bridge Plan Data.

Coordination Findings

It was a requirement of Public Act 325 of 2018 to describe any coordination with other adjacent jurisdictions and utility owners. Project partnering was defined for this study as the agency partnering with another agency or utility on the same project, which was more than simply requiring a utility relocation because of an upcoming project. Providing advanced notice was defined as the agency conducting a coordinated regularly-scheduled meeting such as an annual or monthly summit to notify utilities of future planned projects well in advance of the construction phase. Finally, coordinating utility and network improvements/maintenance was working with utility owners to plan when was the best time to replace the road or bridge and the utility together.

Of the 88 submitted and reviewed plans, 12 plans stated that they partner with others on projects, 51 plans stated that they provide advanced notice to utilities on future projects, and 67 plans stated that they coordinate utility and network improvements/maintenance. In terms of agency type, 34 of the 54 county agency plans said that they coordinate the utility and network improvements/maintenance, 31 of the 32 large city agency plans said they coordinate

the utility and network improvements/maintenance, and 2 of the 2 small city agency plans said that they coordinate the utility and network improvements/maintenance. The remaining results are summarized by agency type in Figure 7, Figure 8, and Figure 9.

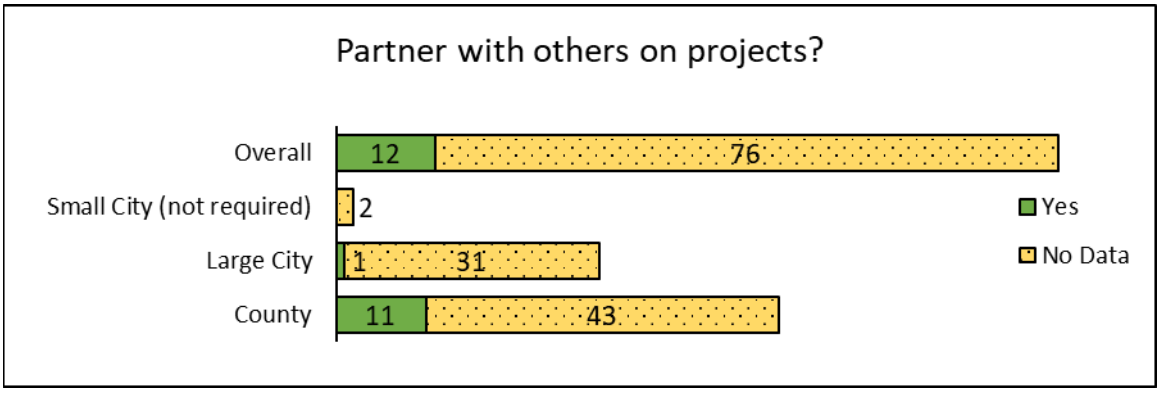


Figure 7: Partner with others on projects?

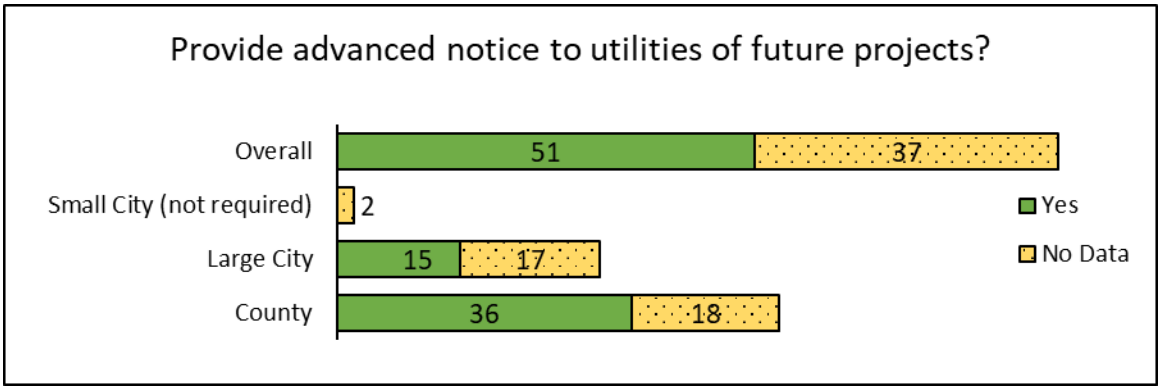


Figure 8: Provide advanced notice to utilities of future projects?

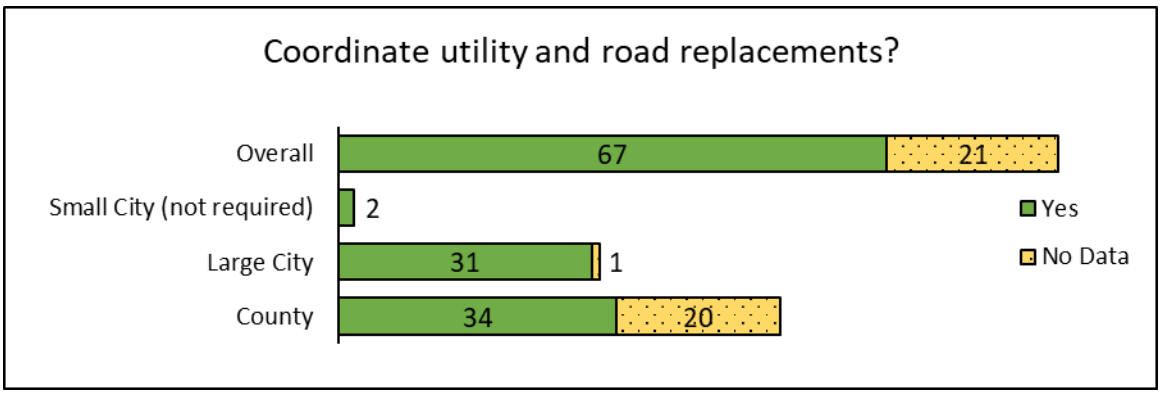


Figure 9: Coordinate utility and road replacements?

Plan and Template Findings

Some general data items were collected on the overall transportation asset management plans as well as on the attached pavement plans and bridge plans. Further investigating the use of the three TAMC asset management plan templates provides data on whether agencies found the templates to be useful tools and whether they went further and adapted it for different needs. The bridge plan template uses a mail-merge tool to populate the template with data and user-selected wording to create a complete customized template while the pavement plan uses a find-and-replace tool to populate the template with data and some user-selected wording to create a customized template with areas requiring additional free writing.

The data item that was globally used across all other data items was the type of agency that submitted the plan.

The transportation asset management plan update cycle was used as the update cycle for the plans without a dedicated pavement or bridge asset management plan.

Transportation Asset Management Plan

For the transportation asset management plans, 60 plans were authored by internal agency staff, 16 plans were authored by consultants, 2 plans were authored jointly by internal agency staff and a consultant, and 6 plans did not list an author. The plan authors are broken down by agency type in Figure 10. Internal staff created 94 percent of the county agency plans, 59 percent of the large city agency plans, and 0 (zero) percent of the small city agency plans that listed out the author and submitted a transportation asset management plan.

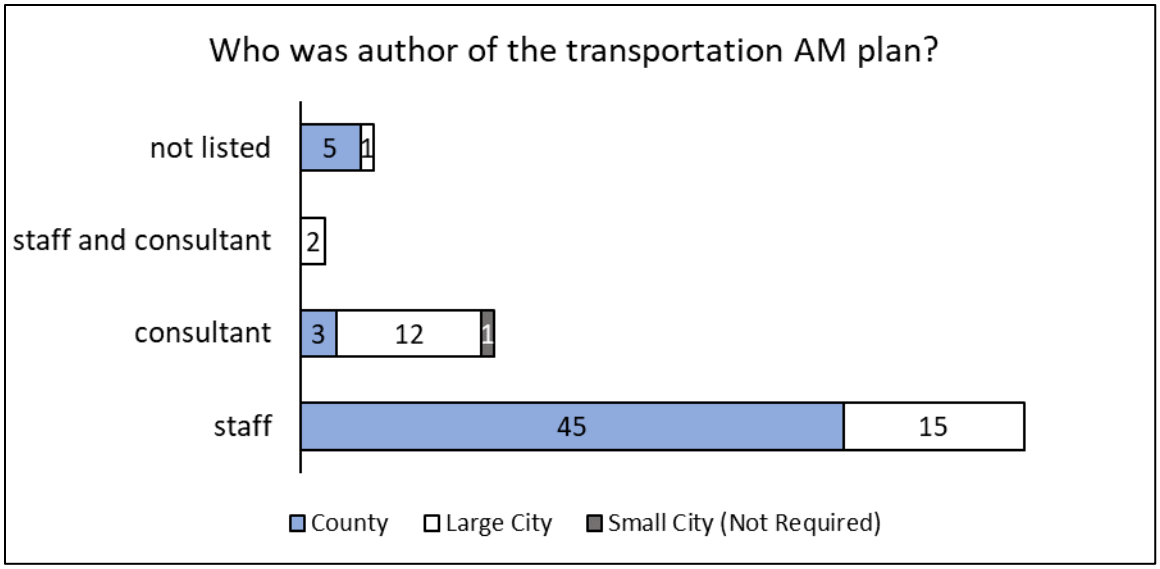


Figure 10: Who was the author of the transportation asset management plan?

Of the 88 submitted plans, 83 plans used the TAMC transportation asset management plan template, 1 (one) plan did not use the template, and 4 plans did not include a transportation asset management plan but only the pavement and/or bridge specific plans. The breakdown by agency type on the use of the TAMC transportation asset management plan template is shown in Figure 11. In terms of agency type, 53 of the 53 (100 percent) county agencies used the TAMC transportation asset management plan template, 29 of the 30 (97 percent) large cities agencies used the template, and 1 of 1 small city agency used the template.

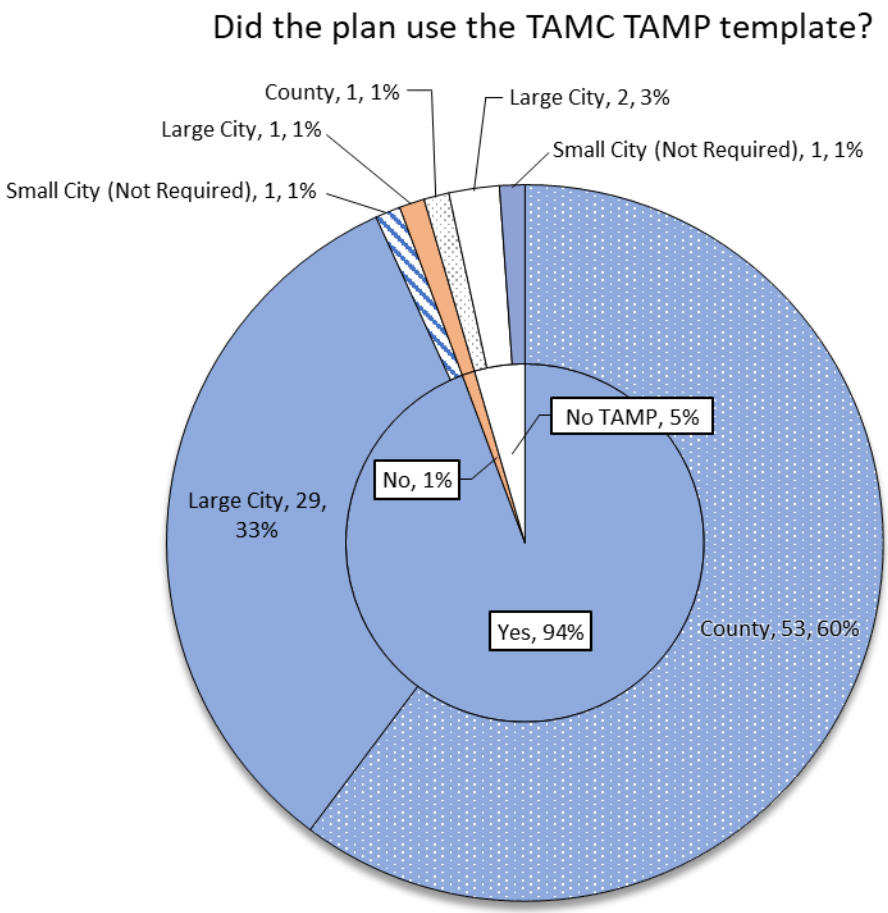


Figure 11: Did the transportation asset management plan use the TAMC template?

Pavement Asset Management Plan

General details about the attached pavement asset management plans were collected in order to add context to other items that were collected. Of the 88 transportation asset management plans, 74 plans had a pavement section and an attached pavement asset management plan and 14 plans had a pavement section but no attached pavement asset management plan. These pavement asset management plans were submitted by 47 county agencies, 25 large city agencies, and 2 small city agencies as shown in Figure 12.

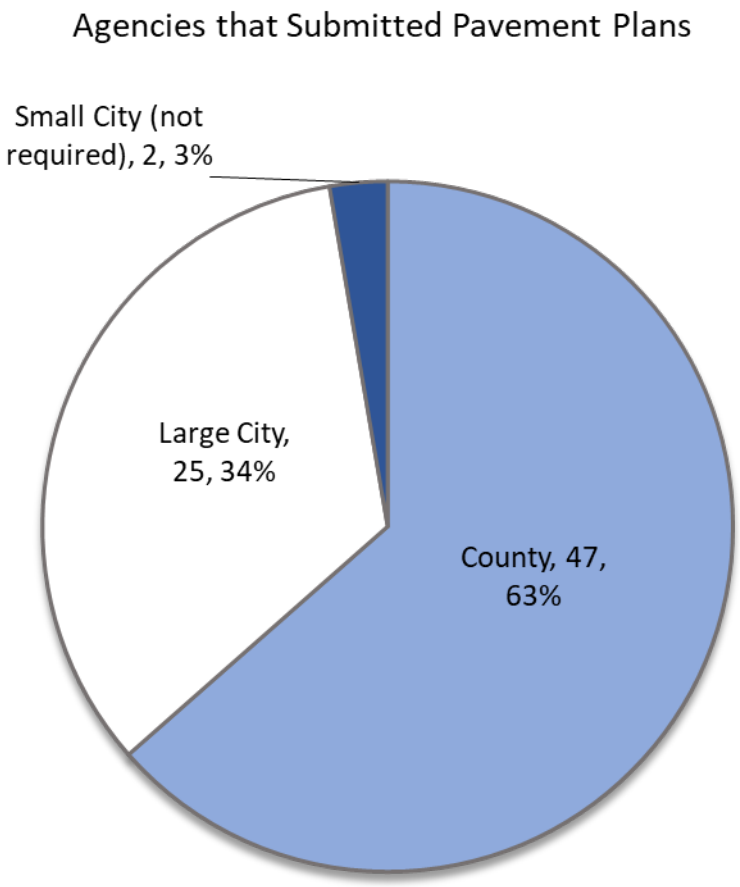


Figure 12: What type of agency submitted the pavement plan?

The update cycle in 80 of the pavement asset management plans was every three years, 3 of the plans was every two years, 4 of the plans was every year, and 1 (one) plan was every five years.

The unaltered pavement plan template was 74 pages (inclusive of redundant content), and the average of all the attached pavement asset management plans was 71 pages. County agencies had an average of 74 pages in their pavement asset management plans, and large city agencies had an average of 68 pages in their plans. The two small city agencies had an average of 42 pages in their pavement asset management plans. The page count included attached appendices. Some plans included many pages of tables and presentation slides to provide additional background details in their plan. The smallest plan size was 12 pages, the largest plan size was 262 pages, and the median plan size was 64 pages. The number of pages in each of the 74 pavement asset management plans is plotted on Figure 13 along with a histogram of this data.

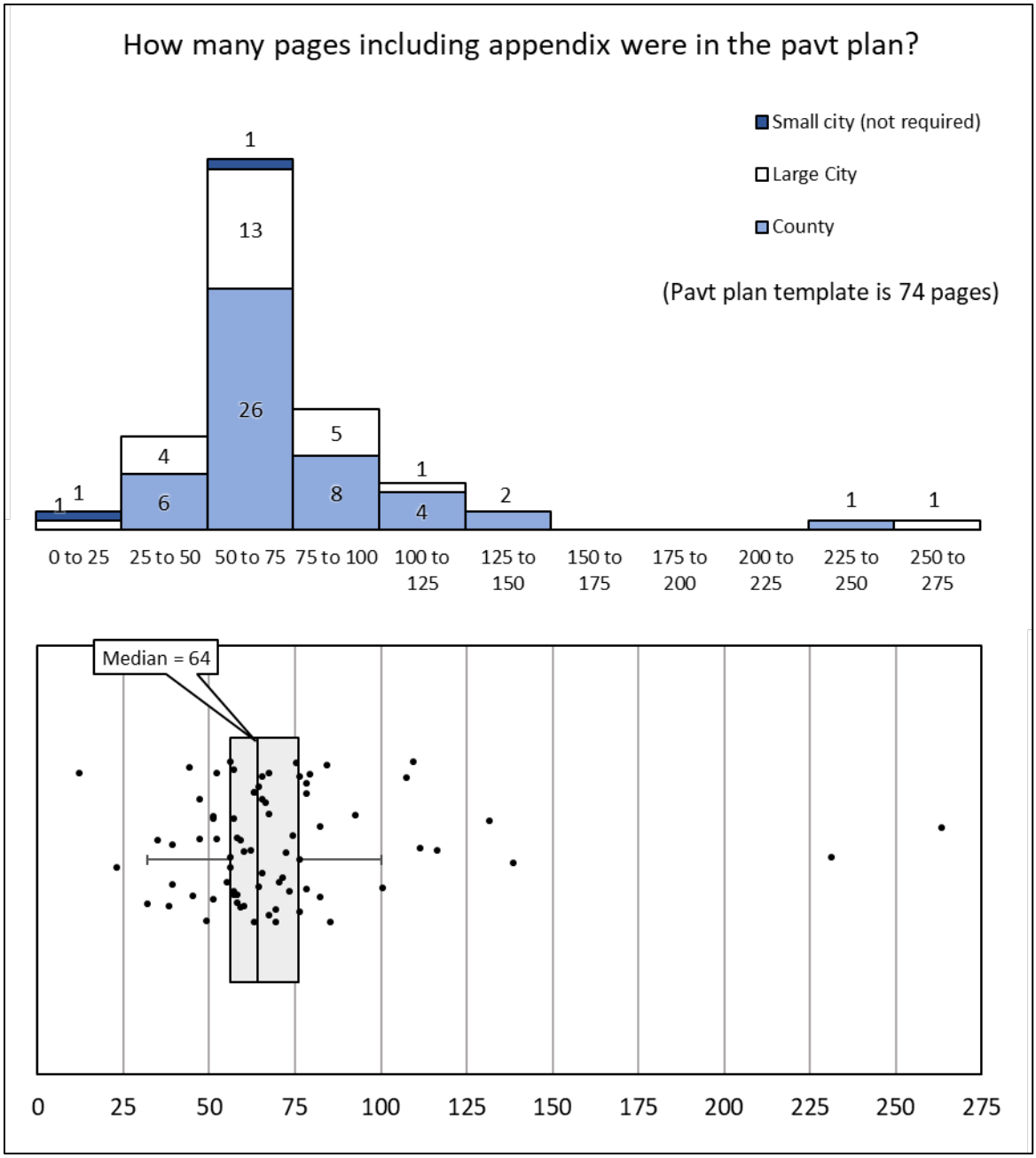


Figure 13: How many pages including the appendix were in the pavement plan?

Of the 74 attached pavement asset management plans, 53 plans were authored by internal agency staff, 15 plans were authored by consultants, 1 (one) plan was authored jointly by internal agency staff and a consultant, and 5 plans were authored by unlisted entities (see Figure 14). In terms of agency type, internal staff created 93 percent of the county agency pavement asset management plans, 56 percent of the large city agency plans, and 0 (zero) percent of the small city agency plans that listed the author.

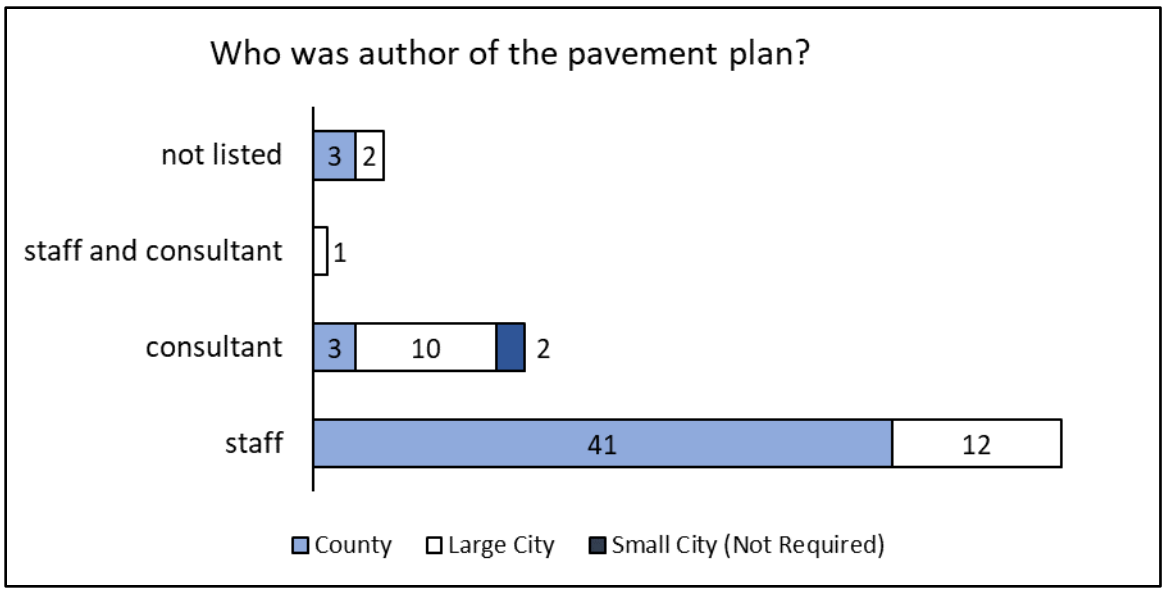


Figure 14: Who was the author of the pavement plan?

Of the 74 agencies that submitted a pavement asset management plan, 68 agencies used the TAMC pavement plan template and 6 did not use it. In terms of agency type, 98 percent (46 of 47) county agencies used the TAMC pavement plan template, 84 percent (21 of 25) large cities agencies used the template, and 50 percent (1 of 2) small city agencies that were not required to submit plans used the template. The breakdown by agency type on the use of the TAMC pavement plan template is shown in Figure 15.

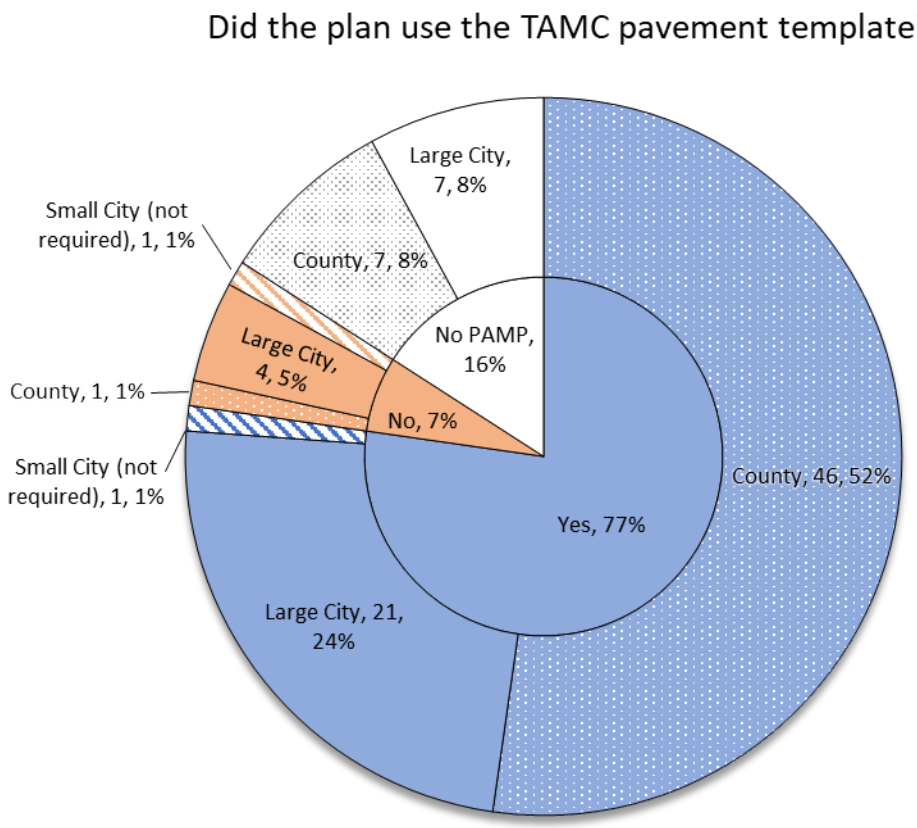


Figure 15: Did the pavement plan use the TAMC pavement template?

The lines of text from the submitted pavement plans were compared to the lines of text in the unedited pavement plan template as a way to quantify how much the plan was customized to fit agencies' needs. An example of the unedited template compared to an agency plan is shown in Figure 16 with a green checkmark being a matching line. Of the agencies that used the pavement asset management plan template, an average of 32 percent of the template text lines were duplicated in the pavement asset management plans. The percentage of the template text lines duplicated in each pavement asset management plan is plotted on Figure 17 along with a histogram of this data. The largest duplication rate was 50 percent, the lowest was 1 (one) percent, and the median was 36 percent. In terms of agency type, county agencies had an average duplication rate of 33 percent, large city agencies had a rate of 30 percent, and the 1 (one) small city agency that used the TAMC pavement template had a rate of 27 percent.

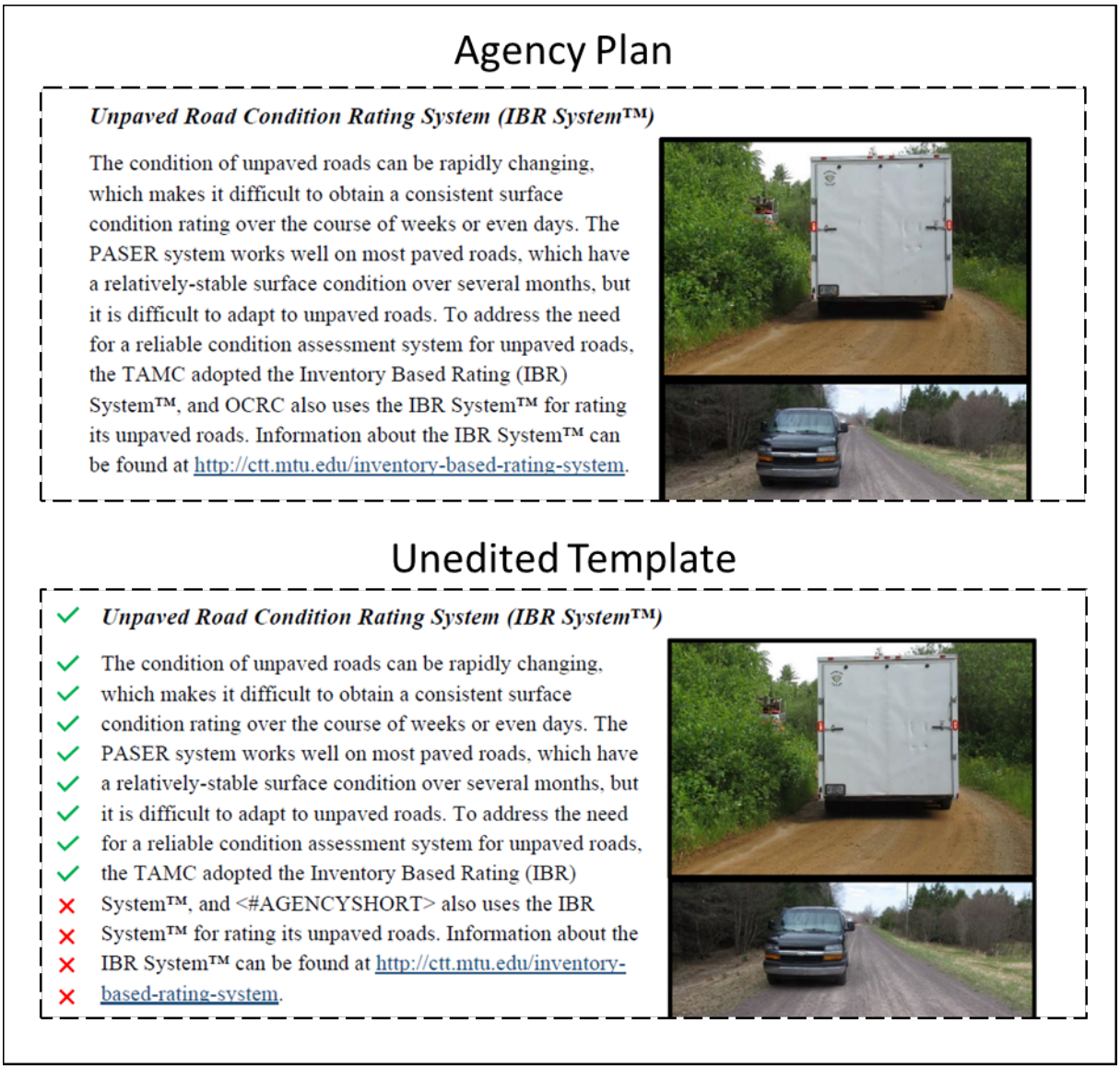


Figure 16: Duplicate Text Line Determination Illustration

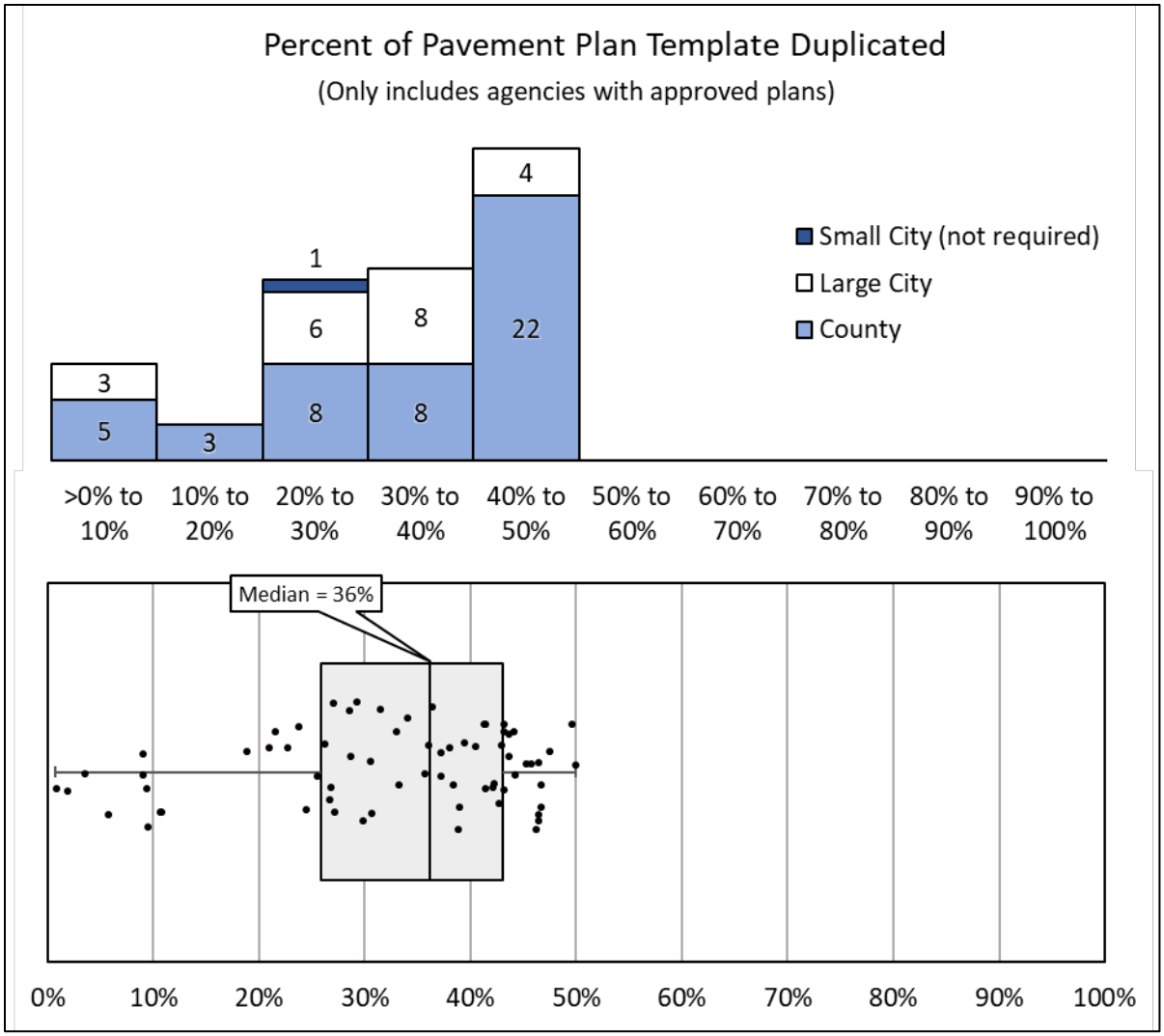


Figure 17: What was the degree of customization of the pavement plan?

Bridge Asset Management Plan

General details about the bridge plans were also collected in order to add context to other items that were collected. Of the 88 submitted transportation asset management plans, 64 plans had an attached bridge asset management plan, 22 plans had a bridge section but did not include an attached bridge asset management plan, and 2 plans had neither a bridge section nor an attached bridge plan.

The update cycle in 71 of the bridge asset management plans was every three years, 4 of the plans was every two years, 1 (one) plan was every year, 1 (one) plan was every four years, and 4 of the plans was every five years.

Of the 64 attached bridge asset management plans, 47 plans were submitted by county agencies and 17 plans were submitted by large city agencies (see Figure 18).

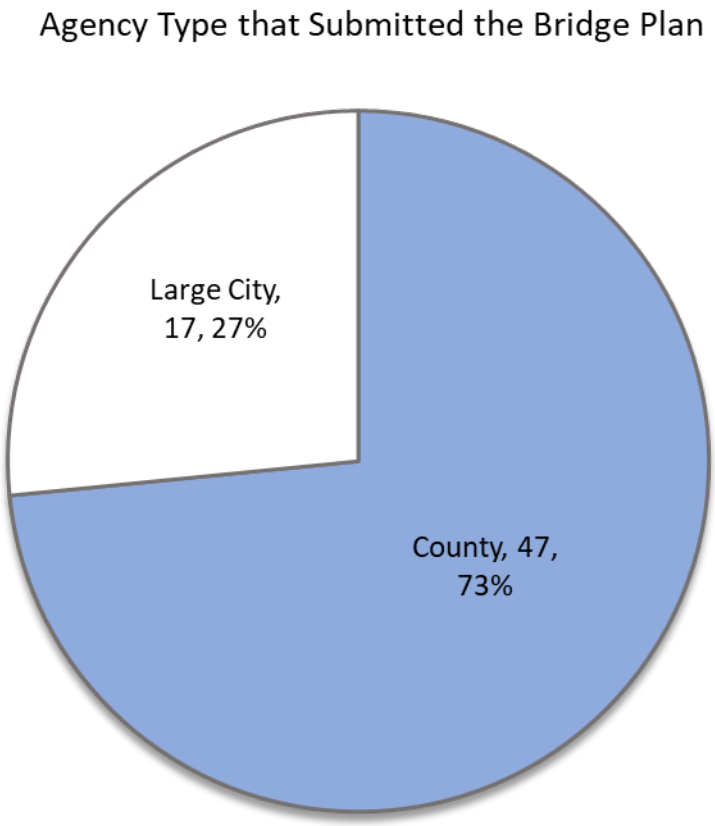


Figure 18: What type of agency submitted the bridge plan?

The unaltered bridge plan template was 38 pages, and the average of all the attached bridge asset management plans was 41 pages. County agencies had an average of 40 pages in their plans, and large city agencies had an average of 43 pages in their plans. None of the small city agencies submitted a bridge asset management plan. The page count included attached appendices. Some plans included many pages of tables to provide additional background details in their plan. The smallest plan size was 11 pages, the largest plan size was 134 pages, and the median plan size was 37 pages. The number of pages in each of the 64 bridge asset management plans is plotted on Figure 19 along with a histogram of this data.

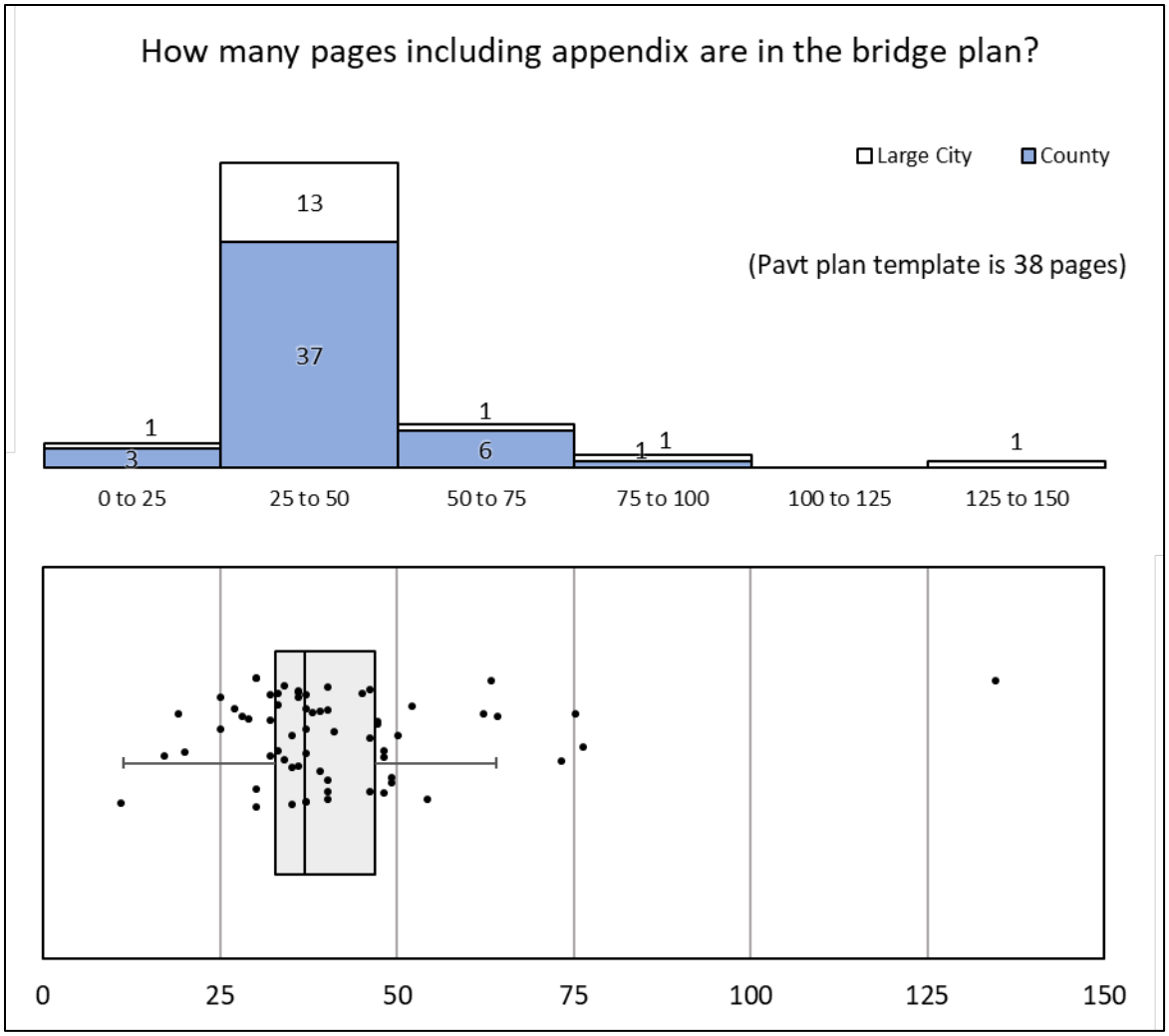


Figure 19: How many pages including the appendix were in the bridge plan?

Of the 64 attached bridge asset management plans, 49 plans were authored by internal agency staff, 10 plans were authored by consultants, and 5 plans were authored by unknown entities. In terms of agency type, internal staff created 91 percent of the county agency bridge asset management plans and 62 percent of the large city agency bridge asset management plans that listed the author. The plan authors are broken down by agency type in Figure 20.

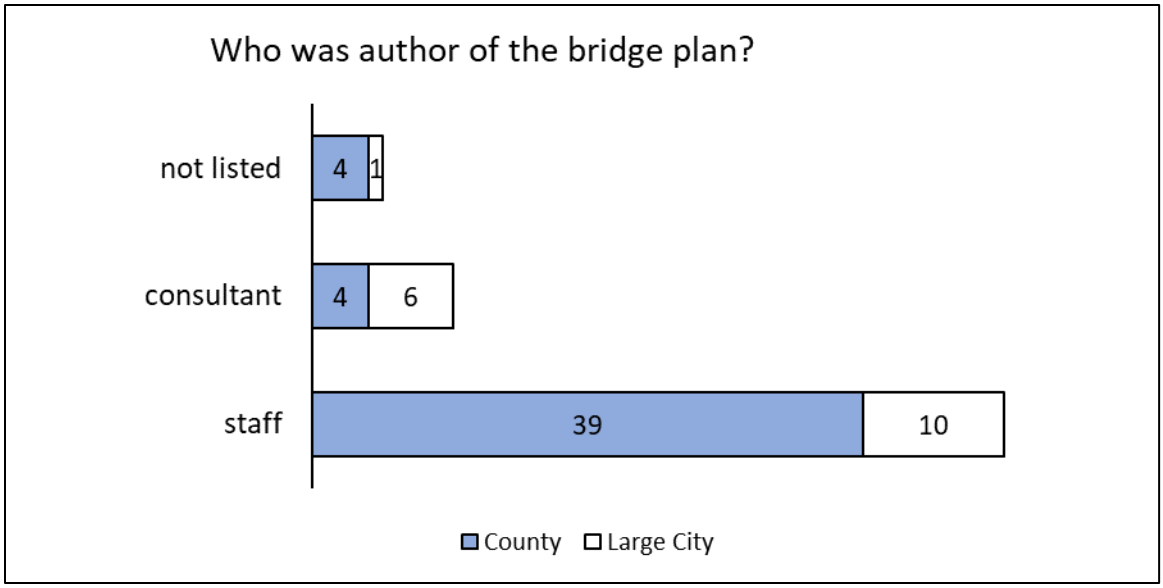


Figure 20: Who was the author of the bridge plan?

Of the 64 agencies that submitted a bridge asset management plan, 62 agencies used the TAMC bridge plan template and 2 did not use it. In terms of agency type, 96 percent (45 of 47) county agencies used the TAMC bridge plan template and 100 percent (17 of 17) large cities agencies used the template. The breakdown by agency type on the use of the TAMC bridge plan template is shown in Figure 21.

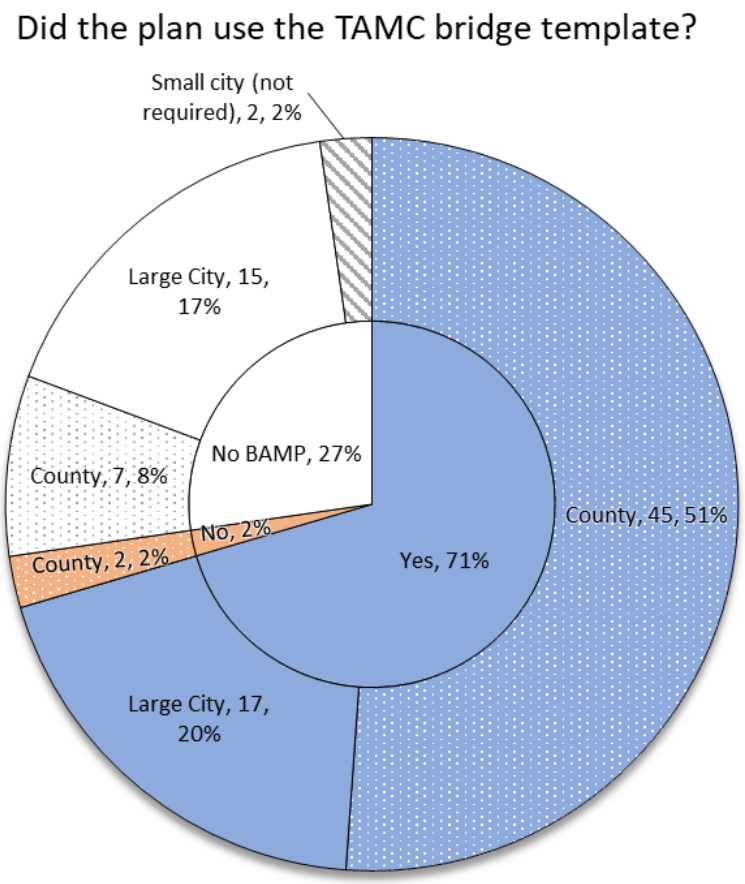


Figure 21: Did the plan use the TAMC bridge template?

The lines of text from the submitted bridge plans were compared to the lines of text in the unedited bridge plan template as a way to quantify how much the plan was customized to fit agencies' needs. Of the agencies that used the TAMC bridge asset management plan template, an average of 45 percent of the template text lines were duplicated in the bridge asset management plans. The percentage of the template text lines duplicated in each bridge asset management plan is plotted on Figure 22 along with a histogram of this data. The largest duplication rate was 70 percent, the lowest was 0 (zero) percent, and the median was 50 percent. In terms of agency type, the county agencies had an average duplication rate of 47 percent and the large city agencies had an average duplication rate of 40 percent.

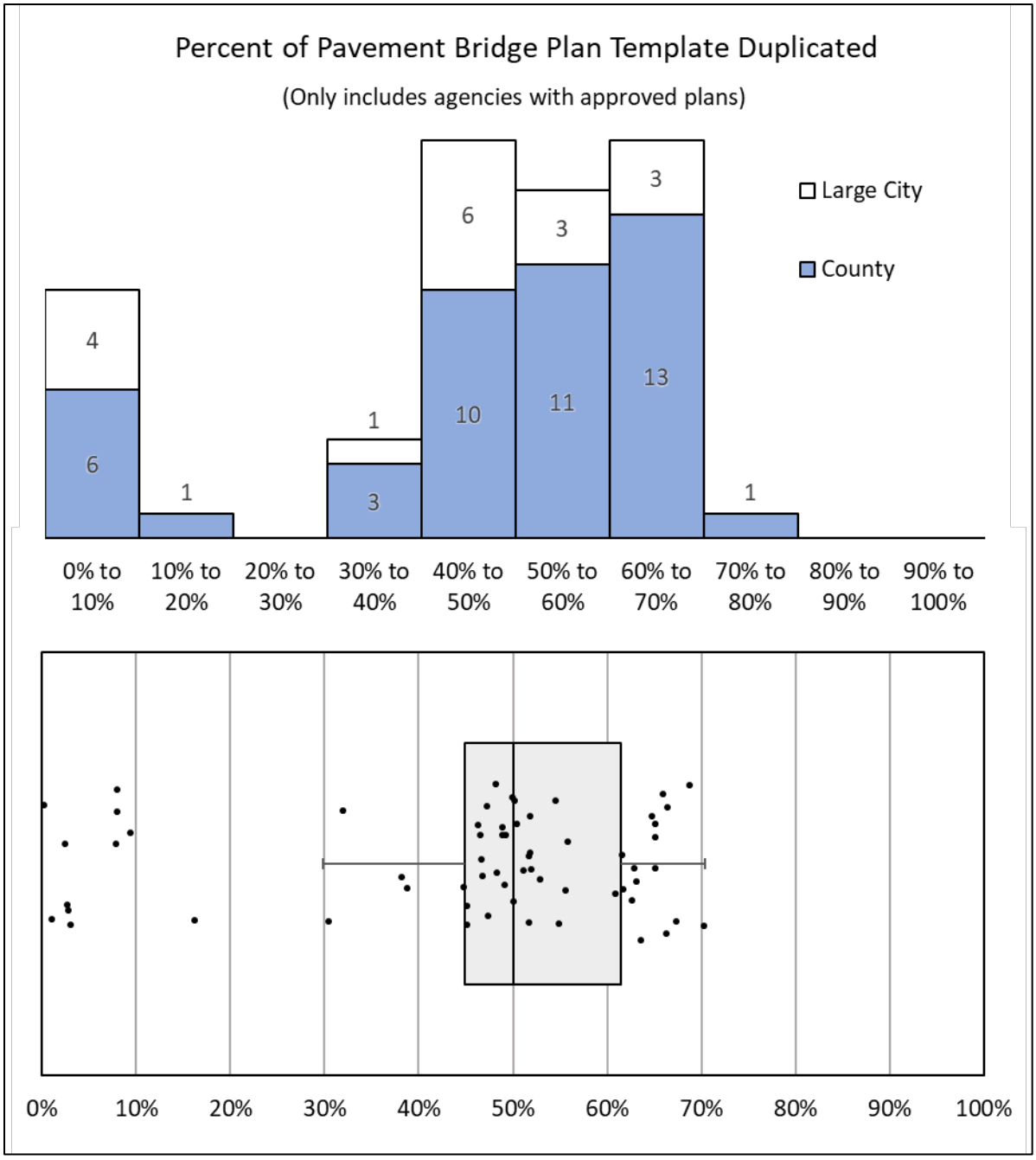


Figure 22: What was the degree of customization of the bridge plan?

DISCUSSION

The transportation asset management plan submission was distributed fairly uniformly during the 2020 through 2022 initial reporting period. It should be understood that the data collected from these plans are not a finite snapshot in time but a three-year average when the data is projected for statewide estimates. Plans were reviewed from 86 of the 122 agencies with 100 or more certified miles of road who were required to submit plans; while this was a very large sample size, at least one very large agency submission was missing from the large city agency type that could potentially influence the 2020-2022 statewide average annual calculations. There were only two local agency plans submitted from agencies who had less than 100 certified miles of road. These small city agencies were not required to submit plans and the sample size was too small to make accurate conclusions from analyzing the data collected.

There were a few findings that merit further discussion and further context in regards to other studies related to Michigan local-agency-owned assets.

The percent of county agencies that submitted plans had a close correlation to the percent of centerline miles represented for the county-maintained networks. By August 3, 2023, 65 percent of the 83 county agencies had submitted plans that covered 64 percent of the county paved primary centerline miles and 63 percent of the county paved local centerline miles. Plans submitted by large city agencies represent 82 percent of the 39 large city agencies and covered 55 percent of the large city paved major centerline miles and 53 percent of the large city paved local centerline miles. The county agency submitted plan representation percentage is nearly equal to the percentage of statewide county network centerline miles, but this is not the case for the large city network. The large city paved local centerline *miles* are underrepresented and the remaining large cities that have not submitted a plan will have a larger influence on statewide large city network averages. The remaining discussion items are listed by plan type.

Pavement Discussion

Agencies did not typically break down planned project spending into TAMC treatment classifications, such as light capital preventive maintenance (CPM) or rehabilitation, but were left in general terms. For instance, 82 percent of the annual planned project spending on the paved primary/major network was defined by a statement of typical projects the agency performs along with the annual total spending that will be done. The plans did not have enough detail for accurately estimating project spending by TAMC treatment classifications.

The 2020-2022 average annual project spending per centerline mile was found to be $17,527 for the paved county primary network and $55,286 for the large city paved major network. The *Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan* report (Manty & Colling, 2018) found that the 2017 average dollar per centerline mile was $11,818 for the County Federal Aid Network and $46,719 for the Top 40 (by

population) City Federal Aid Network. The primary/major and federal-aid networks do not contain all of the same roads, but 97 percent of the local-agency-maintained federal-aid network is made up of primary/major roads. The remaining local-agency-maintained federal-aid network is made up of select county local and city local roads. The 2017 county non-federal-aid network spending was $1,837 compared to $5,878 found in the pavement asset management plans for the county local network. The 2017 Top 40 City non-federal-aid network spending was $14,041 compared to the $21,907 found in the pavement sections and pavement asset management plans for the large city local network. The local and non-federal-aid networks do not contain all of the same roads, but 92 percent of the local-agency-maintained non-federal-aid network is made of county and city local roads. The remaining local-agency-maintained non-federal-aid network is made of up select county primary and city major roads.

When analyzing by centerline miles instead of dollars, the amount of centerline miles that agencies have historically worked on in the past was reported in enough detail to assign them TAMC treatment classifications in 74 percent of the plans submitted by county and large city agencies. This high percentage of reporting by average yearly miles of treatment is due to it being a built-in metric of the default tables of the pavement asset management template. The *Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan* report (Manty & Colling, 2018) summarized 2017 data on projects for county agencies and Top 40 City agencies by lane miles. In order to compare the 2017 findings more equally to the findings in this study, the 2020-2022 average annual paved local treatment centerline miles were approximately converted to lane miles by multiplying by two and is compared in Table 20 for county agencies and large city agencies. The largest increase is the light CPM category when comparing the lane miles of treatments of the 2017 study to this study. This could be due to unreported light CPM treatments not in the 2017 investment reporting tool dataset.

Table 20: Treatment Volume Comparison to 2017 Study in Lane Miles

Pavement Treatment Category	This Study County Paved Local Estimate	2017 County Non-Fed Aid	This Study Large City Paved Local Estimate	2017 Top 40 City Non-Fed Aid
Light CPM	2,060	400	760	104
Heavy CPM	3,260	1,964	340	153
Rehab	300	903	300	161
Recon	100	242	60	63

The TAMC templates included the NCPP network quick check method and Roadsoft pavement condition forecast method for agencies to forecast future trends. There were 61 plans that used Roadsoft as a method of predictive modeling. This amounts to 75 percent of the plans with a pavement predictive model identified. This was a significant finding because the Roadsoft

method of predictive modeling requires more detailed data entry in order to run the predictive model. The NCPP method is a simplified "pen and paper" way to check condition trends using generalized assumptions that are accurate for small networks under stable conditions. When agencies have more detailed data, Roadsoft allows the storage and analysis of data for projects, road conditions, treatments, and costs in order to build customized strategies or automatically generate strategies that are optimized by prioritizing lower cost treatments first. This is useful on larger networks with a higher rate of change in road conditions.

There was only one county agency and no large city agencies that included a forecast of the condition of their unpaved roads. This agency forecasted reaching their unpaved road condition goals not in the three-year-plan duration but in ten years. This improvement forecast was driven by a dedicated millage that was focused on gravel roads and returning a portion of their deteriorated paved roads back to gravel. Having dedicated funding for the unpaved road network makes it possible for local agencies to make accurate forecasts of changes in condition. The IBR System™ for gravel roads is a very stable rating system that does not change quickly over time and is a required rating metric for the federal-aid-eligible unpaved road network in Michigan. The way to change a rating using this rating system is to change the width, gravel thickness, or ditch depth. It typically takes quite a few years to degrade these assessment measures, so the quickest way to change ratings is to devote resources to *improve* them through improvement projects. The stability of the rating system and lack of adequate funds available to perform improvements may be inhibiting local agencies from performing forecasts on their unpaved road networks.

Cross analysis of data items was done in order to identify commonalities between agencies with similar data item results. Most data items did not have obvious trends when analyzed. Trends were more difficult to identity when the data set was parsed up into more detailed segments. This is due to the data samples becoming too small, and other variables were most likely influencing trends in the data. One data set division that is of interest to the TAMC is the paved local network. The paved local network data is submitted to TAMC on a discretionary basis. Any trends in the paved local network that could be identified would be useful for TAMC in determining where to direct future assistance efforts.

Segmenting all paved local network data that was submitted by submission year resulted in a trend of increasing average paved local network centerline miles with condition data and an increasing of overall average percent of culverts that were inventoried from 2020 through 2022 as shown in Table 21. The average percent of paved local network roads that are in the TAMC good/fair (G/F) condition designation from 2020 to 2021 increased and then decreased from 2021 to 2022. There are many factors that impact road condition so the submission year is not the best indicator for condition as it does not include all agencies every year in this data set division. The average percent of paved local network roads in G/F *does* correlate to the average paved local surplus/shortfall percentage when the data set is divided by plan submission year as shown in Table 21. It is intuitive that a lowering of an asset's condition would indicate that

there would be an increase in funding need for the asset. This correlation when dividing the data set by plan submission year provides a good check that there is some useful information in this data set category division.

Table 21: Paved Local Network Data by Plan Submission Year

Submission Year*	Count	Avg Percent of PL with Data	Avg Percent of Culverts Inventoried	Avg PL Percent G/F	Avg PL Surplus/ Shortfall	Avg PL $/Mile
2020	29	83%	32%	52%	-110%	$11,901
2021	27	90%	40%	58%	-69%	$12,831
2022	29	99%	57%	44%	-269%	$12,207
Total	**85**	**90%**	**43%**	**51%**	**-153%**	**$12,331**

**Plan Submission Year of "No Plan", "2019", and "2023" not shown*
PL = Paved Local Network

Another data set category division that offered some useful information on the paved local network was the predictive model used on the paved local network as shown in Table 22. The plans that only used the NCPP quick check method of predictive modeling had a smaller percent of the paved local network with condition data than the plans that used the Roadsoft predictive modeling. The NCPP quick check method is more applicable for agencies that do not have as much useful data as it uses generalized assumptions on treatment data. Another correlation is the average percent of culverts that the agencies had inventoried. There was a drop from 56 percent of average culverts inventoried for plans that used only Roadsoft to 16 percent for plans that used only NCPP as a predictive model for the paved local network. It seems that if an agency does not have as much paved local road condition data than they are likely going to have less of their culverts inventoried as well. There was a decrease in the paved local network average surplus/shortfall percentage from a shortfall of 162 percent when only using the Roadsoft predictive model to a shortfall of 116 percent when only using the NCPP quick check predictive model. This is contrary to what would be expected when looking at the average percentage of G/F conditions for the paved local network which went from 53 percent for those using only the Roadsoft predictive model to 46 percent for those only using the NCPP quick check predictive model. A possible reason for the smaller shortfall even when having a decrease in condition is the NCPP predictive model treatments may be slightly more impactful in projecting improvements to the network than the Roadsoft predictive model treatments.

Table 22: Paved Local Network Data by Model Used

Paved Local (PL) Predictive Model Used*	Count	Avg Percent of PL with Data	Avg Percent Culverts Inventoried	Avg PL Percent G/F	Avg PL Surplus/ Shortfall	Avg PL $/Mile
Roadsoft	48	91%	56%	53%	-162%	$16,098
NCPP & Roadsoft	13	98%	48%	47%	-190%	$7,495
NCPP	20	83%	16%	46%	-116%	$6,553
Total	**81**	**90%**	**44%**	**51%**	**-153%**	**$12,951**

**Predictive Model Used of "Not Listed", "None", and "No Plan" not shown*

Table 23 shows paved local network data after being filtered by first the forecasted outcome of their paved local network and then filtered by which predictive model was used. As stated earlier, it becomes difficult to identify trends when parsing the data set in too fine of detail. One conclusion that can be drawn from this analysis is that local agencies tend to use the NCPP quick check method much more often when they are forecasting their paved local network to decline in condition.

Table 23: Paved Local Network Data by Forecast Outcome then by Predictive Model Used

PL Forecast Outcome* ↳ Model Used	Count	Avg of Percent PL with Data	Avg Percent Culverts Inventoried	Avg PL Percent G/F	Avg PL Surplus/ Shortfall	Avg PL $/Mile
Improve	**33**	**98%**	**69%**	**53%**	**-88%**	**$14,997**
Roadsoft	25	99%	66%	54%	-128%	$17,537
NCPP, Roadsoft	7	96%	75%	50%	39%	$3,819
NCPP	1	100%	Not listed	Not listed	Not listed	Not listed
Maintain	**8**	**99%**	**45%**	**63%**	**-59%**	**$12,045**
Roadsoft	7	99%	42%	60%	-59%	$12,469
NCPP	1	99%	66%	81%	Not listed	$9,078
Decline	**29**	**96%**	**17%**	**43%**	**-228%**	**$9,554**
Roadsoft	8	97%	45%	42%	-402%	$15,069
NCPP, Roadsoft	5	100%	10%	41%	-478%	$10,372
NCPP	15	95%	14%	45%	-116%	$6,324
Not Listed	1	100%	0%	Not listed	Not listed	Not listed
N/A	**9**	**52%**	**36%**	**42%**	**Not listed**	**$8,398**
Roadsoft	4	51%	67%	40%	Not listed	$4,122
NCPP, Roadsoft	1	100%	0%	56%	Not listed	$17,241
NCPP	3	21%	0%	41%	Not listed	Not listed
Not Listed	1	100%	15%	36%	Not listed	$8,108
Not Listed	**9**	**91%**	**55%**	**68%**	**0%**	**$15,304**
Roadsoft	4	75%	33%	71%	Not listed	$24,061
None	1	100%	Not listed	38%	Not listed	$8,451
Not Listed	4	98%	77%	72%	0%	$10,449
Grand Total	**88**	**91%**	**44%**	**51%**	**-150%**	**$12,662**

**PL Forecast Outcome of "No Plan" not shown*
PL = Paved Local Network
N/A = Did not Forecast PL
Not Listed = Did not list out Forecast Outcome specific to PL

Comparing the text lines of the attached pavement plans that used the template to the template itself was a way to quantify the level of template customization. Four of the 11 plans with a line duplication rate of less than 20 percent had pavement plans that were highly customized with graphics and text edits. The remaining 7 plans with a duplication rate of less than 20 percent either changed the paragraphs from align left to justified or changed the font type or font size. The font and paragraph changes adjusted the line wrapping which greatly reduced the amount of found matching lines when comparing the plans to the plan template. These 7 plans with font and paragraph changes should not be considered as customized as the four other pavement plans with a low duplication rate.

Bridge Discussion

Agencies that submitted transportation asset management plans in 2020, 2021, and 2022 had a decrease in the average percentage of bridges in the National Bridge Inventory Standard (NBIS) good/fair rating category from 89 percent to 88 percent to 81 percent and the average bridge spending shortfall increased from $887,864 to $902,235 to $2,622,556. The average number of bridges owned by agencies and the average dollars spent per bridge is also summarized by plan submission year in Table 24.

Table 24: Bridge Data by Plan Submission Year

Submission Year*	Count	Avg of Bridge Shortfall	Avg of Bridge Percent G/F	Avg of $/Bridge	Avg Number of Bridges
2020	29	$887,864	89%	$20,648	70
2021	27	$920,235	88%	$18,880	37
2022	29	$2,622,556	81%	$32,925	45
Total	**85**	**$1,445,316**	**86%**	**$24,462**	**51**

**Plan Submission Year of "2019", "2023", and "No Plan" not shown*

The cross analysis of the bridge goals to the percentage of bridges in the NBIS good/fair category, average planned spending, and average bridge spending shortfalls had some interesting trends as shown in Table 25. Agencies with a bridge goal to “improve” their network condition had lower percentage of bridges in the NBIS good/fair category, higher average spending, and higher bridge spending shortfalls than agencies with a bridge network goal to “maintain” the current condition.

Table 25: Bridge Data by Bridge Network Goal

Bridge Goal*	Count	Avg of Bridge Shortfall	Avg of Bridge Percent G/F	Avg of Planned Spending/ Bridge	Repl Planned Spending/ Agency	Prevent Maint Planned Spending/ Agency	Avg Number of Bridges
improve	41	$2,394,821	82%	$35,641	$1,345,202	$182,893	68
Maintain	39	$528,552	91%	$12,485	$220,718	$78,905	42
Total	**80**	**$1,445,316**	**86%**	**$24,352**	**$782,960**	**$130,899**	**55**

**Bridge Goal of "Maintain or Improve", "Not Listed", and "No Plan" not shown*

Table 26 shows bridge data after being filtered by first agency type and then filtered by the bridge network goal of the agency. The county agencies with a goal to “improve” their bridge network condition had two percent decrease in the average amount of bridges in the NBIS good/fair category and a $1,835,643 increase in their average bridge spending shortfall than the county agencies with a goal to “maintain” their current bridge network condition. The large city agencies with a goal to “improve” their bridge network condition had 21 percent decrease

in the average amount of bridges in the NBIS good/fair category and a $811,848 increase in their average bridge spending shortfall than the large city agencies with a goal to “maintain” their current bridge network condition.

Table 26: Bridge Data by Agency Type then by Bridge Network Goal

Agency Type* ↳ Bridge Goal	Count	Avg Number of Bridges	Avg of Bridge Shortfall	Avg of Bridge Percent G/F	Avg of $/Bridge
County	**53**	**78**	**$2,184,600**	**85%**	**$20,796**
improve	32	83	$2,918,857	84%	$27,499
Maintain	21	70	$1,083,214	86%	$10,583
Large City	**27**	**10**	**$269,182**	**89%**	**$31,332**
improve	9	13	$822,714	75%	$64,589
Maintain	18	8	$10,867	96%	$14,703
Grand Total	**80**	**55**	**$1,445,316**	**86%**	**$24,352**

**Bridge Goal of "Maintain or Improve", "Not Listed", and "No Plan" not shown*

Comparing the text lines of the attached bridge plans that used the template to the template itself was a way to quantifying the level of plan customization. There were 11 plans with a line duplication rate of less than 20 percent (five of these plans were produced by the same agencies that had low duplication rates for the pavement plan). Of these 11 plans, 8 were highly customized with many edits. The remaining 3 plans had either changed the paragraphs from align left to justified or changed the font type. The font and paragraph changes adjusted the line wrapping, which greatly reduced the amount of found matching lines. These 3 plans with font and paragraph changes should not be considered as customized as the 8 other bridge plans with a low duplication rate.

The bridge plans had an average duplication rate of 45 percent and the pavement plans had an average duplication rate of 32 percent. Several reasons may account for this: first, bridges must follow national standards for inspection and spending had historically been tied to bridge condition and functionality. This had standardized how agencies manage bridges and had reduced individuality in regards to how bridges were managed, which could explain why there was less customization of the bridge plans templates as compared to the pavement plan templates. Second, the pavement asset management plan template contains significant portions that are NCPP-only text or Roadsoft-only text. Agencies only use the text that is appropriate to their situation. Third, agencies customize the bridge asset management plan by making selections in the template tools that generate custom phrases and sentences that can be edited after these customizations are mail merged into the customized template output. On the other hand, agencies customize the pavement asset management plan template by free-writing in designated places of the customized template output.

Culvert Inventory Discussion

Based on the transportation asset management plan review there were an estimated 198,600 total culverts owned by Michigan's 83 counties and 39 largest cities. This statewide estimate was calculated from the 64 plans that were submitted that had a known or estimated total number of culverts under their jurisdiction. The *2018 Michigan Local Agency Culvert Inventory Pilot Evaluation Report* (Bershing, Colling, & Gilbertson, 2018) found that there were an estimated 196,000 culverts owned by Michigan local agencies (based on data collected from 49 Michigan local agencies). There were 21 agencies that were both involved in the 2018 culvert pilot study and included in the 64 submitted plans that had a known or estimated total culverts. These 21 repeat agencies were made up of 19 county agencies and 2 large city agencies. These two studies both relied on local agency input. The total from reviewing the transportation asset management plans was 1.3 percent larger than the total culverts estimated in the 2018 study, which is a very small difference.

Signal Inventory Discussion

Based on a review of the 88 submitted transportation asset management plans, a statewide estimate of 8,900 traffic signals can be made for Michigan's 83 counties and 39 large cities. This estimate is 33 percent higher than the 6,690 estimated local-agency-owned signalized intersections in Michigan that was found in the *2020 TAMC Traffic Signal Study Project Report* (Meingast, Colling, & Bufanda, 2020). This 2020 study used geo-located UD-10 crash records to identify signalized intersections. A signalized intersection was defined as two roads that met and had at least one traffic signal head with a red-amber-green phase in the 2020 study (Meingast, Colling, & Bufanda, 2020). The transportation asset management plan templates and tools left it up to the local agency completing the plan to define a traffic signal when reporting the number of owned signals. Thus, there were plans that listed flashing red-amber or red-red beacons in their section on traffic signals which researchers did not include for the projections of this plan review study. However, most agencies did not make a distinction between flashing beacons at intersections and red-amber-green traffic signals at intersections. The estimated 8,900 traffic signals calculated from the review of transportation asset management plans should be considered an upper limit and likely includes more intersections with flashing beacons.

CONCLUSIONS

Michigan is a leader in championing local agency asset management as found in the 2023 *Local Road Asset Management State of Practice Project Report* (Torola, 2023). The conclusions found from evaluating the submitted local agency transportation asset management plans should be considered a starting point for the TAMC in assisting Michigan local agencies with tools for updating and submitting their transportation asset management plans. The findings support much of what already was known about Michigan local-agency-owned assets and provides additional details in areas that were unknown. The *12th Annual Michigan Local Agency Transportation Asset Management Implementation Survey Report* (Torola, 2023) found that only 10% of Michigan's county agency and Top 40 city agency survey respondents *do not* have a written pavement asset management plan. This low percentage would indicate that more agencies have plans and just have not submitted them yet to the TAMC. The conclusions are summarized according to their topic area.

TAMC Template Updates

Taking the time to have a well-defined goal, current and past condition data, the ability to forecast future condition, and identify any funding surplus/shortfall is a critical part of a well-developed transportation asset management plan. Since 2004, Michigan local agencies had been required to collect and report the condition of the locally-maintained federal-aid network, of which 97 percent is comprised of the county primary and city major local-agency roads. Having this data available allows local agencies to be more confident when setting goals and forecasting future road conditions. Not all agencies had current data on their paved and unpaved local network. Furthermore, the Inventory-based Rating System™ for unpaved roads used in Michigan does not have the ability to use a conditon deterioration model like the PASER system used for paved roads. These two factors make it difficult to forecast conditions on unpaved roads. A possible solution that could help with this is to develop a network needs assessment tool in Roadsoft. This would take the foundation of the current strategy module and add user input goals to determine the cost needed to reach the set goals. The remaining key items of cost, deterioration rate, condition, and treatment data are already user entered data fields.

Many of the opportunities for improvement were related to formatting the charts and text in the plan. There was a small percentage of plans that still contained placeholder tags; these items are easily searched and located using a word processor find tool. Having additional reminders in the training to replace these tags would assist in cleaning up the plans before they were submitted. Additionally, there were plans that stated a pavement condition trend in the text but show the opposite trend in the network condition, goals, and trend chart (see Figure 23). This was due to the best fit trend line being thrown off by not having data on a consistent collection pattern and not having all the data collected consistently throughout the reporting

period. Adding data from roads that did not have previous data could also skew the network-level analysis chart. An example of a chart inconsistent with the text is shown in Figure 23. It is likely that Figure 23 does not have all data collected in 2016 and 2021, thus it is skewing the best fit dotted lines. In these instances, it was imperative for users to adjust the chart to display only data that reflect the agency's actual condition, trends, and goals. Creating a checklist to go along with the training could help local agencies perform a final review prior to submitting their plan.

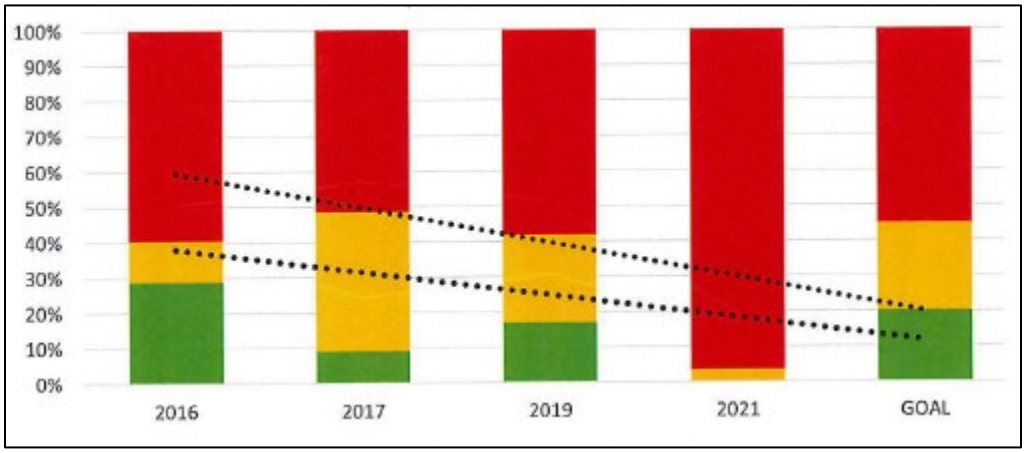


Figure 23: Example of an agency chart with inconsistent data

Local Agency Pavement Project Spending

The total 2020-2022 statewide county agency and large city agency pavement planned project average annual spending was estimated to be $1.02 billion. This includes paved primary/major, paved local, and unpaved roads as detailed in the 75 transportation asset management plans with spending broken apart by network type. The *Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan* report (Manty & Colling, 2018) found that the 2017 total statewide local agency spending to be $0.70 billion. For this present study, the estimated statewide paved primary/major planned spending total was calculated from 61 percent of the agencies who submitted transportation asset management plans that addressed their paved primary/major networks, and from a lower percentage of agencies who submitted plans for their paved local and unpaved networks. Including the agencies that were not included in this study when their plans are submitted can help improve the accuracy of the statewide local pavement project spending estimate.

Local Agency Needs

The goals set by local agencies in their pavement and bridge sections and respective asset management plans generally seem to be aspirational because, on the whole, they want to

"improve" or at least "maintain" the current condition levels despite forecasting meeting their goals only 46 percent of the time. There was a lowering of pavement goal expectations when moving from the paved primary/major to paved local, and then again from paved local to unpaved. There was also a lowering of expectations when moving from large city agency goals to county agency goals on the same network type.

Not meeting the pavement forecast goals was reiterated when the network surplus/shortfall was calculated. Overall, the average paved primary/major shortfall was 40 percent, the average paved local shortfall was 150 percent, and the average unpaved shortfall was 436 percent. Considering just county agency plans, this shortfall pattern is repeated across its networks, but considering just large city agency plans, the shortfall decreased from a 16 percent on its paved city major network to 11 percent on its paved city local network. Multiplying the average network shortfalls from Table 15 by the statewide annual planned project spending estimates from Table 2, the 2020-2022 statewide average annual funding gap was estimated to be $1.07 billion for all local-agency-owned roads and bridges as shown in Table 27.

Table 27: 2020-2022 Statewide Average Annual Funding Gap Estimate

Asset Type	County	Large City	Total
Paved Primary/Major	$ 228,500,000	$ 29,200,000	$ 257,700,000
Paved Local Paved	$ 349,900,000	$ 20,400,000	$ 370,300,000
Unpaved	$ 240,200,000	N/A	$ 240,200,000
Bridges (Table 18)	$ 189,400,000	$ 10,000,000	$ 199,400,000
Total	**$ 1,008,000,000**	**$ 59,600,000**	**$ 1,067,600,000**

The need for additional funding for roads in Michigan had been well documented by the Michigan TAMC annual reports (Michigan Transportation Asset Management Council, 2022) for many years and even by the Michigan legislature as they explain in the 2011 *Michigan's Roads Crisis: What will it Cost to Maintain Our Roads and Bridges?* report (Olson & Schmidt, 2011). This review of the Michigan local agency transportation asset management plans offers some insight into the need on local agency roads from the individual road-owner perspective. Local agencies have collected data on nearly their entire paved primary network, nearly all of their paved local network, and between 20 and 30 percent of the unpaved network, however it is not clear how current the data on the paved local network and unpaved network is. Implementing a way for TAMC to fund data collection on the local paved network and unpaved network would benefit local agencies in updating their plans in the future.

APPENDIX A – PAVEMENT PLAN DATA

1. What year was the pavement plan submitted?

Year	Total	County	Large City	Small city (not required)
2019	2	1	1	0
2020	29	19	10	0
2021	27	14	12	1
2022	29	19	9	1
2023	1	1	0	0
Nothing Submitted	36	29	7	0

2. How often was the pavement plan to be updated?

	Total	County	Large City	Small city (not required)
5 years	1	0	1	0
3 years	80	51	28	1
2 years	3	2	1	0
1 year	4	1	2	1
Nothing submitted	36	29	7	0

3. What type of agency submitted the pavement plan?

	Count	No PAMP Submitted	No Plan Submitted
County	47	7	29
Large City	25	7	7
Small City (not required)	2	0	0

4. Did the pavement plan use the TAMC template?

	County	Large City	Small city (not required)
Yes	46	21	1
No	1	4	1
No Pavement Plan	7	7	0
Nothing Submitted	29	7	0

5. How many pages including appendix are in the pavement plan?

	Total	County	Large City	Small city (not required)
Nothing Submitted	36	29	7	0
No PAMP	14	7	7	0
0 to 25	16	0	1	1
25 to 50	10	6	4	0
50 to 75	40	26	13	1
75 to 100	13	8	5	0
100 to 125	5	4	1	0
125 to 150	2	2	0	0
150 to 175	0	0	0	0
175 to 200	0	0	0	0
200 to 225	0	0	0	0
225 to 250	1	1	0	0
250 to 275	1	0	1	0

6. What method of pavement predictive modeling was used?

	Total	County	Large City	Small city (not required)
NCPP	20	17	3	0
NCPP and RoadSoft	13	10	3	0
RoadSoft	48	23	23	2
Not Listed	6	3	3	0
None	1	1	0	0
Nothing submitted	36	29	7	0

7. What networks did the plan include?

Included Paved Primary/Major?	Total	County	Large City	Small city (not required)
Yes	87	54	32	1
No	1	0	0	1

Included Paved Local?	Total	County	Large City	Small city (not required)
Yes	86	53	31	2
No	2	1	1	0

Included Unpaved?	Total	County	Large City	Small city (not required)
Yes	73	52	20	1
No	15	2	12	1

8. What was the condition of each network?

Paved Primary/Major Condition?	Total	County	Large City	Small city (not required)
Good (centerline miles)	5213.9	4722.2	490.7	1.0
Fair (centerline miles)	6903.1	6134.6	768.4	0.0
Poor (centerline miles)	7485.5	6669.9	815.7	0.0
Condition Not included	129.6	10.7	117.0	1.9
No Plan Submitted	8165.8	7058.0	1107.8	Unknown
Total	27897.9	24595.5	3299.5	Unknown

Paved Local Condition?	Total	County	Large City	Small city (not required)
Good (centerline miles)	4669.0	3948.6	719.6	0.8
Fair (centerline miles)	8020.5	5910.7	2102.4	7.4
Poor (centerline miles)	12415.3	10039.4	2365.4	10.5
Condition Not included	1324.6	862.4	466.6	0.0
No Plan Submitted	10396.4	7591.0	2805.4	Unknown
Total	36825.8	28352.0	8459.4	Unknown

Unpaved Condition?	Total	County	Large City	Small city (not required)
Good (centerline miles)	2044.8	2032.3	12.5	0.0
Fair (centerline miles)	3220.9	3178.3	42.6	0.0
Poor (centerline miles)	1973.0	1955.9	17.1	0.0
Condition Not included	17920.1	17848.0	69.4	2.8
No Plan Submitted	12418.0	12418.0	Unknown	Unknown
Total	37576.8	37432.5	141.5	Unknown

9. What was the goal for each network?

Paved Primary/Major Goal?	Total	County	Large City	Small city (not required)
Improve	24	10	14	0
Improve or Maintain	52	36	16	0
Maintain current condition	10	8	1	1
Not listed	1	0	1	0
N/A	1	0	0	1

Paved Local Goal?	Total	County	Large City	Small city (not required)
Improve	20	8	11	1
Improve or Maintain	52	33	18	1
Maintain current condition	8	7	1	0
Maintain or Manage decline	1	1	0	0
Guide townships	1	1	0	0
Not listed	4	3	1	0
N/A	2	1	1	0

Unpaved Goal?	Total	County	Large City	Small city (not required)
Improve	5	2	2	1
Improve or Maintain	37	28	9	0
Maintain current condition	21	17	4	0
Maintain and Integrate IBR	1	0	1	0
Integrate IBR	1	1	0	0
Pave unpaved	1	0	1	0
Not listed	7	4	3	0
N/A	15	2	12	1

10. Did their condition trend indicate they would accomplish their goal?

Trend Shows Paved Primary/Major Goal Met?	Total	County	Large City	Small city (not required)
Yes	48	26	22	0
No	33	26	6	1
Not listed	6	2	4	0
N/A	1	0	0	1

Trends Show Paved Local Goal Met?	Total	County	Large City	Small city (not required)
Yes	25	9	15	0
No	47	35	11	2
Not listed	14	9	5	0
N/A	2	1	1	0

Trends Show Unpaved Goal Met?	Total	County	Large City	Small city (not required)
Yes	2	2	0	0
No	5	5	0	0
Not listed	66	45	20	1
N/A	15	2	12	1

11. What was the outcome of the condition forecast?

Paved Primary/Major Forecast?	Total	County	Large City	Small city (not required)
Improve	47	29	18	0
Maintain	15	9	4	1
Decline	14	9	6	0
Not listed	10	6	4	0
N/A	2	1	0	1

Paved Local Forecast?	Total	County	Large City	Small city (not required)
Improve	33	17	16	0
Maintain	9	5	3	0
Decline	28	19	8	2
Not listed	9	5	4	0
N/A	9	8	1	0

Unpaved Forecast?	Total	County	Large City	Small city (not required)
Improve	1	1	0	0
Maintain	0	0	0	0
Decline	0	0	0	0
Not listed	72	51	20	1
N/A	15	2	12	1

12. What was the surplus and shortfall for each network relative to the goal?

Paved Primary/Major Surplus or Deficit?	Total	County	Large City	Small city (not required)
Surplus	17	13	3	0
Met Goal	19	6	13	0
Deficit	45	34	11	1
Not Listed	6	1	5	0
N/A	1	0	0	1

Paved Local Surplus or Deficit?	Total	County	Large City	Small city (not required)
Surplus	5	2	2	0
Met Goal	13	3	10	0
Deficit	53	38	14	2
Not Listed	8	3	5	0
N/A	9	8	1	0

Unpaved Surplus or Deficit?	Total	County	Large City	Small city (not required)
Surplus	0	0	0	0
Met Goal	0	0	0	0
Deficit	7	6	0	1
Not Listed	46	31	15	0
N/A	35	17	17	1

13a. Annual Planned Project Spending on Paved Primary/Major Network (Local Spending not included)

	Various M-of-F (incl. Recon)	Recon Only	Rehab Only	Resurfacing Only	Heavy CPM Only	PM Only	Total Dollars
County	$249,024,641	$0	$5,288,555	$16,066,000	$4,316,870	$1,363,900	$276,059,966
Large City	$58,996,615	$12,999,000	$4,697,764	$20,411,956	$260,000	$2,821,656	$100,186,991
Small City (not required)	$0	$0	$0	$0	$0	$4,000	$4,000
	$308,021,256	**$12,999,000**	**$9,986,319**	**$36,477,956**	**$4,576,870**	**$4,189,556**	**$376,250,957**

13b. Annual Planned Project Spending on Paved Local Network

	Various M-of-F (incl. Recon)	Various M-of-F (No Recon)	Recon Only	Rehab Only	Resurfacing Only	Heavy CPM Only	PM Only	Total Dollars
County	$89,812,048	$5,300,000	$0	$475,305	$4,511,625	$2,880,750	$1,240,900	$104,220,628
Large City	$77,412,319	$2,221,667	$911,500	$4,684,444	$8,690,361	$0	$5,140,619	$99,060,910
Small City (not required)	$300,000	$0	$0	$0	$0	$0	$0	$300,000
	$167,524,367	**$7,521,667**	**$911,500**	**$5,159,749**	**$13,201,986**	**$2,880,750**	**$6,381,519**	**$203,581,538**

13c. Annual Pavement Project Miles

Network Type	Light CPM Miles	Heavy CPM Miles	Rehab Miles	Recon Miles
County Paved Primary (45 agencies)	1100.0	1600.0	197.0	77.4
Large City Paved Major (19 agencies)	216.8	100.8	37.1	35.4
Small City (not required) Paved Major (1 agency)	0.5	0.0	0.0	0.0
County Paved Local (45 agencies)	558.5	1157.3	161.4	68.3
Large City Paved Local (19 agencies)	188.7	165.9	72.7	80.6
Small City (not required) (1 agency)	0.5	0.5	0.0	0.3

14. What type of coordination with other assets was included?

Partner with others on projects?

County	11
Large City	1
Small City (not required)	0
Overall	12

Provide advanced notice to utilities of future projects?

County	36
Large City	15
Small City (not required)	0
Overall	51

Coordinate utility and road replacements?

County	34
Large City	31
Small City (not required)	2
Overall	67

15. What type of critical pavement assets were included?

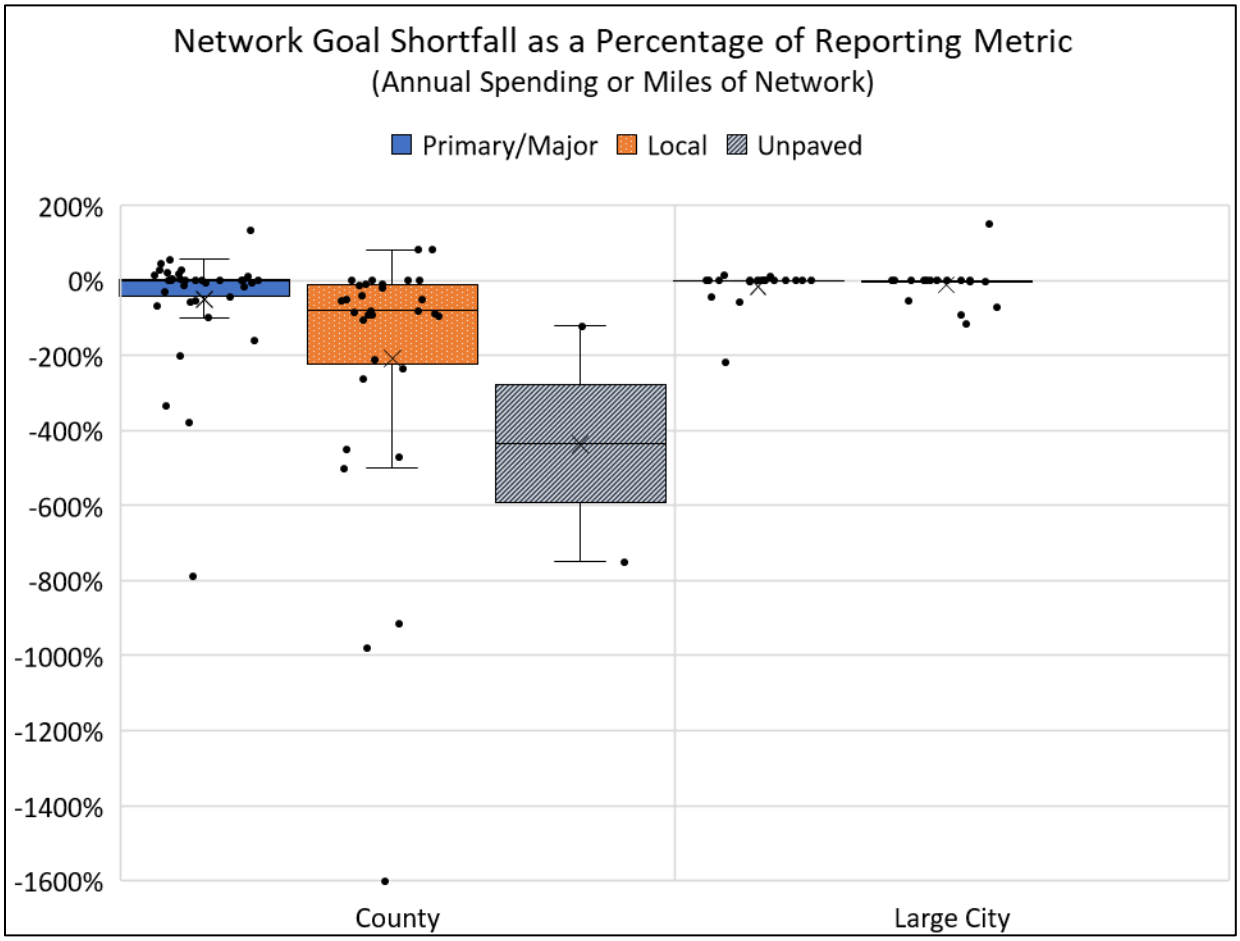
Critical Road Category	Count
No risk section	2
No roads listed in Risk of Failure Analysis	8
Don't have any critical roads	9
Specific Category (NHS, Primary, All Season, Fed-Aid, All Roads)	8
Specific to Geographic Divides	1
Specific to Emergency Alternate Routes	3
Specific to Limited Access Areas	5
Specific to Main Access to key districts	6
Poor Condition Roads	1
List of roads not specified by type	53
	96

16. What was the degree of customization of the pavement report?

Percent of PAMP Template Duplicated	Total	County	Large City	Small City (not required)
Template not used	6	1	4	1
>0% to 10%	8	5	3	0
10% to 20%	3	3	0	0
20% to 30%	15	8	6	1
30% to 40%	16	8	8	0
40% to 50%	26	22	4	0
50% to 60%	0	0	0	0
60% to 70%	0	0	0	0
70% to 80%	0	0	0	0
80% to 90%	0	0	0	0
90% to 100%	0	0	0	0
No PAMP	14	7	7	0
Nothing submitted	36	29	7	0

17. Who was author of the pavement plan?

Pavement Plan Author	County	Large City	Small City (Not Required)	Total
staff	41	12	0	53
consultant	3	10	2	15
staff and consultant	0	1	0	1
not listed	3	2	0	5
No Pavement Plan	7	7	0	14
Nothing submitted	29	7	0	36



APPENDIX B – BRIDGE PLAN DATA

1. What year the bridge plan was submitted?

	Total	County	Large City	Small city (not required)
2019	2	1	1	0
2020	28	20	8	0
2021	23	13	10	0
2022	28	19	9	0
2023	1	1	0	0
No Plan Submitted or Bridge Section	42	29	11	2

2. How often was the bridge plan to be updated?

	Total	County	Large City	Small city (not required)
6 years	1	1	0	0
5 years	4	3	1	0
4 years	1	1	0	0
3 years	71	45	26	0
2 years	4	3	1	0
1 year	1	1	0	0
No Plan Submitted or Bridge Section	42	29	11	2

3. What type of agency submitted the bridge plan?

	Count	No BAMP	Nothing Submitted	Total
County	47	7	29	83
Large City	17	15	7	39
Small City (not required)	0	2	0	2

4. Did the plan use the TAMC bridge template?

	Total	County	Large City	Small city (not required)
Yes	62	45	17	0
No	2	2	0	0
No BAMP	24	7	15	2
Nothing Submitted	36	29	7	0

5. How many pages including appendix are in the bridge plan?

	Total	County	Large City	Small City (Not Required)
Nothing Submitted	36	29	7	0
No BAMP	24	7	15	2
0 to 25	4	3	1	0
25 to 50	50	37	13	0
50 to 75	7	6	1	0
75 to 100	2	1	1	0
100 to 125	0	0	0	0
125 to 150	1	0	1	0

6. What was the goal for the bridge network?

	County	Large City	Small City (Not Required)
Improve	32	9	0
Maintain or Improve	1	0	0
Maintain	21	18	0
Not Listed	0	1	0
Nothing Submitted	29	11	2

7. Did their condition trend indicate they would accomplish their bridge goal?

	County	Large City	Small City (Not Required)
Yes	21	17	0
Most	6	2	0
Some	10	2	0
No	4	1	0
Uncertain	9	0	0
Not Listed	4	6	0
Nothing Submitted	29	11	2

8a. What was the dollar volume unfunded (gap) bridge projects?

	County	Large City	Small City (Not Required)
Avg Dollar Volume	$ 4,108,050	$ 1,480,500	N/A
Plans with Gap Listed	20	4	0
Plans with No Gap	16	19	0
Not Listed	18	6	0
Nothing Submitted	29	10	2

8b. What was the type of unfunded (gap) bridge projects?

	County	Large City	Small City (Not Required)
Scheduled Maintenance	1	0	0
Preventive Maintenance	8	2	0
Rehabilitation	8	1	0
Replacement	17	1	0
Removal	0	1	0
Not listed	18	6	0
No Gap	16	19	0
Nothing Submitted	29	10	2
	97	40	2

9. Did they include a revenue and expenses summary for bridges?

	County	Large City	Small City (Not Required)
Yes	43	19	0
No	11	9	0
Nothing Submitted	29	11	2

10. What was the degree of customization of the bridge report?

	Total	County	Large City	Small city (not required)
Nothing Submitted	36	29	7	0
No BAMP	24	7	15	2
Templ. Not Used	2	2	0	0
0% to 10%	10	6	4	0
10% to 20%	1	1	0	0
20% to 30%	0	0	0	0
30% to 40%	4	3	1	0
40% to 50%	16	10	6	0
50% to 60%	14	11	3	0
60% to 70%	16	13	3	0
70% to 80%	1	1	0	0
80% to 90%	0	0	0	0
90% to 100%	0	0	0	0

11. Who was author of the bridge plan?

Bridge Plan Author	County	Large City	Small City (Not Required)	Total
staff	39	10	0	49
consultant	4	6	0	10
staff and consultant	0	0	0	0
not listed	4	1	0	5
No BAMP	7	15	2	24
Nothing submitted	29	7	0	36

12. What was the condition of Bridges?

	Total	County	Large City	Small City (Not Required)
Good	1912	1783	129	0
Fair	1872	1772	100	0
Poor	659	630	29	0
Not Rated	2	2	0	0
Struct. Deficient	574	554	20	0
Posted	641	615	26	0
Closed	43	39	4	0

13. What type of critical bridge assets were included?

Critical Bridge Category	Count
No risk section	2
No Bridges Listed in Risk of Failure Analysis	26
Don't have any	9
Specific Category (All, Primary, High Traffic, Largest, Historic)	12
Specific to Geographic Divides	10
Specific to Limited Access Areas	1
Specific to Main Access to key districts	1
Poor Condition Bridges	9
Scour Critical Bridges	10
List of bridges not specified by type	21
	101

APPENDIX C – TRANSPORTATION ASSET MANAGEMENT PLAN DATA

1a. What was the status of the culvert inventory?

	County	Large City	Small City (Not Required)	Total
Ratings and Inventory	27	7	0	34
Inventory	46	15	0	61
Total Not Known	5	0	0	5
Counted or Estimated Total	45	16	0	61
Nothing submitted	29	7	0	36
None inventoried	4	13	2	19
None Owned	0	3	0	3

1b. Number of known culverts and inventory status

	County	Large City	Small City (Not Required)	Total
Rated and Inventoried	49,159	1,242	-	50,401
Inventoried only	27,247	916	-	28,163
Rated only	-	94	-	94
Not Inventoried or rated	28,146	585	-	28,731
Total	104,552	2,837	-	107,389
Total Agencies	45	19	0	64
Estimated Statewide Total	**192,840**	**5,823**	**-**	**198,664**

2a. Total signals

	Total	County	Large City	Small City (not required)
Nothing Submitted	36	29	7	0
None Invntr'd	12	3	8	1
0	62	45	16	1
>0 to 10	8	8	0	0
10 to 25	6	5	1	0
25 to 50	7	4	3	0
50 to 100	10	3	7	0
100 to 200	8	2	6	0
200 to 500	4	2	2	0
500 to 1000	0	0	0	0
1000 to 2000	2	2	0	0

2b. Signals inventoried

	County	Large City	Small City (Not Required)	Total
Inventory	4135	1857	0	5992
Not Inventoried	12	0	0	12
Total	4147	1857	0	6004
Total Agencies	51	24	1	76
Estimated Statewide Total	**6,258**	**2,682**	**0**	**8,941**

3. Did the plan use the TAMC transportation asset management template?

	County	Large City	Small City (Not Required)	Total
Yes	53	29	1	83
No	0	1	0	1
No TAMP	1	2	1	4
Nothing Submitted	29	7	0	36

4. Who was author of the transportation asset management plan?

TAMP Author	County	Large City	Small City (Not Required)	Total
staff	45	15	0	60
consultant	3	12	1	16
staff and consultant	0	2	0	2
not listed	5	1	0	6
No TAMP	1	2	1	4
Nothing submitted	29	7	0	36

WORKS CITED

Bershing, S., Colling, T., & Gilbertson, C. (2018). *Michigan Local Agency Culvert Inventory Pilot Evaluation Report.* Hougton: Michigan Technological University on behalf of the Michigan Transportation Asset Management Council.

Center for Technology & Training. (2023). *Instruction Guide for using the Pavement Asset Management Plan Template.* Houghton: Center for Technology & Training on behalf of the Michigan Transportation Asset Management Council.

County Road Association of Michigan. (2023). *2023-2024 Member Directory.* Lansing: County Road Association of Michigan.

Manty, A., & Colling, T. (2018). *Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan.* Houghton: Center for Technology & Training on behalf of the Michigan Transportation Asset Management Council.

MDOT. (2023, December 13). *Michigan Bridge Conditions.* Retrieved from Michigan Department of Transportation Web site: https://mdot.maps.arcgis.com/apps/MapSeries/index.html?appid=fb70725b2be04dc7b01703d0b6c91bb6

MDOT LAP Bridge Unit. (2023, November 21). *Business: Local Government: Local Agency Program: Bridge Program: 2023 Selected Projects for FY 2026.* Retrieved from Michigan Department of Transportation Web site: https://www.michigan.gov/mdot/business/local-government/local-agency-program/bridge-program

MDOT LAP Bridge Unit. (2023, April 7). *Business: Local Government: Local Agency Program: Bridge Program: FY 2026 Local Bridge Applications Received.* Retrieved from Michigan Department of Transportation Web site: https://www.michigan.gov/mdot/business/local-government/local-agency-program/bridge-program/local-bridge-applications-received

Meingast, P., Colling, T., & Bufanda, L. (2020). *TAMC Traffic Signal Study Project Report.* Houghton: Center for Technology & Training on behalf of the Michigan Transportation Asset Management Council.

Michigan Department of Transportation. (2019, November 4). *Act 51 Mileage Certification Maps*. Retrieved August 9, 2023, from Michigan Department of Transportation Web Site: https://mdotjboss.state.mi.us/SpecProv/act51.htm

Michigan Transportation Asset Management Council. (2022). *Michigan's 2022 Roads & Bridges Annual Report.* Lansing: Michigan Transportation Asset Management Council.

Michigan Transportation Asset Managment Council. (2023, October 5). *Home: TAMC: About the Council: TAMC Policies.* Retrieved from State of Michigan Web Site: https://www.michigan.gov/mic/tamc/about-the-council/tamc-policies

Olson, R., & Schmidt, R. (2011). *Michigan's legislature as explain in Michigan's Roads Crisis: What will it Cost to Maintain Our Roads and Bridges?* Lansing: Work Group on Transportation Funding of the Michigan House of Representatives Transportation Committee.

Torola, P. (2023). *12th Annual Michigan Local Agency Transportation Asset Management Implementation Study Report.* Houghton: Center for Technology & Training on behalf of the Michigan Transportation Asset Management Council.

Torola, P. (2023). *Local Road Asset Management State of Practice.* Houghton: Center for Technology & Training on behalf of the Michigan Transportation Asset Management Council.

United States, Federal Highway Administration. (2022, May 6). National Bridge Inspection Standards. *87 FR 27396*, 27396-27437. Washington DC.