DYE MANAGEMENT GROUP, INC.
Skyline Tower • Suite 1910 • 10900 NE 4th Street • Bellevue, WA 98004
T: (425) 637-8010 • F: (425) 637-8020 • www.dyemanagement.com

Michigan Transportation Asset Management Council

Michigan Department of Transportation

Framework for Asset Management Study Results—Research Report

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16. Abstract

Dye Management Group, Inc. (DMG) collected and analyzed local agency inventory, cost, and condition assessment information in order to provide the Michigan Transportation Asset Management Council (TAMC) with (a) the costs expended to maintain its roadway system on a per mile basis and (b) the projected dollars per lane mile that need to be spent in order to bring 100 percent of its system into fair to good condition and to maintain it at that level over the next twenty years. Based on inventory, condition, and expenditure data provided, the analysis showed that Michigan would need to spend approximately $14,123 per lane mile (in 2011 dollars) on an annual basis to bring all of its local agency pavement, bridge, and roadside assets to a fair to good condition level, and to maintain them at this level over a twenty-year period. During the course of this analysis, DMG produced two distinct outputs. First, DMG captured the costs per mile of maintaining pavements, bridges, and roadside assets, and of conducting winter maintenance activities. Second, DMG prepared an updatable workbook tool that the TAMC and local agencies can use to track local agency expenditures and conditions against the projections developed.

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TAMC and Michigan DOT—A Framework for Asset Management

Study Results—Research Report

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I. Executive Summary

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A. Goals of Analysis

Dye Management Group, Inc. (DMG) has collected and analyzed local agency inventory, cost, and condition assessment information in order to provide the Michigan Transportation Asset Management Council (TAMC) with (a) the costs expended to maintain its roadway system on a per mile basis and (b) the projected dollars per lane mile that need to be spent in order to bring 100 percent of its system into fair to good condition and to maintain it at that level over the next twenty years.[1]

The structure of this analysis provides cost details for several general maintenance activity categories (i.e., pavement, bridge, roadside assets[2], and winter maintenance). It also provides costs per mile by agency type (county and city), region, and roadway type. Costs at this level of detail will enable the TAMC to provide more informed guidance on the most appropriate local agency asset management strategy to the Michigan Transportation Commission and to the Michigan Legislature.

DMG has structured this analysis to enable a comparison of the need projections to dollars spent per fiscal year over a twenty-year time span, as well as to enable a comparison of the resulting overall roadway system conditions that correspond to projected versus actual expenditures. DMG intends for these cost and condition comparisons to provide the TAMC with a tool for communicating the longer-term impact of budget decisions to the Michigan Transportation Commission and to the Michigan Legislature.

B. Overview of Research Methodology

DMG collected and analyzed inventory, cost, and condition data provided by nine diverse local agencies. We obtained data from at least one agency in each of the Michigan Department of Transportation's (MDOT) seven regions, and for multiple county road commissions and cities.[3]

[1] The annual costs per lane mile required to bring all roadway assets to a fair to good condition level and to maintain them at this level do not include possible costs associated with the paving of what are currently maintained as unpaved roads or any costs associated with system expansion.

[2] We used the following "roadside asset" categories for the purposes of this analysis: drainage, traffic and safety, roadside, facilities, winter maintenance, and "other." "Other" is comprised primarily of general overhead, leave time, clerical, equipment purchase and repair, and supervision costs—all activities not specifically identified as related to pavement or bridge assets comprise the roadside asset category. Indirect costs associated with all asset types have also been included in this category.

[3] DMG initially attempted to obtain data from eleven county road commissions and from seven cities. However, we reduced our target number to five counties and four cities, since a number of agencies we reached out to either provided us with no data or provided us with incomplete or inaccurate data.

Participating local agencies provided inventory and condition information for pavement and bridges from RoadSoft (a pavement asset management system in use by most agencies in Michigan), Pontis (a bridge inspection and inventory database system widely used across the U.S.), and BCFS (the Bridge Condition Forecasting System used by MDOT[4]). The participating agencies were unable to provide inventory or condition information for roadside assets, since local agencies do not currently collect this information in a standardized format.[5]

DMG assessed historical costs for 2008 through 2010.[6] We relied on Act 51 Report information to determine historical costs for local agencies. These costs provided us with a historical record of expenditures, but did not factor into the need projections made for pavement and bridges, which were driven by inventory and condition data. In contrast, the need projections made for roadside assets relied strictly on these Act 51 Report costs, since (as noted above) standardized inventory and condition information for roadside assets could not be provided.

DMG developed pavement need projections based on a twenty-year planning horizon using the default settings in the PASER system and bridge need projections using the bridge deterioration and cost models developed by MDOT for the BCFS. We selected a twenty-year planning horizon since this length of time will facilitate road work being done without undue stress being placed on Michigan's drivers; that is, a shorter planning horizon would have resulted in an unreasonably high volume of maintenance work occurring at any given period of time. The analysis applies a five-percent annual inflation factor for all projections. Going forward, this figure can be adjusted within the *TAMC Updatable Workbook for Local Agency Data* tool (more on this below) based on recorded inflation rates.

During the course of this analysis, we produced two distinct outputs. First, we captured the costs per mile of maintaining pavements, bridges, and roadside assets, and of conducting winter maintenance activities in non-updatable Excel workbooks. Second, we prepared an updatable workbook tool that the TAMC and local agencies can use to track local agency expenditures and conditions against the projections we developed. The updatable workbook uses these fixed-need projections in conjunction with annually updated inventory and annual cost information (1) to assess how closely Michigan is tracking to the twenty-year expenditure plan and (2) to evaluate the impact on roadway conditions of these actual versus projected needed expenditures.

DMG based pavement projections for all local agencies on the pavement condition data obtained from nine diverse local agencies—it is important to note that this data may not precisely reflect the overall conditions for each of Michigan's regions. Since no centralized

[4] BCFS uses average deterioration rates and costs, and relies on current National Bridge Inventory (NBI) data.
[5] As a result of this absence of roadside asset data, we used the current level of spending on roadside assets, adjusted for inflation, for projections in this analysis—that is, we conservatively assumed that Michigan local agencies will be able to maintain their roadside assets in fair to good condition using current roadside asset expenditure levels. Based on the views expressed by MDOT and local agency staff with whom we spoke, we have reason to believe that current roadside asset expenditure levels are not sufficient for the maintenance of roadside assets. However, we could not obtain data to develop even a rough estimate of roadside asset needs and needed expenditure levels.
[6] 2011 data was not yet available for all data points needed at the time we undertook this analysis.

database repository currently houses local agency pavement's non-federal aid eligible road information, and since approximately two-thirds of Michigan roads are non-federal aid eligible,[7] a comprehensive approach for pavement data collection was not feasible. However, we were able to obtain all bridge condition information from Pontis, which includes comprehensive bridge condition information, and as a result, our bridge condition projections relied on a comprehensive data set.

C. Inventory, Cost, and Condition Updating Process Overview

All Michigan county road commissions and those cities in Michigan with 100 miles or more of roadway will be asked to contribute to the updating of the *TAMC Updatable Workbook for Local Agency Data* by providing up-to-date inventory and condition information on their roadways and bridges, as well as up-to-date expenditure information for all maintenance activities performed. The three largest cities in both the Superior and North regions will also be asked to contribute to this effort, since no city in either of these regions currently has at least 100 miles of roadway. Based on this list of participants, each region will be represented by at least three counties and by at least three cities.

Staff at each of the 128 local agencies who will be participating in the updating of the workbook will need to complete a *Local Agency Data-Reporting Tool* document and provide it to the TAMC. The TAMC will then enter the data provided into the *Updatable Workbook*. The TAMC's GIS Coordinator will oversee and coordinate the data transfer and analysis on an annual basis.

The following information will be entered in the updatable workbook:

Inventory: The TAMC will populate as much local agency pavement and bridge inventory information as is available, and each participating local agency will supplement this inventory as needed to ensure the inventory data is accurate and up to date. Contributors will need to update inventory information annually.

Conditions: Each participating agency will also be tasked with entering all of their pavement and bridge condition information in the workbook annually. They will extract this information from RoadSoft (or another pavement management system, if used) and from Pontis. This information will be used by the updatable workbook to determine how Michigan is tracking to the twenty-year projections.

Expenditures: Lastly, participating local agencies will be asked to enter their annual maintenance expenditures, based on Act 51 Report information. This information will also be used by the updatable workbook to determine how Michigan is tracking to the twenty-year projections.

Once inventory, condition, and expenditure information has been entered into the updatable workbook, detailed information will be generated by the workbook on the actual costs

[7] Approximately two-thirds of Michigan local agency roads, as measured in centerline miles, fall within the road classes County Local and City Local; these roads are generally not federal-aid eligible.

versus projected expenditure needs across Michigan's local agencies. The tool will detail this information by region, agency type, and roadway type. Overall pavement and bridge conditions will also be tracked and compared. This information can be used by the TAMC to assist in generating its statewide asset management strategy guidance.

D. Research Findings Summary

Based on inventory and condition data provided, our analysis shows that Michigan would need to spend approximately $14,123 per lane mile (in 2011 dollars) on an annual basis to bring all of its local agency pavement, bridge, and roadside assets[8] to a fair to good condition level, and to maintain them at this level during a twenty-year time span. We provide this estimate in terms of lane miles (in addition to pavement assets, it also includes the maintenance of all roadside assets and bridges in the local agency roadway network).

Looking to information from the Act 51 database maintained by MDOT, it appears that, in 2010, Michigan's local agencies spent $1.62 billion on local agency roads[9] (equivalent to $1.76 billion in 2011 dollars). In terms of Michigan's current local agency roadway network (approximately 235,743 lane miles), Michigan spent $6,886 per lane mile in 2010, the equivalent of $7,478 per lane mile in 2011 dollars. This expenditure level is approximately 53 percent of what the data indicates Michigan would need to spend to bring all local agency assets to a fair to good condition level. More specifically, while bridge assets would require a 54 percent increase in annual funding for local agencies to bring 100 percent of their bridges to a fair to good condition level by 2030, local agencies would need to spend 179 percent more than they currently do annually on their pavement assets to bring all of them to a fair to good condition level by 2030. This gap in needed versus actual pavement expenditures indicates that, without a substantial increase in pavement funding levels, the amount of local agency pavement rated in poor condition will continue to rise.

The *Updatable Workbook* can track the impact of Michigan's local agency expenditures to 2030 on pavement and bridge assets for greater than 92 percent of Michigan's local agency roadway system. It can track condition levels against actual expenditures, as well as against needed expenditure levels and the condition levels that correspond to them—to provide a comprehensive picture of the impact of funding decisions on the local agency roadway system.

E. Recommendations for Future Data Collection

DMG identified a number of opportunities for improving data collected and how it is shared within and across Michigan's roadway agencies. These improvement opportunities can be categorized as related to data collection, the collection methods used, and information coordination efforts. The extent of standardized data collection and information sharing

[8] We conservatively assume that local agencies currently maintain all roadside assets at a fair to good condition level, and as a result, apply the same expenditure level in our cost projections.
[9] We have excluded local agency expenditures on trunkline roads from this figure.

currently in use varies by asset type, with the most robust information available for bridges and the least for roadside assets.

Pontis currently serves as a centralized repository of bridge inventory and condition information for Michigan's roadway system. However, Michigan agencies do not currently record non-federal aid eligible pavement data in a centralized information system—rather, they use their own individual pavement management system (generally RoadSoft) for approximately two-thirds of their roadways, as measured in centerline miles. Ideally, each local agency's pavement system(s) of record would aggregate this data in a single system. We have prepared the *Updatable Workbook Tool for Local Agency Data*, in part, to accomplish this purpose. So long as each local agency records its pavement information consistently and accurately and manually transfers summary data, the updatable workbook can be maintained for use in planning and budgeting at the state level.

Local agencies currently collect no standardized information on roadside asset inventory or condition levels, as noted above. If agencies were to collect this information in a standardized format, it could then be used to more accurately project budgetary needs for maintenance costs related to them. A maintenance quality assurance (MQA) program consisting of work reporting, the use of activity performance guidelines, level of service (LOS) tracking, and budget development through the use of these tools would enable performance-based maintenance planning.

We were able to develop bridge and pavement need cost projections based, in part, on the inventory and condition data collected on these assets; we could not do the same for roadside assets. Since any current roadside asset deficiencies could not be estimated in the absence of standardized information, we assumed the current expenditure level of local agencies to be sufficient for the maintenance of roadside assets in a fair to good condition. Need projections for roadside assets have likely been underestimated in the *Updatable Workbook* as a consequence of this approach—a result which could be avoided in the future with the availability of standardized roadside asset inventory and condition data.

We relied on local agency expenditure information obtained from Act 51 Reports to conduct this analysis. Since Act 51 requires expenditure information be provided in terms of general expenditure categories, we could only apportion costs across asset and activity types based on approximate ratios. Going forward, if local agencies could track and report expenditure information by asset and activity type, then this cost allocation could be more accurately performed. It would allow the TAMC and each local agency to better assess spending needs if routine maintenance costs, capital and preventative maintenance costs, and rehabilitation and reconstruction costs were kept distinct for reporting purposes. It would also assist in needs analysis if each agency were to distinguish costs used to expand the current infrastructure network from costs used to maintain it. We recommend Michigan local agencies take steps to move toward recording and reporting expenditure information with these attributes.

Additionally, it would enable the assessment of per-lane-mile costs if the precise number of centerline and lane miles of roadway were tracked in each region by local agency type and

by roadway class.[10] In this analysis, we made certain approximations in order to develop a comprehensive picture of overall local agency inventory. However, an exact inventory would improve future analysis. The *Updatable Workbook for Local Agency Data* will capture a large portion of this inventory

As a general direction, we recommend that the TAMC and local agencies look to information technology tools that bring together accurately tracked inventory, condition, and expenditure information (such as data warehousing applications) and that enhance the ability to track this information (such as maintenance management systems) as an additional means of improving system-wide tracking and planning. One example of a possible improvement in this direction would be for Michigan to develop data interfaces between RoadSoft and Pontis and the *Updatable Workbook*, to expedite the data transfer process to it.

[10] We used the roadway classes corresponding to Act 51 Reports, so that expenditures could be incorporated into the analysis most accurately. These categories are "County Primary" and "County Local," "City Major" and "City Local." "County Primary" and "City Major" roads generally correspond to National Function Classes (NFCs) one through five, while "County Local" and "City Local" roads generally correspond to NFCs six and seven.

II. Research Methodology

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A. Overall Approach

DMG collected local agency inventory, condition, and expenditure data to develop estimates of the required cost per mile to bring the entire Michigan local agency roadway system up to a fair to good condition level. The bridge analysis included data from all local agencies, since this information could be obtained from a centralized bridge data source. However, in order to develop cost-per-mile figures for pavement and roadside assets, DMG needed to solicit and obtain information directly from a select number of local agencies. At least one local agency from which we obtained data represented each of the seven geographical regions in Michigan. Five counties and four cities provided their inventory, condition, and expenditure data for pavement and roadside asset analysis. This ensured we made projections based on an assessment of conditions and expenditures by geographical location and by agency type.

The following local agencies participated in our data collection efforts:

- The City of Marquette (Superior Region)
- Alcona County Road Commission (North Region)
- The City of Alpena (North Region)
- Kent County Road Commission (Grand Region)
- Genesee County Road Commission (Bay Region)
- Cass County Road Commission (Southwest Region)
- Kalamazoo County Road Commission (Southwest Region)
- The City of Lansing (University Region)
- The City of Port Huron (Metro Region)

1. Goals of Analysis

We performed this analysis and developed the *TAMC Updatable Workbook Tool for Local Agency Data* to provide the TAMC and local agencies with a tool for tracking costs and conditions of the vast majority of the Michigan local agency road systems to provide enhanced guidance. The updatable workbook will quantify the dollars needed to bring Michigan's city and county roadway systems to a uniformly fair to good condition level, as well as to sustain this level, over the course of a twenty-year period. It will also demonstrate the impact on pavement and bridge conditions when agencies cannot spend the dollar amounts recommended by comparing actual condition levels

to those projected if the expenditure levels needed to bring all assets to a fair to good condition level were met. This should increase the TAMC's ability to provide informed guidance on the funding of Michigan's roadway assets, and to communicate the consequences of not meeting these funding levels.

2. Data Collection Efforts

A number of roadway agencies provided us with data to conduct this analysis. As noted above, nine local agencies provided their pavement inventory and condition data to us.[11] They supplied this data from their RoadSoft systems. MDOT provided bridge inventory and condition information from Pontis, its centralized bridge database. We also obtained comprehensive Act 51 expenditure data from MDOT.

3. Structure of Analysis

We structured our analysis by asset type, conducting a detailed analysis of 2008 to 2010 expenditures in three separate workbooks: one for pavement, one for bridges, and one for roadside assets and winter maintenance costs. This analysis can be found in the files "Bridge—Populated Data Matrix," "Pavement—Populated Data Matrix," and "Roadside Assets—Populated Data Matrix." The pavement and bridge files also contain pavement and bridge condition information recorded as of 2011, as well as projections for future needs.

We combined the actual and projected costs analysis for these asset types in a workbook named "Local Agency Costs for All Asset Types." This workbook includes rollups of all costs and provides a comprehensive picture of local agency current and needed expenditures per lane mile across Michigan regions, local agency types, and roadway types. It also includes total annual expenditure projections for each of these categories, and for each asset type.

Finally, we prepared an updatable local agency workbook tool, the "TAMC Updatable Workbook for Local Agency Data," which will serve as a repository for local agency inventory, condition, and expenditure data. This information will be tracked against expenditure projections and their associated condition levels over a twenty-year period.

[11] DMG initially attempted to obtain data from eleven county road commissions and from seven cities. However, we reduced our target number to five counties and four cities, since a number of agencies we reached out to either provided us with no data or provided us with incomplete or inaccurate data.

B. Inventory Data

1. Pavement Inventory

a. Information sources

The nine local agencies that provided pavement inventory data to us recorded a total inventory of 15,272 lane miles as of mid-2011. Each agency supplied us with the centerline mile inventory data it exported from its RoadSoft software (the pavement management system in use by the majority of local agencies in Michigan). We converted the centerline mile data provided by local agencies to lane miles based on the lane information included in the RoadSoft data provided.

These inventory numbers were shared with each local agency for validation. Where any agency directed us to another system of record as the source to use, DMG supplemented RoadSoft inventory data with inventory information from Act 51 Reports or provided by a local agency's staff—as directed by the local agency.

We used the roadway classes corresponding to Act 51 Reports, so that expenditures could be incorporated into the analysis most accurately. National Function Class (NFC) one through five roads were classified as "County Primary" or "City Major," depending on their local agency owner. NFC six and seven roads were classified as "County Local" or "City Local," depending on their owner.

b. Assumptions made

DMG assessed the inventory information provided by each agency in the context of all inventory information available for a given agency. We resolved inconsistencies by using information supplied by the most reliable information source—generally determined to be local agency staff with first-hand knowledge of current pavement inventory.

c. Accuracy of data

DMG considers the pavement inventory data included in this analysis to be reliable. However, we know of no verification methods currently in place for Michigan local agency inventory checks.

2. Bridge Inventory

a. Information sources

Pontis, the bridge management software tool maintained by the Michigan DOT, contains all bridge inventory information used in this analysis. DMG performed its analysis using data on all Michigan local agencies' bridges from Pontis.

Pontis includes all bridges open to the public within the boundaries of the State of Michigan, regardless of ownership. MDOT's bridge management unit provided DMG with guidance to exclude any bridges not owned by Michigan's local agencies (e.g., the International Bridge, the Ambassador Bridge, the Blue Water Bridge, etc), since the Act 51 Report cost information assessed does not include these bridges.

MDOT provided an export of their Pontis database, current as of March 30, 2011. MDOT bridge inspectors update inventory information on a continual basis; this information is updated frequently due to construction, improvement (e.g., widening), and the demolition of structures.

We used the roadway classes corresponding to Act 51 Reports for bridge mapping as well. Bridges on or under National Function Class (NFC) one through five roads were classified as "County Primary" or "City Major," depending on their local agency owner. Bridges on or under NFC six and seven roads were classified as "County Local" or "City Local," depending on their owner.

b. Assumptions made

We did not make any assumptions regarding bridge inventory other than relying on the data set exported from Pontis.

c. Accuracy of data

DMG has treated bridge inventory information available in Pontis to be accurate and up to date, since MDOT's bridge management unit maintains and updates it on a regular basis.

3. Roadside Asset Inventory

a. Roadside asset definition

We use the term "roadside assets" as a catch-all category for assets not associated with pavement or bridge activities, including any indirect costs related to all asset types. We have broken roadside asset activities down into the following subcategories: drainage, traffic and safety, roadside, facilities, winter maintenance, and "other." Roadside asset "other" costs consist primarily of general overhead, leave time, clerical, equipment purchase and repair, and supervision costs. The "other" category also includes debt retirement and interest payments.

b. Information sources

Since local agencies do not record information on specific roadside asset inventories in a standardized, reported format, we allocated roadside asset costs

across pavement inventories to determine per-lane-mile costs associated with all roadside assets.

c. Assumptions made

We did not make any assumptions regarding roadside asset inventories, since local agencies could not provide us with a sample of roadside asset inventories in a standardized format. Any assumptions noted above regarding pavement inventory also apply here.

C. Condition Data

1. Pavement Condition Data

a. Information sources

Local agencies provided pavement condition data for 2008, 2009, and 2010 in the form of Pavement Surface Evaluation and Rating (PASER)[12] condition information, as stored in RoadSoft. DMG treated averages of these conditions as reflective of local agency pavement conditions across the state.

b. Approach for analysis

We classified pavement conditions as "good," "fair," or "poor" based on MDOT PASER classifications. MDOT classifies a PASER condition of eight to ten as "good," five to seven as "fair," and one to four as "poor."

This analysis assumes that the condition data provided by the nine participating local agencies reasonably reflects the condition of all pavement conditions across the state. In the future, as local agency condition information is tracked in the *Updatable Workbook*, more comprehensive data will be available for making future need projections.

2. Bridge Condition Data

a. Information sources

We relied on the same comprehensive data source for bridge condition data as we used for bride inventory—MDOT's export of their Pontis database, current as of March 30, 2011. Typically, MDOT inspects and updates each bridge in Pontis once every two years; however, certain bridges may be inspected more or less frequently.

[12] PASER is a system for visually rating the surface condition of pavement on a scale of one to ten. The ratings are intended to correspond to the type of work that should be performed on pavement (e.g., crack sealing or minor patching, preservation treatments, structural improvements, reconstruction).

b. Approach for analysis

We classified bridge conditions as being in "fair to good" or in "poor" condition using MDOT's classification system. MDOT designates a bridge with condition ratings of five or above for its deck, superstructure, substructure, and culvert (National Bridge Inventory [NBI][13] items 58, 59, 60, and 62) as being in "fair to good" condition, and any bridge with a rating lower than five as being in "poor" condition. We adhered to the same mapping of ratings.

3. Roadside Asset Condition Data

a. Information sources

No standardized condition data could be obtained for roadside assets.

b. Approach for analysis

Since no standardized condition data could be obtained for roadside assets, we did not have information on which to base estimates of roadside asset conditions. As a result, we conservatively assumed all roadside assets belonging to Michigan's local agencies to be in fair to good condition. It is unlikely that this assumption is uniformly the case, however.

D. Maintenance Expenditure Data

1. Pavement Maintenance Expenditures

a. Information sources

Data for 2008 through 2010 in the Act 51 Reports served as the information sources for pavement expenditures. To provide an overall annual expenditure figure, we inflated these costs to 2011 dollars by applying the Producer Price Indices (PPI) used by MDOT and then taking their average.

Since the pavement analysis focused on inventory and condition information for nine local agencies, we only included the expenditure information for these local agencies in the analysis. We excluded local agency expenditures on trunkline assets, since MDOT reimburses these costs.

[13] The NBI is a database compiled by the Federal Highway Administration that includes information on all bridges and tunnels in the United States that have roads above or below them. It includes detailed information on these assets. For bridges, some examples of the information it contains include bridge type and specification, condition, geometric data, and functional descriptions.

b. Assumptions made

Act 51 Report requirements differ for counties and cities; therefore, we made different assumptions regarding each—these are detailed immediately below.

(1) County expenditures

Construction/Capacity Improvement expenditures listed in county Act 51 Reports consist of money spent on building new roads and on the widening of existing roads to improve traffic flow, capacity, and level of service. We excluded this expenditure data from the cost-per-lane-mile analysis because it focused on expenditures and conditions associated with existing pavement inventory only. Tracked costs in the *Updatable Workbook for Local Agency Data* will include construction and capacity improvement costs, since inventories will be updated in the workbook to reflect any increased capacity associated with these costs.

Preservation—Structural Improvement expenditures listed in county Act 51 Reports consist of money spent on reconstructing, rehabilitating, and resurfacing existing roads. Pavement work expenditures generally comprise the majority of these project costs, but preservation and structural improvement costs typically also include the cost of performing upgrades to various roadsides items, such as striping, signs, guardrails and barriers, culverts and storm drains, ditches, and slopes. As a result, we used engineering judgment to apply 10 percent of these costs to the roadside asset analysis and excluded it from the pavement analysis.

Maintenance expenditures in county Act 51 Reports consist of dollars spent performing preventive and routine maintenance on existing roads. Pavement preventive maintenance activities include the application of various types of surface treatments, such as chip seals, micro-surfacing, and thin asphalt overlays. Routine maintenance activities include localized corrective actions, such as pothole repairs and crack filling/sealing, which can be performed on roadside assets. A review of Michigan's trunkline expenditures for 2010 showed an even split between the expenditure amount devoted to pavement and roadside asset maintenance activities. Therefore, we included 50 percent of these costs in the pavement analysis and 50 percent of these costs in the roadside asset analysis.

(2) City expenditures

Construction—Street expenditures in city Act 51 Reports correspond to the same activities identified in the section on County Construction/Capacity Improvement above. For the same reasons detailed there, we did not include these costs in the analysis. Also for the same reasons noted above, tracked costs in the updatable workbook will include construction and capacity improvement costs.

Preservation—Streets expenditures in city Act 51 Reports consist of both the Preservation/Structural Improvement and the Maintenance expenditure categories. As a result, this broad category includes expenditures related to reconstruction, resurfacing, rehabilitation, preventive maintenance, and routine maintenance.

Based on the ratio of total preservation to total maintenance costs for the five counties' expenditures reviewed during this analysis, we estimated that 25 percent of these costs should be allocated to preservation and 75 percent should be allocated to maintenance. Using this determination, along with the ratios applied to county preservation and maintenance costs (see county expenditure section above), we determined that 60 percent of these costs should be applied to the pavement analysis and 40 percent should be applied to the roadside asset analysis.

Counties spent 33 percent of their combined preservation and maintenance budgets on pavement preservation/structural improvements and the remaining 67 percent on maintenance activities. We applied these ratios to the pavement portion of the preservation—streets costs to distinguish between preservation/structural improvement costs for cities and maintenance costs for cities.

c. Accuracy of data

While the costs obtained from Act 51 data provide a reliable data source for local agency expenditures, we restricted this analysis to the nine local agencies for which we were able to obtain inventory and condition information. As a result, the per-lane-mile costs noted for each region should be considered approximate.

Since details on each local agency's expenditures were not available to us, we approximately divided the expenditures between pavement activities and roadside asset activities. For city pavement expenditures, we similarly needed to apportion preservation/structural improvement costs between preservation and maintenance activities based on approximate estimates.

2. Bridge Maintenance Expenditures

a. Information sources

We used the Act 51 database maintained by MDOT as the source of the bridge expenditure information used. Because MDOT maintains all bridge inventory and condition information, we were able to incorporate all bridge expenditure information into this analysis.

We used costs from 2008 to 2010 to provide an average annual bridge expenditure figure. We inflated these costs to 2011 dollars, applying the PPI used by MDOT, and then averaged them. We excluded local agency expenditures on trunkline assets, since MDOT reimburses these costs.

b. Assumptions made

For the purposes of determining costs per square foot of deck area for bridges, we relied on Pontis data. We calculated a single cost per square foot of deck area to maintain bridges by summing all structural costs for each county (i.e., Construction/Capacity costs, Preservation/Structural Improvement costs, and Maintenance costs) and by summing all structural improvement costs for each city (i.e., Construction—Structure costs and Preservation—Structure costs).

c. Accuracy of data

We did not apply any approximations to estimate annual bridge expenditures.

3. Roadside Asset Maintenance Expenditures

a. Information sources

Data for 2008 through 2010 in the Act 51 Reports served as the information source for roadside asset expenditures. We inflated these costs to 2011 dollars, applying the PPI used by MDOT, and then averaged them.

Similarly to pavement, since the roadside asset analysis focused on inventory and condition information for nine local agencies, we only included the expenditure information for these local agencies in the current expenditure analysis. However, for roadside asset projections, we used comprehensive 2008 to 2010 expenditure data for all local agencies. We excluded local agency expenditures on trunkline assets, since MDOT reimburses these costs.

b. Assumptions made

Act 51 Report requirements differ for counties and cities; therefore, we made different assumptions regarding each—these are explained immediately below.

(1) County expenditures

Construction/Capacity Improvement expenditures listed in county Act 51 Reports consist of money spent on the building of new roads and the widening of existing roads to improve traffic flow, capacity, and level of service. We excluded this expenditure data from the roadside asset analysis because we focused solely on expenditures and conditions of roadside assets associated with existing pavement inventory. These costs should be included in the *Updatable Workbook*, however, since up-to-date inventory recorded in it will correspond to these costs.

Preservation—Structural Improvement expenditures listed in county Act 51 Reports include money spent on reconstructing, rehabilitating, and resurfacing existing roads. Generally, such projects are mostly comprised of pavement work, but also include costs for performing upgrades to various roadsides items, such as striping, signs, guardrails and barriers, culverts and storm drains, ditches, and slopes. We used engineering judgment to apply 10 percent of these costs to the roadside asset analysis.

Maintenance expenditures in county Act 51 Reports consist of money spent performing preventive and routine maintenance on existing roads. Based on Michigan's trunkline expenditures in 2010, we determined that these costs should be split evenly between pavement and roadside asset activities. Therefore, we included 50 percent of these costs in the roadside asset analysis.

(2) City expenditures

Construction—Street expenditures in City Act 51 Reports include the same activities identified for the Construction/Capacity Improvement county category above. We did not include these costs in the analysis.

Preservation—Streets expenditures in City Act 51 Reports consist of both the Preservation/Structural Improvement and the Maintenance expenditure categories for counties. This broad category includes expenditures related to reconstruction, resurfacing, rehabilitation, preventive maintenance, and routine maintenance.

Based on the ratio of total preservation to total maintenance costs for counties, we estimated that 25 percent of these costs should be allocated to preservation and 75 percent of these costs should be allocated to maintenance. Using this split, along with the ratios applied to county preservation and maintenance costs, we determined that 60 percent of preservation costs should be applied to the pavement analysis and 40 percent should be applied to the roadside asset analysis.

For primary roads, counties spent 30 percent of their combined preservation and maintenance primary road budgets on roadside asset preservation/structural improvements and the remaining 70 percent on maintenance activities. For local roads, counties spent 20 percent of their combined preservation and maintenance local road budgets on roadside asset preservation and the remaining 80 percent on maintenance activities. We applied these county ratios for each pavement type to the pavement portion of the city preservation—streets costs to separate preservation/structural improvement costs and maintenance costs for cities.

c. Accuracy of data

While the costs obtained from Act 51 data provide reliable data for local agency expenditures, we restricted this analysis to the nine local agencies from which we obtained inventory and condition information. We had pavement inventory for only these nine agencies and developed cost-per-lane mile estimates based on these inventories.

Since we could not obtain more detailed information on each local agency's expenditures, we estimated the expenditures applied to pavement activities and those applied to roadside asset activities based on ratios of costs across these asset types. These estimates approximate expenditure allocations across the categories, while the overall cost rollups are precise for the nine local agencies.

For city pavement expenditures, we also needed to apportion costs identified as "preservation" between preservation and maintenance activities based on approximate allocation estimates. We could not obtain precise information on expenditures in each category, so the allocation of total cost across these two categories is also estimated in the case of cities.

E. Maintenance Need Projections

1. Cost per Unit of Measure

For the asset type matrices, we calculated actual and needed costs (1) per lane mile for pavements and winter maintenance, (2) per centerline mile for non-winter maintenance roadside activities, and (3) and in terms of total costs for bridges. We determined what these costs need to be by region, as well as for primary/major roads and for local roads. In addition, we calculated total actual and needed costs combined for all asset types per lane mile to obtain a system-wide local agency cost. We converted roadside asset costs and bridge costs to lane miles to do so.

The inventory numbers used to calculate overall costs per lane mile, as well as to calculate bridge costs per lane mile, included approximations. While MDOT provided us with data on the number of centerline miles in each region's counties and in each region's cities, comprehensive inventory information was not available. Therefore, we apportioned these centerline miles by road class (county primary versus county local, city major versus city local), using road class inventory ratios calculated based on the inventory data provided by the nine participating local agencies. We also estimated the number of lane miles in each region, local agency type, and road class based on the proportion of lane miles to centerline miles based on the nine local agencies' inventories that we collected.

a. Pavement costs per lane mile

DMG used lane miles as the unit of measure for pavement costs, since lane miles best reflect the amount and cost of pavement maintenance and preservation costs.

b. Bridge costs

DMG calculated total costs for bridges, because costs per square foot of deck area could not readily be incorporated into per-lane mile cost rollup figures. When combining costs across asset types, we divided bridge costs by pavement lane-mile inventories.

c. Roadside asset (non-winter) costs per centerline mile

We used centerline miles for roadside asset costs not associated with winter maintenance activities in our roadside asset cost analysis, since non-winter maintenance roadside asset activities generally do not vary as a function of the number of lanes on a given road. When combining costs across asset types, we converted these centerline-mile costs to lane-mile costs.

d. Winter maintenance costs per lane mile

We calculated winter maintenance costs in terms of lane miles because the costs of winter maintenance activities performed on a stretch of roadway vary in relation to the number of lanes on that portion of the roadway.

2. Need Assessment Duration—2011 to 2030

DMG determined that a twenty-year period for annual need projects would provide a reasonable length of time for Michigan local agencies to bring all assets currently in poor condition to a fair to good state, as well as to maintain all assets in a fair to good condition, once that condition-level has been reached. We have projected annual needs out to 2030 by applying a five-percent inflation factor for all assets. MDOT provided this inflation estimate, which can be adjusted in the *Updatable Workbook* once these rates become historical.

As noted above, we did not include possible costs associated with the paving of what are currently maintained as unpaved roads or any costs associated with system expansion in the per-lane-mile cost projections made.

3. Pavement Projections

a. Analysis approach

We used RoadSoft's default pavement deterioration models as the basis for modeling pavement performance for local agencies. We revised these performance models for each region, road class/functional class based on the pavement mileage in each pavement-type category (i.e., lane-miles of asphalt, concrete, composite and seal coat). These deterioration models treat pavement conditions as a proxy for age of the pavement.

In the *Bridge—Populated Data Matrix* workbook, we have provided average pavement costs from 2008 to 2010, as well as overall annual need projections, in terms of costs per lane mile. We have also separated these overall costs into preservation/structure improvement costs vs. preventive/routine maintenance costs. Based on statewide expenditures between 2008 and 2010, we estimated that 75 percent of the projected expenditures needed would be allocated to preservation/structural improvement work and 25 percent of the projected needs would be allocated to preventive/routine maintenance work.

We have used these same projections in *Local Agency Costs for All Asset Types* workbook and in the *TAMC Updatable Workbook for Local Agency Data*.

b. Assumptions made

We took the condition data provided by the nine local agencies participating in this collection effort to be reflective of the conditions across each local agency's region. Accuracy of projections

Our projections should provide an approximate estimate of needed expenditures based on estimates of current local agency, system-wide condition levels. Once the TAMC has entered all 128 top local agencies' condition information in the *Updatable Workbook*, the accuracy of these projections can be better assessed.

Based on the information available to us, we have made the most accurate projections possible at this time. We believe that our analysis will provide a reasonable degree of accuracy regarding necessary pavement expenditures.

4. Bridge Projections

a. Analysis approach

We used the MDOT Bridge Condition Forecasting System (BCFS)—which MDOT relies on to generate state trunkline bridge needs—to generate our projections for local agency bridge conditions.[14] For the purpose of the current study, we modified BCFS to perform a twenty-year simulation and to obtain an ending condition of 100 percent of Michigan's local agency bridges in fair to good condition.[15]

We ran BCFS simulations two times in order to obtain need projections—once at the county level and once at the city level. Since BCFS works from a summary of current conditions of the inventory subset to be analyzed, we first obtained a summary of all inventory from Pontis using a SQL query. We then used the total needs generated by BCFS, allocating them by region and functional class proportionately to bridge deck area, since costs should roughly correspond to bridge deck area.

b. Assumptions made

BCFS is a network level model and does not conduct simulations for individual bridges, neither does it consider functional needs (such as widening) that a bridge may require. The results it provides that we used in this analysis reflect overall

[14] BCFS simulates ten years of deterioration, associating costs of replacement, rehabilitation, and capital preventive maintenance that occur because of these deteriorated conditions. Once a budget constraint has been applied to each year of the simulation, BCFS produces the forecast condition of the bridge inventory. The budget can be iteratively adjusted by the user to obtain any desired condition target.

[15] MDOT uses targets lower than 100 percent for bridge planning purposes in BCFS. As a result, we needed to adjust the BCFS models for generating needs and efficacy of activities, in order to obtain valid results for the higher condition targets.

conditions of the bridge inventory, rather than the conditions of any particular bridges.

c. Accuracy of projections

In the aggregate, the projections provided in this analysis should be considered reliable. However, since the analysis provides system-wide averages of projections, the bridge deck area proportions used to allocate the overall projections by region and by road type should be considered approximate apportionments of total costs.[16]

5. Roadside Asset Projections

a. Analysis approach

Without standardized roadside asset inventory and condition data, we could not project future needs for maintaining roadside assets in fair to good condition based on current conditions. Instead, we relied on average expenditure amounts for 2008 to 2010 (adjusted for inflation) to use a steady-state approach to roadside asset cost projections.

Because winter maintenance costs are independent of other roadside asset expenditures, and because winter weather conditions largely drive winter maintenance costs, we treated these separately in the analysis. As a result, non-winter maintenance projections use only the non-winter maintenance expenditures and maintain this steady-state of funding, adjusted only for inflation.

Likewise, we based our winter maintenance projections on the average expenditure amounts from 2008 to 2010, adjusted only for inflation. While we cannot predict winter maintenance costs in any given year, this three-year average should provide a rough estimate of winter maintenance costs over the twenty-year period for which we have made projections.

b. Assumptions made

Our analysis assumes that all roadside assets are currently in fair to good condition. Based on anecdotal input provided by MDOT and local agency staff, we believe that this may not be the case.

We also assumed that, on average, winter conditions over the next twenty years will approximately match overall winter conditions between 2008 and 2010.

[16] This BCFS analysis should not be used to conduct a needs analysis for a smaller area, such as a single city or county, since the estimates are very inexact for small subsets of the bridge inventory. For the purposes of individual cities or counties, MDOT's Pontis models would be a much more accurate source of bridge need estimates.

c. Accuracy of projections

If local agency roadway managers feel that current roadside asset conditions are not acceptable, then non-winter maintenance need projections for future years should be increased. Similarly, if local agency roadway managers expect deterioration rates to lower current conditions to unacceptable levels in future years, non-winter maintenance need projections for future years should also be raised.

Unfortunately, without standardized roadside asset condition data to look to, future need assessments can only be based, at best, on rough estimates determined through a general assessment of current condition levels, and on anticipated and desired conditions for the future.

Though winter maintenance cost projections should be roughly accurate when applied to the twenty-year projection period, though any single year could diverge rather sharply, depending on winter weather conditions in that year.

F. Local Agency Costs for All Asset Types

The *Local Agency Costs for All Asset Types* workbook provides comprehensive information on needed expenditures, per lane mile and in terms of total expenditures, by asset type to bring all local agency assets to a fair to good condition level. It also includes current expenditure information per lane mile by asset type.

1. Overall Annual Needs

DMG calculated the total expenditure amounts provided in the *Local Agency Costs for All Asset Types* workbook by using the output of the three asset type-specific analyses, located in the *Pavement—Populated Data Matrix, Bridge—Populated Data Matrix*, and the *Roadside Assets—Populated Data Matrix*. We incorporated high-level details of actual and need projection expenditures from these matrices to provide a comprehensive picture of local agency costs and needs.

2. Costs per Lane Mile

We converted all expenditures to per-lane mile costs in order to total expenditures for all asset types. Costs and needs provided on a per-lane mile basis can be allocated based on pavement inventory and can be used to compare local agency funding levels.

3. Data Sources and Assumptions

We have calculated need projections based on condition and expenditure information provided by the nine participating local agencies for pavement, and based on comprehensive information provided for bridges. The static-state roadside asset condition assumptions (stated above) apply here as well.

We used MDOT GIS Coordinator inventory data on all certified public roads by local agency as the source of local agency road inventory by region, agency type, and for the total centerline-mile inventory in Michigan. We apportioned and allocated costs by region and agency type based on this data. However, in order to apportion and allocate costs according to road class, we needed to use approximate ratios determined based on data from the nine participating local agencies. In addition, because we needed inventory in terms of lane miles for the purposes of this analysis, we used approximate lane-mile to centerline-mile ratios to convert inventory and cost data where needed. We based these conversion factors on the inventory data received from the nine participating local agencies.

III. Summary of Research Findings

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A. Projected Needs to Bring All Assets to Fair to Good Condition[17]

We have developed annual cost estimates as part of our twenty-year forecast for bringing all local agency assets up to fair to good condition and maintaining them at this level. They are detailed by agency, road, and asset type below. Based on complete condition data for bridges exported from Pontis, 87.1 percent of bridges (measured as a percentage of deck area) appear to be in fair to good condition. Based on the RoadSoft condition data collected from nine participating local agencies, we estimate that approximately 62.0 percent of pavement (measured as a percentage of lane-miles) is currently in fair to good condition.

1. Overall

Accounting for all costs, DMG estimates that Michigan's local agencies require $14,123 per year per lane mile (in 2011 dollars) to bring all assets to a fair to good condition level (assuming a static state for roadside asset conditions). Counties require $12,133 per lane mile and cities require $22,907 per lane mile. Primary county and major local roads will require $19,431 per lane mile, while county and city local roads will require $11,269 per lane mile.

In 2010, Michigan local agencies spent $6,886 per lane mile on all of their assets. Adjusted for inflation, this would be equivalent to $7,478 per lane mile of expenditure in 2011, or approximately 52.9 percent of the annual amount of expenditures needed to bring all local agency assets to a fair to good condition level and to maintain them at this level.

In 2009, Michigan local agencies spent $7,370 per lane mile on all roadway system assets, or $8,461, in terms of 2011 dollars. This represents 59.9 percent of the annual amount of expenditures required to bring all local agency assets to a fair to good condition level and to maintain them at this level. In 2008, Michigan local agencies spent $7,623 per lane mile on their roadway system assets—$8,081 per lane mile, in 2011 dollars. This amount represents 57.2 percent of the annual amount of expenditures needed to bring all local agency assets to a fair to good condition level and to maintain them at this level.

Expenditures appear to be trending downward as a percentage of dollars required per lane mile to maintain all assets at a fair to good condition level. Even at its highest

[17] Approach used to determine the projected needs provided below can be found in the research methodology section above.

point between 2008 and 2010, only six out of ten dollars neeeded could be expended by Michigan's local agencies on the maintenance of their roadway system assets.

2. Pavement

Pavement needs comprise the largest portion of overall local agency needs, totaling $9,624 per lane mile (in 2011 dollars) per year, or 68.1 percent of all needed annual expenditures. We estimate that counties will require $8,713 per lane mile and cities will require $14,406 per lane mile to maintain and improve their road surfaces. Primary county and major city roads will require $11,888 per lane mile, while local county and city roads will require $8,406 per lane mile.

Michigan local agencies spent $3,174 per lane mile on pavement assets in 2010, equivalent to $3,447 in 2011 dollars. This represents 35.8 percent of the amount of expenditure required annually to bring all pavement assets to, and to maintain them at, a fair to good condition level.

3. Bridge

We estimate the annual amount needed to bring and maintain all bridges in fair to good condition to be $573 per lane mile (in 2011 dollars). This cost comprises 4.1 percent of all annual expenditures needed in our forecast. Counties require $560 per lane mile of this amount, while cities require $619 of it. Bridges on or under primary county routes or major city routes will require $1,030 per lane mile, and bridges on or under local county or city routes will require $327 per lane mile.

In 2010, Michigan local agencies spent $344 per lane mile on their bridges, or $373 per lane mile, in terms of 2011 dollars. This translates into a bridge expenditure level of 65.1 percent of the target level needed for all bridges to be brought to and maintained at a fair to good condition level.

4. Roadside Assets

To maintain roadside assets at the current condition level, Michigan local agencies will need $3,047 per lane mile in expenditures (in 2011 dollars) annually, or 21.6 percent of all local agency expenditures required. Two-thousand one-hundred and sixty-two dollars per lane mile will be needed by counties and $6,329 per lane mile will be needed by cities. Primary county and major city roads will require $5,112 per lane mile, while local county and city roads will require $1,937 per lane mile.

A needs-driven assessment of roadside asset costs has not been conducted. We have projected needs based solely on actual roadside asset expenditures between 2008 and 2010; they will therefore track to current levels, adjusted for inflation.

5. Winter Maintenance

We estimate that winter maintenance costs will average $879 per lane mile (in 2011 dollars) annually, comprising 6.2 percent of overall annual costs. Of this amount, $698 per lane mile will be needed for county winter maintenance and $1,553 will be needed for city winter maintenance. Primary county and major city roads will require $1,401 per lane mile and local county and city roads will require $599 per lane mile.

A needs-driven assessment of winter maintenance costs has not been conducted. We have projected needs based solely on actual winter maintenance expenditures between 2008 and 2010; they will therefore track to current levels, adjusted for inflation.

B. Assessment of Current Funding Level

A significant increase in the per-lane-mile funding of pavement-related activities at the local-agency level is required if pavement asset conditions are to be improved system-wide. By comparison to pavement funding levels, bridge funding levels appear to be relatively close to what Michigan local agencies need to improve and maintain their bridges at a fair to good condition level. It is likely that roadside assets would also benefit from an increase in per-lane-mile funding, but this cannot be quantified reliably without standardized inventory and condition data being reviewed to estimate roadside asset needs.[18]

[18] Possible costs of system expansion or the paving of unpaved roads have not been included in this funding-level evaluation.

IV. Recommendations for Data and Process Reconciliation Improvements

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A. Overview of Recommendations

Based on DMG's data collection experiences over the course of this project, we believe the availability of local agency expenditure and asset condition information could be improved. Comprehensive pavement (for non-federal aid eligible roads) and standardized roadside asset information is not currently warehoused or otherwise centralized in most instances. Through Act 51 Reporting, MDOT centralizes certain expenditure information, but this data aggregation is limited to summary expenditure information.

Information appears to be housed in information silos both within and across roadway agencies, which may limit a management-level view of system-wide expenditure, condition, and forecasting information. We recommend that the TAMC and local agencies work to better integrate expenditure and condition data for improved system-wide asset management and planning.

We have developed the *TAMC Updatable Workbook for Local Agency Data* to centralize inventory, expenditure, and condition data for the purpose of system-wide asset management and planning. It focuses on providing information rollups of data to enable a more comprehensive assessment of pavement and bridge expenditures, conditions, and needs[19] for 128 local agencies that own approximately 92 percent of roadway centerline miles in Michigan. These rollups can be tracked against our expenditure need projections and condition levels that correspond to them as a twenty-year target.

Additional efforts we recommend to improve data collection and analysis will be detailed in the sections that follow. We provide recommendations below specifically for improving standardized data availability—this data will still need to be translated into management-level tools once available, so that the comprehensive, system-wide information can facilitate informed decision making.

B. Inventory Data Availability and Recommendations

1. Pavement Inventory

Throughout the course of this project, we could not obtain detailed, comprehensive road inventory information for all federal and non-federal aid local agency roads. We recommend that all local agency inventory (for both paved and unpaved roads, federal funding eligible and non-federal funding eligible roads) be compiled and updated on

[19] Roadside asset conditions could not be included in the workbook, since they are not currently tracked.

an annual basis. While we were able to obtain total centerline mileage by local agency, this information did not include roadway classes of the inventory, nor did it include the number of lane miles of each roadway.

It would expedite analysis and planning if pavement inventory information could be stored and updated in a single database to which all local agencies could contribute.

2. Bridge Inventory

Pontis includes comprehensive bridge inventory information, which can be exported for management-level planning purpose. No additional data is needed for bridge inventory tracking.

3. Roadside Asset Inventory

We were not able to obtain any roadside asset inventory data, since local agencies do not currently record this information in a standardized format. It would be helpful for work planning, tracking, and budgeting purposes to maintain a standardized inventory of roadside assets.

C. Condition Data Availability and Recommendations

1. Pavement Condition Data

During this project, we were unable to locate a centralized source of pavement condition data that included non-federal aid eligible roads. Each local agency uses its own pavement management system, comprehensive, non-federal aid eligible roadway data from which is not warehoused in a centralized location. In the future, centralizing pavement data across local agencies would provide a comprehensive view of overall conditions that could readily be summarized and tracked.

2. Bridge Condition Data

MDOT stores comprehensive bridge condition data for all public bridges in Michigan in Pontis. We do not have recommendations for any changes to the current practices in this area.

3. Roadside Asset Condition Data

Similar to roadside asset inventory, local agencies do not currently record roadside asset conditions in a standardized format. At a minimum, we would recommend that the TAMC work to develop roadside asset standardized condition assessment evaluation criteria that could be adopted by each local agency. Standardized evaluation cut-offs for each condition levels would be provided by the TAMC for uniform, objective assessments. A local agency that assessed their roadside assets using this standardized criteria could then communicate their findings to the TAMC,

and since collected using standardized grade cut-offs, the TAMC could then compile this information for use in future planning and budgeting efforts.

D. Expenditure Data Availability and Recommendations

Local agencies report aggregated, summary expenditure information when they submit their Act 51 Reports annually. MDOT maintains this information in an Act 51 Report database. However, detailed, project-level expenditure information is not available for pavement, bridge, or roadside asset work. In addition to the information included in Act 51 Reports, we recommend that Michigan local agencies to record the asset type, specific asset, activity type, and specific activity associated with expenditure information using a uniform recording method and categorization process. If this information could be recorded by each local agency and consolidated across them, it would provide more precise expenditure information regarding the activities and assets on which work is being performed.

E. Long-Term Improvement Efforts

In order to continue to improve system-wide asset tracking and planning across local agencies, more information should be made available to the TAMC and local agencies in a form that is both accessible and usable. Annual use of the *TAMC Updatable Workbook for Local Agency Data* should be considered a first step towards improved data collection, consolidation, and utilization for system-wide planning purposes. (If data interfaces to RoadSoft and Pontis could be developed, this would expedite the updating of the workbook.) More generally, information technology tools that bring together accurately tracked inventory, condition, and expenditure information (such as a data warehousing application) and/or that enhance the ability to track this information (such as a maintenance management system) would further assist the TAMC and local agencies in improving system-wide tracking and planning.

V. Updatable Local Agency Tool: User Manual

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A. Updatable Local Agency Tool Overview

Dye Management Group (DMG) has conducted an analysis to estimate what the per lane mile cost would be to Michigan's local agencies if they were to bring all roadway systems assets to a fair to good condition level and maintain them at this level. The *TAMC Updatable Workbook for Local Agency Data* incorporates the cost and condition projections developed for this purpose. It also provides rollups of inventory, cost, and condition information at the regional, agency-type, and road class level, and compares actual expenditures and conditions to projected ones.

In order for the workbook to provide the outputs for which it has been developed, information will have to be provided annually by the 122 local agencies that currently have public roadways of 100 miles or more in their jurisdictions, as well as by the three local agencies in the Superior region and the three local agencies in the North region that have under 100 miles of public roadway in their jurisdictions, but that have the largest inventories of all the cities in their regions.

A *Local Agency Data-Reporting Tool* will be provided to each participating local agency on an annual basis to assist them in their efforts to document this information, and to ensure all agencies use a consistent format and data collection method. Once completed by a local agency, the data collection tool will be submitted to the TAMC. The TAMC's GIS coordinator will then manage updating of the centralized workbook.

After the information has been entered in the workbook, the tool will provide summary, as well as more detailed, information on local agency roadway system inventory, condition, and expenditures for the purposes of condition tracking and budget planning.

1. Inventory Data

Pavement and bridge inventories will be checked and updated annually by each local agency. Lane-mile inventory data will be used by the workbook to determine total cost needs. (Actual and forecast cost rollups will be generated by the workbook per lane mile and as total dollar values.)

2. Condition Data

Local agencies will need to provide their pavement and bridge condition data annually—they will record this information in terms of the percent of assets in good, fair, and poor condition. Once this information has been entered in the workbook, average pavement and bridge conditions will be available at the region, agency-type,

and road-class level, as well as statewide. This data will be compared with condition rollups for the twenty-year need scenario prepared for and included in the workbook.

3. Expenditure Data

Annual costs will need to be entered by local agencies using their Act 51 Report data. These costs will ultimately be combined with data provided by other local agencies in terms of region, agency-type, and road class.

4. Forecast Conditions and Costs

We have already input per-lane mile forecast costs in the tool. Inflation factors will need to be updated and total cost forecasts will vary based on the inventory updates made, but these costs will otherwise serve as a fixed point of comparison to actual costs. Similarly, we have fixed forecast conditions, which assume that local agencies will do the amount of work corresponding to the projected need expenditures in the forecast. The forecast conditions will also serve as a point of comparison to the actual conditions achieved.

B. Updating Local Agency Data Collection Worksheets

The TAMC will annually provide each participating local agency with a *Local Agency Data Reporting Tool*, an Excel document consisting of several data collection worksheets each year. Local agencies will need to populate it with inventory, condition, and expenditure information and return the completed document by the requested submission date.

1. Information Sources

Local agencies will populate the worksheets using information from their pavement management system (generally, this will be RoadSoft), Pontis, and their annual Act 51 Report.

2. Inventory

Inventory information will need to be populated for pavement and bridge inventories by local agencies. At a minimum, total lane-miles of pavement should be entered in the inventory worksheet. If a local agency tracks inventory information by pavement type, this information should be included. Centerline mile inventory entries are optional.

Inventory will be classified as primary or local for counties, and as major or local for cities. “County Primary” and “City Major” roads correspond to National Function Classes (NFCs) one through five, while “County Local” and “City Local” roads correspond to NFC’s six and seven.

a. Pavement inventory instructions

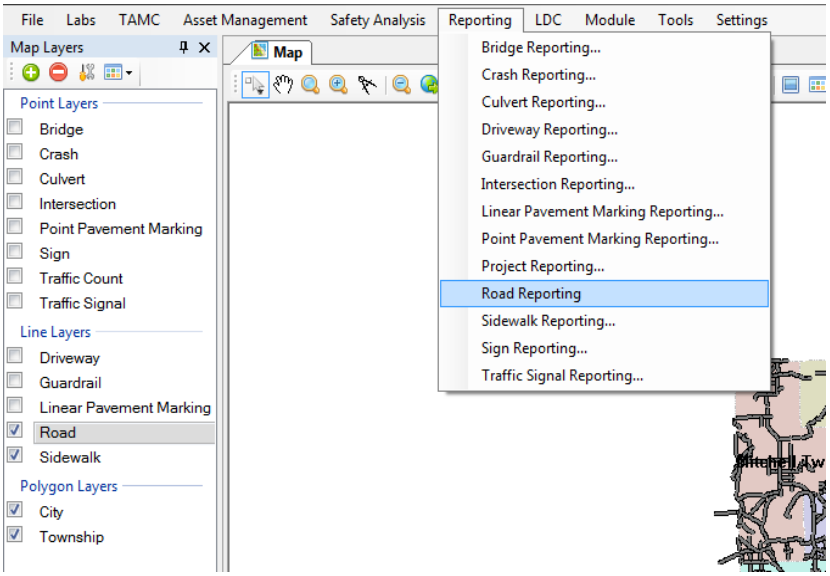
Local agencies will first need to make sure that their RoadSoft data is up to date, if it is their inventory system of record. Once they have done so, they will need to extract the relevant pavement inventory data from it by following the instructions below. (If a local agency has more accurate inventory information available from another source, RoadSoft need not be used.)

After obtaining condition information, it should be entered into the *Updatable Workbook Data Entry Tool*. The inventory calculation worksheet will automatically convert functional classes to local agency road class.

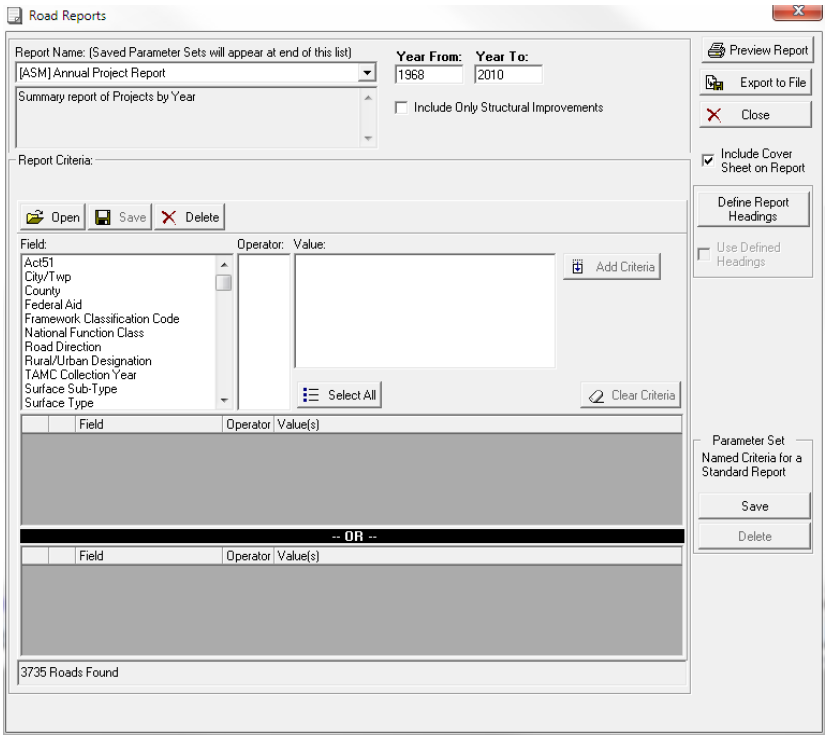
The following procedure can be followed to extract the information needed from RoadSoft:

1. Open RoadSoft.

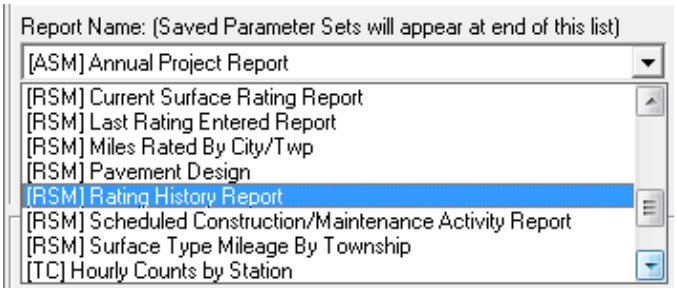
2. Click on the "Reporting" menu and select "Road Reporting" from the dropdown menu, as show below.



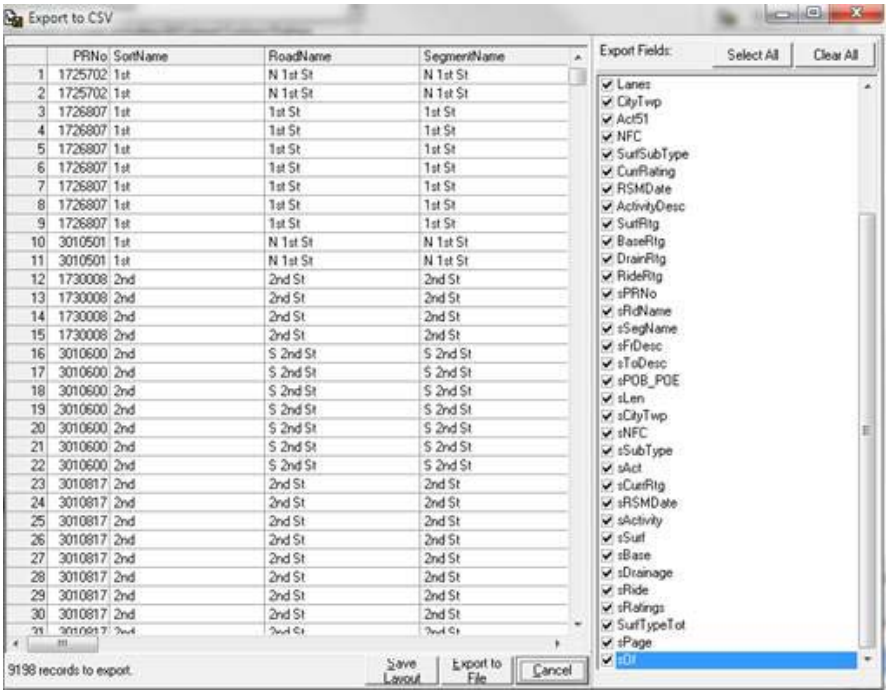
Once you have done so, the following popup window will appear:



3. Select “Rating History Report” from the “Report Name” drop-down menu, as shown below. Then click “Export to File.”



The following window should now appear:



4. Click on the "Export to File" button at the bottom of the window. This will save the file in a .csv format, which can be viewed in Excel.

5. Repeat steps (1) to (4) above, selecting the applicable report as listed in the window shown in step (3), to generate the *Detailed Road and Segment Report* and the *Multi-Year Program Project Report.*

6. After exporting this information, inventory totals should be entered into the *Updatable Workbook Data Entry Tool*.

b. Bridge inventory instructions

Local agencies can obtain bridge inventory information using an SQL query performed on the Pontis database. Alternatively, each bridge owned by a local agency can be accessed individually in Pontis or in the Michigan Bridge Information System (which uses the same database) to obtain its length and width. However, if the area is obtained in square meters, it will need to be converted manually to square feet.

After obtaining this information, inventory totals should be entered into the *Updatable Workbook Data Entry Tool*. The inventory calculation worksheet will automatically convert functional classes to road class based on the mapping summarized in the inventory section above.

The SQL query for generating this information should be run by staff members familiar with Pontis data and experienced running SQL queries. The latest *Pontis Bridge Management User's Manual* should provide any needed guidance to the experienced user. The SQL query that can be used is provided below:

```
select
(if b.district='01' then '(1) Superior' else
if b.district='02' then '(2) North' else
if b.district='03' then '(3) Grand' else
if b.district='04' then '(4) Bay' else
if b.district='05' then '(5) Southwest' else
if b.district='06' then '(6) University' else
'(7) Metro' endif endif endif endif endif endif) as Region,
'Bridge' as Asset,
(if ub.brdg_ownr_cd=1 or ub.brdg_ownr_cd=15 or ub.brdg_ownr_cd=16 then 'City' else
if ub.brdg_ownr_cd=2 then 'County' else
'State' endif endif) as Level,
'Sq.Ft.' as Units,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='01' then 1 else 0 endif)) as FC01,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='11' then 1 else 0 endif)) as FC11,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='02' then 1 else 0 endif)) as FC02,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='12' then 1 else 0 endif)) as FC12,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='14' then 1 else 0 endif)) as FC14,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='06' then 1 else 0 endif)) as FC06,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='16' then 1 else 0 endif)) as FC16,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='07' then 1 else 0 endif)) as FC07,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='17' then 1 else 0 endif)) as FC17,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='08' then 1 else 0 endif)) as FC08,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='09' then 1 else 0 endif)) as FC09,
sum(b.length*b.deckwidth*3.281*3.281*(if mr.fc='19' then 1 else 0 endif)) as FC19,
sum(b.length*b.deckwidth*3.281*3.281) as FCTotal
from bridge b,userbrdg ub,inspevnt i,
(select r.brkey,max(r.funcclass) as fc from roadway r
  where r.funcclass>='01' and r.funcclass<='19'
  and right(r.funcclass,1)=(select min(right(rr.funcclass,1)) from roadway rr where
rr.brkey=r.brkey and rr.funcclass>='01' and rr.funcclass<='19')
  group by r.brkey) mr
where b.brkey=ub.brkey and b.brkey=mr.brkey
and i.brkey=b.brkey and i.inspkey=(select max(ii.inspkey) from inspevnt ii where
ii.brkey=b.brkey
  and ii.inspdate=(select max(iii.inspdate) from inspevnt iii where iii.brkey=b.brkey))
and (ub.brdg_ownr_cd<9 or ub.brdg_ownr_cd>14) and ub.brdg_ownr_cd>0
and not (ub.brdg_ownr_cd=1 and ub.cty_rsp_cd in (8005,8020,8039))
and b.length>0 and b.deckwidth>0 and Level<>'State'
group by Level,Region
order by Level Desc,Region
```

This query will perform the following data transformations:

- Omits the International Bridge, the Ambassador Bridge, the Blue Water Bridge, the Mackinac Bridge, the Grosse Ile Toll Bridge, and the Standish Correctional Facility, as well as the bridges owned by Michigan State University, Western Michigan University, and Metro Airport
- Omits all forty-six bridges marked as having an unknown owner, all bridges the length or width of which is coded as zero or less (i.e., all bridges missing value codes), and all structures that lack inspection data
- Determines the level of government of each bridge's owner, based on the Pontis data item userbrdg.brdg_ownr_cd
- Determines the highest functional class of all roads on or under each bridge, based on the Pontis data item roadway.funcclass (National Bridge Inventory item 26, federal functional classification); for example, if a collector road passes over an Interstate, the bridge is categorized in the Interstate functional class
- Determines the region in which each bridge is located, using Pontis data item bridge.district (National Bridge Inventory item 2)
- Computes deck area by multiplying structure length (National Bridge Inventory item 49) by deck width (National Bridge Inventory item 52) and converts deck area to square feet
- Sums the square footages over all combinations of each agency type, region, and functional class, in a manner that places the functional classes in separate columns and also provides a total across functional classes
- Sorts the rows of the table by level of government and region

These results can be filtered for a particular city or county by using userbrdg.brdg_ownr_cd, and userbrdg.mdotcnty_cd or userbrdg.cty_rsp_cd, and the city's or county's code. If a local agency does not have its code, Pontis database administrators should be able to provide it to local agency staff.

3. Condition Data

The condition worksheet should be populated with pavement and bridge condition data. No condition data will be entered for roadside assets.

a. Pavement conditions

Pavement condition information should be obtained from RoadSoft (or from the pavement management system in use by a local agency, if it is not RoadSoft), and should be the most recent information available.

A PASER rating of eight to ten should be categorized as "good," five to seven as "fair," and one to four as "poor." Percentage of pavement for each pavement type (by lane miles) in each condition should be entered in the condition worksheet. If

inventory information has only been entered for total pavement, then condition information should only be entered for total pavement.

If a local agency does not know how to export the condition information needed from RoadSoft, tutorials can be found at http://www.roadsoft.org/training/tutorialvideos. Any questions should be directed to RoadSoft support personnel. Contact information is available at http://www.roadsoft.org/about.

After obtaining condition information, it should be entered into the *Updatable Workbook Data Entry Tool*. The condition calculation worksheet will automatically convert functional classes to road class (see inventory section above for mapping).

b. Bridge conditions

The SQL query for obtaining bridge condition information should be run by staff members familiar with Pontis data and experienced running SQL queries. The latest *Pontis Bridge Management User's Manual* should provide any needed guidance to the experienced user.

Alternatively, each bridge owned by a local agency can be accessed individually in Pontis or in the Michigan Bridge Information System (MBIS) (which uses the same database) to obtain its condition. If a local agency uses the MBIS, it will need to use the MBIS scores to identify bridges in poor and fair to good condition.

Once the data has been obtained, transfer it to the *Updatable Workbook Data Entry Tool*. The condition calculation worksheet will automatically convert functional classes to road class (see inventory section above for mapping).

The SQL query that can be used is provided below:

```
select
(if b.district='01' then '(1) Superior' else
if b.district='02' then '(2) North' else
if b.district='03' then '(3) Grand' else
if b.district='04' then '(4) Bay' else
if b.district='05' then '(5) Southwest' else
if b.district='06' then '(6) University' else
'(7) Metro' endif endif endif endif endif endif) as Region,
'Bridge' as Asset,
(if ub.brdg_ownr_cd=1 or ub.brdg_ownr_cd=15 or ub.brdg_ownr_cd=16 then 'City' else
if ub.brdg_ownr_cd=2 then 'County' else
'State' endif endif) as Level,
'Pct' as Units,
(if sum(wi.totsqm*(if mr.fc='01' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='01' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='01' then 1 else 0 endif))*100.0
```

```
endif) as FC01,
(if sum(wi.totsqm*(if mr.fc='11' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='11' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='11' then 1 else 0 endif))*100.0
endif) as FC11,
(if sum(wi.totsqm*(if mr.fc='02' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='02' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='02' then 1 else 0 endif))*100.0
endif) as FC02,
(if sum(wi.totsqm*(if mr.fc='12' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='12' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='12' then 1 else 0 endif))*100.0
endif) as FC12,
(if sum(wi.totsqm*(if mr.fc='14' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='14' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='14' then 1 else 0 endif))*100.0
endif) as FC14,
(if sum(wi.totsqm*(if mr.fc='06' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='06' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='06' then 1 else 0 endif))*100.0
endif) as FC06,
(if sum(wi.totsqm*(if mr.fc='16' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='16' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='16' then 1 else 0 endif))*100.0
endif) as FC16,
(if sum(wi.totsqm*(if mr.fc='07' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='07' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='07' then 1 else 0 endif))*100.0
endif) as FC07,
(if sum(wi.totsqm*(if mr.fc='17' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='17' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='17' then 1 else 0 endif))*100.0
endif) as FC17,
(if sum(wi.totsqm*(if mr.fc='08' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='08' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='08' then 1 else 0 endif))*100.0
endif) as FC08,
(if sum(wi.totsqm*(if mr.fc='09' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='09' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='09' then 1 else 0 endif))*100.0
endif) as FC09,
(if sum(wi.totsqm*(if mr.fc='19' then 1 else 0 endif))=0 then null else sum(wi.oksqm*(if
mr.fc='19' then 1 else 0 endif))/sum(wi.totsqm*(if mr.fc='19' then 1 else 0 endif))*100.0
endif) as FC19,
(if sum(wi.totsqm)=0 then null else sum(wi.oksqm)/sum(wi.totsqm)*100.0 endif) as
FCTotal
from bridge b,userbrdg ub,
(select r.brkey,max(r.funcclass) as fc from roadway r
  where r.funcclass>='01' and r.funcclass<='19'
  and right(r.funcclass,1)=(select min(right(rr.funcclass,1)) from roadway rr where
rr.brkey=r.brkey and rr.funcclass>='01' and rr.funcclass<='19')
  group by r.brkey) mr,
(select bb.brkey,i.brok*bb.length*bb.deckwidth as oksqm,bb.length*bb.deckwidth as
totsqm
  from bridge bb,
  (select brkey,inspkey,
    (if dkrating>='0' and dkrating<='4' then 0 else 1 endif) as dkok,
    (if suprating>='0' and suprating<='4' then 0 else 1 endif) as spok,
    (if subrating>='0' and subrating<='4' then 0 else 1 endif) as sbok,
    (if culvrating>='0' and culvrating<='4' then 0 else 1 endif) as cvok,
```

```
   (dkok*spok*sbok*cvok) as brok
  from inspevnt) i
  where i.brkey=bb.brkey and i.inspkey=(select max(ii.inspkey) from inspevnt ii where
ii.brkey=bb.brkey
    and ii.inspdate=(select max(iii.inspdate) from inspevnt iii where iii.brkey=bb.brkey)))
wi
where b.brkey=ub.brkey and b.brkey=mr.brkey and b.brkey=wi.brkey
and (ub.brdg_ownr_cd<9 or ub.brdg_ownr_cd>14) and ub.brdg_ownr_cd>0
and not (ub.brdg_ownr_cd=1 and ub.cty_rsp_cd in (8005,8020,8039))
and b.length>0 and b.deckwidth>0 and Level<>'State'
group by Level,Region
order by Level Desc,Region
```

The above query will perform the following data transformations:

- Omits the International Bridge, the Ambassador Bridge, the Blue Water Bridge, the Mackinac Bridge, the Grosse Ile Toll Bridge, and the Standish Correctional Facility, bridges owned by Michigan State University, Western Michigan University, and Metro Airport, and all forty-six bridges marked as having an unknown owner
- Omits all bridges the length or width of which is coded as zero or less (i.e., ismissing value codes)
- Finds the most recent inspection for each bridge, omitting any structure that lacks inspection data
- Determines the level of government of each bridge's owner, based on the Pontis data item userbrdg.brdg_ownr_cd
- Determines the highest functional class of all roads on or under each bridge, based on the Pontis data item roadway.funcclass (National Bridge Inventory item 26, federal functional classification); for example, if a collector road passes over an Interstate, the bridge is categorized in the Interstate functional class
- Determines the region in which each bridge is located, using Pontis data item bridge.district (National Bridge Inventory item 2)
- Computes deck area by multiplying structure length (National Bridge Inventory item 49) by deck width (National Bridge Inventory item 52) (conversion from square meters to square feet is not needed since the results are expressed as a percentage)
- Determines the condition of each bridge by examining the four National Bridge Inventory condition assessments: deck (item 58), superstructure (item 59), substructure (item 60), and culvert (item 62); if any of these four items has a value from zero to four, the bridge is considered to be in poor condition; if all four items have numeric values greater than four, the bridge is considered to be in good or fair condition

- Sums the deck areas over all combinations of level of government, region, and functional class, in a manner that places the functional classes in separate columns and also provides a total across functional classes, then divides by total deck area and converts to a percentage
- Sorts the rows of the table by level of government and region

These results can be filtered for a particular city or county by using userbrdg.brdg_ownr_cd, and userbrdg.mdotcnty_cd or userbrdg.cty_rsp_cd, and the city's or county's code. If a local agency does not have its code, Pontis database administrators should be able to provide it to local agency staff.

4. Expenditure Data

A local agency should obtain the expenditure information needed for the cost worksheet from its Act 51 Report. Expenditures associated with trunkline data should not be included in the worksheet, since the state reimburses local agencies for these costs.

Act 51 Report costs entered in the cost worksheet will automatically be assigned to pavement, bridge, roadside asset, or winter maintenance activities based on approximations, as detailed below. Costs will also be assigned to more discrete expenditure categories based on approximations (also see below). If an agency would like to provide more precise data for each category in the worksheet, it can do so—however, the local agency should then include their data source at the top of the worksheet, and the total dollar value entered must equal their total Act 51 Report expenditures (less trunkline costs).

a. County expenditures

County expenditures from the Act 51 Report will be allocated across asset types by the expenditure worksheet using the percentages provided in Exhibit 1 below. Additionally, "Other/work for others" costs will be split evenly between the Primary Road Fund and the Local Road Fund.

Exhibit 1: Act 51 Report: County Expenditures Allocation

Expenditure Type	Expenditure Sub-Type	Pavement	Roadside Assets	Winter Maint.	Bridge
Construction/ Capacity Improvement	Roads	90%	10%	-	-
	Structures	-	-	-	100%
	All other Construction/ Cap. Improv. categories		100%	-	-
Preservation—Structural Improvements	Roads	90%	10%	-	-
	Structures	-	-	-	100%
	All other Preservation/ Struct. Improv. categories	-	100%	-	-
Maintenance	Roads	50%	50%	-	-
	Structures	-	-	-	100%
	Winter Maintenance	-	-	100%	-
	All other Maintenance categories	-	100%	-	-
Other	All other categories (except trunkline)		100%		

b. City expenditures

City expenditures from the Act 51 Report will be allocated similarly to county expenditures—with minor differences, as shown in Exhibit 2 below.

Exhibit 2: Act 51 Report: City Expenditures Allocation

Expenditure Type	Expenditure Sub-Type	Pavement	Roadside Assets	Winter Maint.	Bridge
Construction	Streets (Incl. Eng. & R.O.W.)	90%	10%	-	-
	Structures (Incl. Eng. & R.O.W.)	-	-	-	100%
Preservation	Streets	60%	40%	-	-
	Structures	-	-	-	100%
Winter Maintenance	Streets and Structures	-	-	100%	-
All Others	Other	-	100%	-	-

An additional allocation will be needed for cities. Since city Act 51 Reports do not distinguish between preservation/structural improvement costs and maintenance costs, the worksheet will also apply factors to allocate "Preservation—Streets" costs between the two. This division has been determined based on a review of MDOT's trunkline expenditures for 2008 to 2010. (The factors to be applied are provided in Exhibit 3 below.)

Exhibit 3: Act 51 Report: City "Preservation—Streets" Cost Allocations

Asset Type	Preservation Allocation	Maintenance Allocation
Pavement's 60% Preservation—Street Costs	33%	67%
Roadside Asset's 40% Preservation—Street Costs	30% for Primary/ 20% for Local	70% for Primary/ 80% for Local

C. Populating *TAMC Updatable Workbook for Local Agency Data*

Once local agencies have submitted their worksheets, The TAMC's GIS coordinator will incorporate the information in the updatable local agency workbook.

While the *Local Agency Data-Reporting Tool* can be reused each year, the *TAMC Updatable Workbook for Local Agency Data* is where all information will be stored for information tracking and analysis. Data should never be overridden in it.

All cells that require annual updating are shaded in bright yellow in the *Updatable Workbook*. Nine worksheets total require data entry in it—four for counties, four for cities,

and one for inflation rates. The remaining worksheets will auto-populate based on the data entered in these nine worksheets.

1. Inventory Data

Pavement inventory data provided by local agencies will need to be entered in the Updatable Workbook's county and city inventory worksheets annually. Lane miles must be updated, while centerline miles will auto-calculate based on the lane mile entries (using conversion factors listed in the "Ln-Mi to Ctrline-Mi" worksheet). If a local agency provides its centerline miles, these can be entered to override the approximations. Should a local agency not have access to its pavement inventory data by pavement type, total inventory levels for pavement can be entered manually (overriding the formulas).

Bridge deck area will need to be entered in the workbook in square feet. Workbook administrators should verify these areas have been provided in square feet (and not square meters) if the SQL query provided for bridge inventory above is not used to extract this information from Pontis.

2. Condition Data

Pavement condition data should be entered for all pavement types (if available) and by road type as percentage in good, fair, and poor condition. Once this information has been entered in the county and city condition worksheets, the worksheets will auto-calculate the overall pavement conditions for a county or city. If a local agency has only provided inventory information by total (instead of by pavement type), then only total condition information should be entered (overriding the formulas).

Likewise, bridge condition data should be provided as percentage of bridges in "fair to good" or in "poor" condition. Once entered for each road type, the worksheet will auto-calculate totals for counties and cities.

3. Cost Data

Each local agency should submit its annual expenditures using the Local Agency Data-Reporting Tool, which includes specific expenditure categories.

For pavement costs, routine maintenance and capital preventative maintenance will be combined; rehabilitation/reconstruction and construction/capacity improvement costs will each be entered separately. The worksheets will auto-calculate total pavement costs based on these entries. Bridge costs should be entered as a single line-item in the same cost data worksheets used for pavement costs.

Roadside asset costs should be entered as winter maintenance, non-winter maintenance, preservation, construction/ capacity improvements, and other expenditures. The worksheets will auto-calculate total roadside asset costs based on these entries.

4. Need Projections

Forecast costs should populate automatically once a year's inventory data has been entered in the workbook. However, inflation rates should be updated based on actual inflation that has occurred in a given year. Year-over-year inflation rates have been set to "5%" as a default for projections, but these should be adjusted for accuracy. They can be updated in row 6 of the "Forecast costs" worksheet on an annual basis, and should reflect a twelve-month adjustment in costs.

D. Outputs of Updatable Local Agency Workbook

1. Summary Inventory

The "SUM INV" worksheet summarizes all entered lane-mile, centerline-mile, and bridge deck area inventory information by region, road class, and approximations of federal aid and non-federal aid roads (approximated, based on road type) in three separate tables. It treats county primary and city major roads as federal aid roads and county local and city local roads as non-federal aid roads, and provides summary sub-totals for each.

This worksheet also provides total lane mile inventory information for each type of road listed (asphalt, concrete, composite, seal coat, and unpaved) if local agencies submit these details.

2. Summary Conditions

The "SUM COND" worksheet will provide overall pavement and bridge condition information for each region in terms of road class, for county primary and city major roads combined (federal-aid roads, approximately), and for county and city local roads combined (non-federal-aid roads, approximately). Overall statewide averages will also be generated.

3. Summary Actual Costs and Actual Per-Lane-Mile Costs

The "Co Cost Summary" and "Ci Cost Summary" worksheets consolidate asset type cost information entered in the four cost worksheets that precede it. The "SUM COST" worksheet provides cost rollups by region, agency type, and road class for all counties and cities participating. The worksheet includes totals for each expenditure type listed in the earlier worksheets, and for all asset types.

The "Real Costs per Mi" worksheet provides the same information as the "SUM COST" worksheet, but does so by lane mile, based on the inventory information corresponding to the year the local agencies incurred the expense. This information can more readily be compared across regions, agency types, and road classes, since variations in inventory levels will not impact the costs listed in the worksheet.

4. Forecast Cost and Forecast Per-Lane-Mile Cost Needs

The "Forecast Costs" worksheet will auto-populate once inventory data has been entered for each year. However, inflation amounts will need to be updated (see need projections" section above for details). Forecast costs per mile, located in the "Forecast Costs per Mi" worksheets will drive all forecast need expenditures based on the pavement lane-mile inventory amounts entered earlier in the workbook.

5. Forecast Conditions

With the exception of the "total" and "subtotal" rows and columns in this worksheet, the "Forecast Conditions" worksheet includes fixed projections of forecasts. No data entry will be needed for this worksheet. Totals and subtotals will be based on the inventory amounts entered annually in the inventory worksheets.

Condition forecasts for bridges are most accurate the more general they are. The worksheet provides bridge condition forecasts by agency type, but not by region for this reason. The Bridge Condition Forecasting System (BCFS) does overall, system-wide forecasting most effectively.

While the worksheet provides more detailed condition forecasts for pavement—by agency type, as well as by region and road class—these forecasts are based on pavement condition data provided by only nine agencies, and should be considered approximations.

6. Actual Costs versus Forecast Cost Needs

The "Real vs Forecast Costs per Mi" and "Real vs Forecast Cost Summary" worksheets will auto-populate based on earlier entries in the workbook. The "Real vs Forecast Costs" worksheet will subtract the totals in the forecast costs worksheet from the totals in the real costs worksheet. If the amount expended in a given year exceeds the forecast needs, the numbers listed will be positive; if local agencies spend less than the forecast needs, the numbers will be negative. The "Real vs Forecast Cost Summary" will show both actual and forecast costs side by side.

7. Actual Costs versus Forecast Cost Needs—Cumulative

The updatable local agency workbook provides a running total of the divergence of actual costs from forecast needs in the "Real vs Fcst Costs—CUMULAT" worksheet. Cumulative totals for each year will auto-populate through the current year for which data has been entered.

8. Actual versus Forecast Conditions

A comparison of actual to forecast conditions (associated with the comparison cost worksheet provided) will be available in the "Real vs Forecast Cond Summary"

worksheet. It will auto-populate and show the difference between actual and forecast conditions, by providing both sets of condition data side by side.

9. Cost and Condition Charts

The "Summary Charts" worksheet will display actual and forecast cost and condition information for local agency pavement and bridges, and actual and forecast cost information for local agency roadside and winter maintenance in graphical form for each region and overall.

E. Glossary of Terms[20]

Bridge Condition Forecasting System (BCFS): System in use by the Michigan Department of Transportation; uses average deterioration rates and average costs, and relies on current National Bridge Inventory (NBI) data.

Capital preventative maintenance costs (CPM): For pavement, considered part of county Act 51 Report "Maintenance" costs and part of city Act 51 Report "Preservation—Streets" costs.

Construction/capacity improvement costs: For pavement and roadside assets, considered part of "Construction/ capacity improvement" for county Act 51 costs, and part of "Construction—Streets (Incl. Eng. & R.O.W.)" for city Act 51 costs.

Fair: A pavement condition rating of "fair" corresponds to a PASER condition rating of five to seven.

Fair to good: A bridge condition rating of "fair to good" corresponds to a bridge with an NBI rating of five or above for its deck, superstructure, substructure and culvert.

Good: A pavement condition rating of "good" corresponds to a PASER condition rating of eight to ten.

Local Agency Data-Reporting Tool: An Excel workbook that local agencies will use to annually enter their inventory, condition, and cost data; the TAMC will update the *TAMC Updatable Workbook for Local Agency Data* with this information.

Local city roads: City roads identified as roughly corresponding to National Functional Classes (NFCs) six and seven.

Local county roads: County roads identified as roughly corresponding to National Functional Classes (NFCs) six and seven.

Major city roads: City roads identified as roughly corresponding to National Functional Classes (NFCs) one through five.

National Bridge Inventory (NBI): A database compiled by the Federal Highway Administration that includes information on all bridges and tunnels in the United States that have roads above or below them. It includes detailed information on these assets; for bridges, some examples include bridge type and specification, condition, geometric data, and functional descriptions.

Non-winter maintenance costs: For roadside assets, all maintenance costs not associated with winter maintenance in Act 51 Reports.

[20] This glossary defines terms as they are used in the *TAMC Updatable Workbook for Local Agency Data*, and not using any other definition that might apply to them.

Other expenditures: For roadside assets, all non-trunkline costs included in the "Other" category of county Act 51 Reports and rows 31 to 33, and 35 to 37 of the city Act 51 Reports (from 2008 to 2010).

Pavement Surface Evaluation and Rating System (PASER): A system for visually rating the surface condition of pavement on a scale of one to ten. The ratings are intended to correspond to the type of work that should be performed on pavement, e.g., crack sealing or minor patching, preservation treatments, structural improvements, or reconstruction.

Poor: A pavement condition rating of "poor" corresponds to a PASER rating of one to four; a bridge condition rating of "poor" corresponds to a bridge with an NBI rating below five for its deck, superstructure, substructure, or culvert.

Preservation costs: For roadside assets, considered part of "Preservation—Structural Improvement" costs in county Act 51 Reports and part of "Preservation—Streets" costs in city Act 51 Reports.

Primary county roads: County roads identified as roughly corresponding to National Functional Classes (NFCs) one through five.

Rehabilitation and reconstruction costs (R&R): For pavement, considered part of "Preservation—Structural Improvement" Act 51 costs for counties and part of "Preservation—Streets" Act 51 costs for cities.

Roadside assets: Assets associated with drainage, traffic and safety, roadside, facilities, winter maintenance, and "other." "Other" is comprised primarily of general overhead, leave time, clerical, equipment purchase and repair, and supervision costs (i.e., all roadway and roadside assets not specifically identified as pavement or bridge assets). Indirect expenditures related to work on all assets are included in this category.

RoadSoft: A pavement asset management system in use by most roadway agencies in Michigan, developed by the Center for Technology & Training at Michigan Technological University.

Routine maintenance costs (RM): For pavement, considered part of county Act 51 Report "Maintenance" costs and part of city Act 51 Report "Preservation—Streets" costs.

***TAMC Updatable Workbook for Local Agency Data*:** Excel workbook that tracks inventory, condition, and cost information for 128 local agencies, provides rollups of this information by region, agency, and road type, and then compares these rollups to twenty-year cost and condition forecasts.

Winter maintenance costs: For roadside assets, line item cost in Act 51 report for both counties and cities.

F. Appendix—Updatable Workbook Data Entry Tool Tables

1. Inventory Data Worksheet—Inventory Tables

Users of tool will enter data in yellow and orange cells. Blue cells auto-populate.

3 Pavement Inventory - Lane Miles

	National Functional Class (NFC)							County Road Class		
Pavement Type	NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Asphalt								0	0	0
Concrete								0	0	0
Composite								0	0	0
Seal Coat								0	0	0
Unpaved								0	0	0
Total Pavement	0	0	0	0	0	0	0	0	0	0

4 Pavement Inventory - Centerline Miles

	National Functional Class							County Road Class		
Pavement Type	NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Asphalt								0	0	0
Concrete								0	0	0
Composite								0	0	0
Seal Coat								0	0	0
Unpaved								0	0	0
Total Pavement	0	0	0	0	0	0	0	0	0	0

5 Bridge Inventory - Square Feet of Deck Area

	National Functional Class							County Road Class		
Bridge Deck Area	NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Total Bridge								0	0	0

2. Condition Data Worksheet—Condition Tables

Users of tool will enter data in yellow and orange cells. Blue cells auto-populate.

3 Pavement Conditions (as % of lane-miles at each condition level)

Pavement Type	Condition	National Functional Class							County Road Class		
		NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Asphalt	Good										
	Fair										
	Poor										
Concrete	Good										
	Fair										
	Poor										
Composite	Good										
	Fair										
	Poor										
Seal Coat	Good										
	Fair										
	Poor										
Total Pavement	Good										
	Fair										
	Poor										

4 Bridge Conditions (as % of bridge deck area at each condition level)

Bridge Deck Area	Condition	National Functional Class							County Road Class		
		NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Total Bridge	Fair to Good										
	Poor										

3. Expenditure Data—Expenditure Tables

Users of tool will enter data in yellow and orange cells. Blue cells auto-populate.

2 Expense Act 51 Category	Primary Road Fund	Local Road Fund	Co. Road Commission Road Fund
Construction/Capacity Improvement			
Roads			-
Structures			-
Roadside Parks			-
Special Assessments			-
Other (please specify):			-
Total Construction/Capacity Improvement	**$0.00**	**$0.00**	-
Preservation - Structural Improvements			
Roads			-
Structures			-
Safety Projects			-
Roadside Parks			-
Special Assessments			-
Other (please specify):			-
Total Preservation - Structural Improvement	**$0.00**	**$0.00**	-
Maintenance			
Roads			-
Structures			-
Roadside Parks			-
Winter Maintenance			-
Traffic Control			-
Total Maintenance	**$0.00**	**$0.00**	-
Other (i.e., miscellaneous)			
Administrative Expense			
Equipment Expense - Net			
Capital Outlay - Net			
Debt Principal Payment			
Interest Expense			
Drain Assessment			
Other (please specify):			
Other (please specify):			
Total Other (i.e., miscellaneous)	**$0.00**	**$0.00**	**$0.00**
Total - All Expenditures	**$0.00**	**$0.00**	**$0.00**
Total - All Road Classes	**$0.00**		

Expense Asset & Work Type	County Primary	County Local	Total
Pavement			
Routine Maint (RM) & Cap Prev Maint (CPM)	$0.00	$0.00	$0.00
Rehab & Reconst (R&R)	$0.00	$0.00	$0.00
Const/ Capac Improv	$0.00	$0.00	$0.00
Total Pavement	$0.00	$0.00	$0.00
Total Bridges	**$0.00**	**$0.00**	**$0.00**
Roadside Assets			
Winter Maint (WM)	$0.00	$0.00	$0.00
Maintenance (Non-WM	$0.00	$0.00	$0.00
Preservation	$0.00	$0.00	$0.00
Constr/ Capac Improv	$0.00	$0.00	$0.00
Other Expenditures	$0.00	$0.00	$0.00
Total Roadside Assets	**$0.00**	**$0.00**	**$0.00**
Total - All Assets	**$0.00**	**$0.00**	**$0.00**

VI. Conclusion

■

A. Cost Analysis Goals and Final Structure

DMG has developed cost-per-lane mile figures of actual expenditures, as well as of the expenditures needed to bring and maintain them at a fair to good condition level.[21] We have developed cost-per-lane mile estimates for each region, agency type, and local agency road class. We have also developed the *TAMC Updatable Workbook for Local Agency Data* tool that can track actual costs and conditions against forecast needs. The *Updatable Workbook* will provide detailed summaries of inventory, cost, and condition information based on data provided by local agencies in a *Local Agency Data-Reporting Tool*. A user manual has also been developed (and is included above) to provide users with guidance on both of these tools.

We have structured this analysis based on the available data for each asset type assessed. For pavement, we focused on information provided by nine local agencies. For bridges, we obtained comprehensive bridge data from Pontis and comprehensive cost data from the Act 51 Report database. Finally, for roadside assets, no standardized inventory or condition information could be provided; as a result, we only had expenditure information on which we based our roadside asset analysis.

The updatable workbook tool has been structured to serve as a comprehensive repository of information for inventory, condition, and expenditure data for 128 of Michigan's local agencies, representing approximately 92 percent of Michigan local agencies' roadways. It incorporates more comprehensive information than was available during this project. We have developed it, in part, as a tool that the TAMC and local agencies can use for future assessment of local agency costs, conditions, and related forecasting efforts.

DMG developed need forecasts based on the condition data obtained throughout this project, and used it to make projections on pavement and bridge needs and conditions. In contrast, we relied on current expenditure levels to develop roadside asset and winter maintenance projections. The amounts needed to bring local agency assets to a fair to good condition level and to maintain all local agency assets at this level should be considered approximations. They nonetheless can serve as a reasonable bar against which to compare future expenditures and condition levels.

B. Review of Obstacles and Challenges Faced

Throughout this project a number of challenges related to data collection efforts arose. While we were able to obtain sufficient data for the analysis, we found the absence of

[21] Possible costs of system expansion or the paving of unpaved roads have not been included in this funding-level evaluation.

centralized and consistent data sources a significant obstacle to developing the most robust analysis methodology possible. Ideally, a wider range of data would have been more accessible, as well as more readily synthesized. Instead, information from one source often needed to be categorized or labeled differently to be combined or compared with data from other sources.

The absence of standardized data on roadside assets proved the most significant limiting factor we confronted during this effort. Without any standardized inventory or condition information on roadside assets available to us, we could not develop forecasts for future spending needs based on anything other than past expenditure amounts. It would have been extremely helpful to have a sample of roadside asset inventory and condition data collected and compiled in a standard format available to incorporate in the analysis.

C. Key Findings of Cost Analysis

Based on our analysis, DMG found that Michigan's local agencies should be spending significantly more on their pavement assets on a per-lane-mile basis. While bridge assets could benefit from a 34.9 percent increase in funding to obtain a target level of 100 percent of bridges in fair to good condition, the most significant deficit currently appears to be in the funding of pavement activities. If Michigan local agencies cannot spend close to three times as much annually per mile as they spent in 2010 on pavement activities, they will not be able to achieve the target level of 100 percent of roadways in fair to good condition in twenty years. More critically, without a substantial increase in per-lane-mile funding levels, the amount of pavement rated in poor condition will continue to rise.

As mentioned above, roadside asset per-lane-mile funding levels could not be assessed due to an absence of standardized inventory and condition information. However, roadside assets may also be suffering from a deficit in funding. Additional efforts need to be undertaken to fully evaluate whether expenditure levels need to increase to maintain all roadside assets at a fair to good condition level.

D. Recommendations for Next Step Efforts

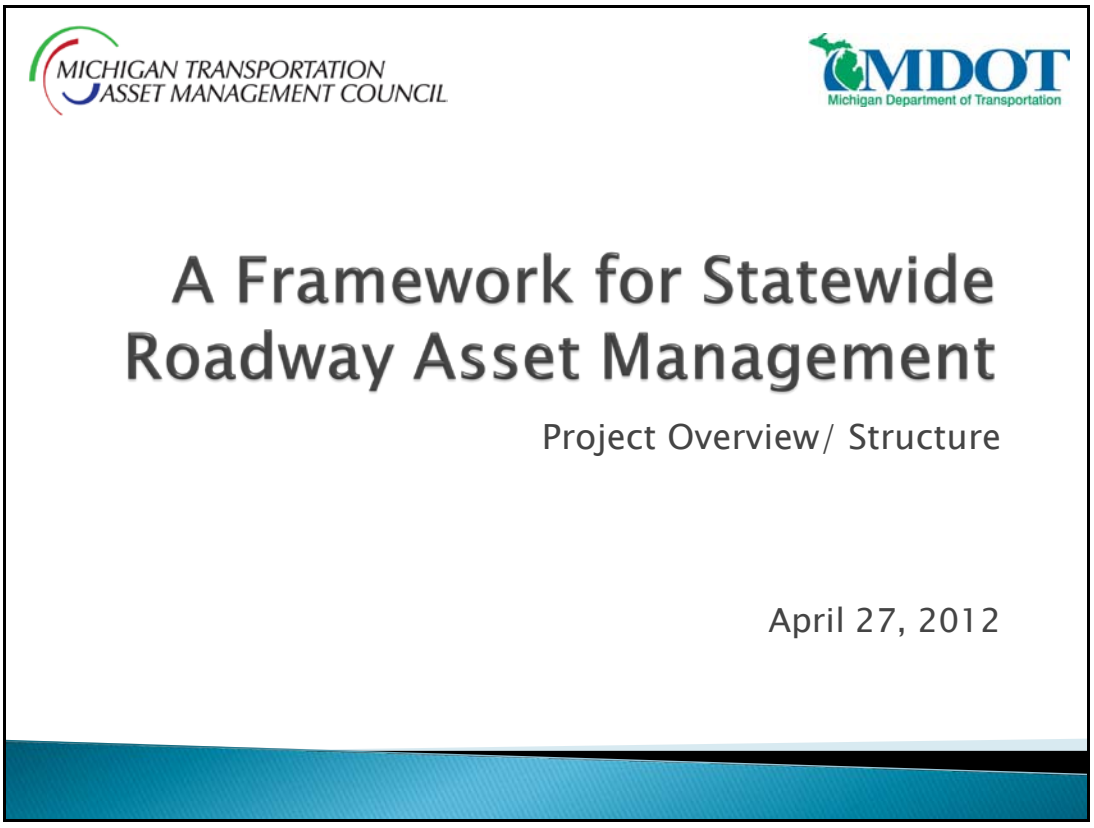
We recommend the TAMC and local agencies continue to bring together asset information from various sources for more integrated assessments of conditions, expenditures, and needs across, as well as within, Michigan's roadway agencies. Management-level assessments of conditions across the state would benefit a great deal from the availability of comprehensive information capable of being integrated and summarized without a prohibitive amount of coordination and synthesis being required to bring this information together.

While a centralized bridge database exists, pavement activity planning cannot currently rely on a comparable centralized data source, since none includes non-federal aid eligible local roads, or two-thirds of local agency inventory (as measured by centerline miles). Planning efforts would benefit from a more centralized and accessible comprehensive pavement data repository. In addition, roadside asset need assessments cannot currently be based on

condition levels. Local agencies do not collect roadside asset inventory or condition information in a standardized format, and without it, actual needs and condition levels cannot drive roadside asset budgets. We recommend local agencies improve roadside asset management capabilities by standardizing information recorded on these assets.

Lastly, use of the *TAMC Updatable Workbook for Local Agency Data* itself can serve as a valuable tool to the TAMC and local agencies—as a means of centralizing local agency inventory, condition, and expenditure information, both for tracking and for planning purposes. It can provide the TAMC and local agencies with data that can be used to drive roadway system condition tracking and budget development. The *Updatable Workbook* is intended to serve as a tool to improve inventory, condition, and expenditure data tracking and analysis, and as an impetus to further improvements in these areas.

Appendix A: Project Overview/ Structure



Purpose of Asset Management Framework Project

This project has been carried out to meet two goals: (1) to determine current annual expenditures in cost-per-lane-mile terms by agency type, roadway type, and region, and (2) to develop a tool that can be used to assess costs and conditions in these terms going forward.

- Dye Management Group, Inc. (DMG) collected and analyzed local agency inventory, cost, and condition assessment information in order to provide the Michigan Transportation Asset Management Council (TAMC) with:
  - The costs expended to maintain its roadway system on a per-lane-mile basis by agency type, roadway type, and MDOT region
  - The projected dollars per lane mile that need to be spent to bring 100 percent of the local agency roadway system to fair-to-good condition, and to maintain it at this level, over the next twenty years
- DMG also developed an *Updatable Workbook for Local Agency Data*, which combines the cost and condition projections with actual inventory, cost, and condition data (to be entered annually), to provide actual and projected rollups of inventory, cost, and condition information

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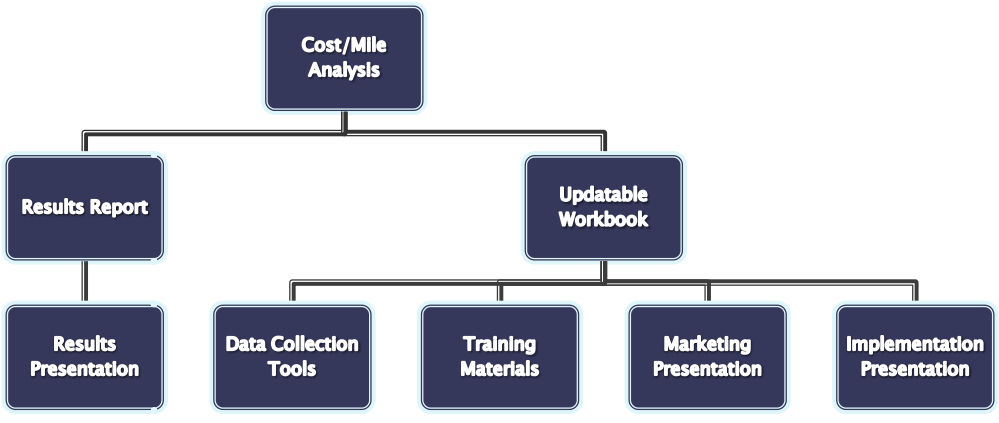
Structure of Project Outputs

The cost-per-mile analysis perfomed drove all deliverables prepared during this project—the result deliverables and the *Updatable Workbook* and its supporting materials.



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Summary of Deliverables (Part 1)

Twelve documents have been prepared in total—four as part of the cost-per-mile analysis, two providing information on the results of the analysis, and the *Updatable Workbook for Local Agency Data*, to be populated annually.

- Cost-Per-Mile Analysis Deliverables
  - (1) Local Agency Costs for All Asset Types
  - (2) Pavement—Populated Data Matrix
  - (3) Bridge—Populated Data Matrix
  - (4) Roadside Assets—Populated Data Matrix
- Analysis Results Deliverables
  - (5) TAMC Study Results—Research Report
  - (6) TAMC Analysis Results Presentation
- (7) TAMC Updatable Workbook for Local Agency Data

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Summary of Deliverables (Part 2)

The remaining deliverables provided include support materials for the *Updatable Workbook*, viz., two data-entry collection tools, a user guide and training presentation, and marketing and implementation presentations.

- Data Collection Tools
  - (8) Updatable Workbook Data-Entry Tool for Counties
  - (9) Updatable Workbook Data-Entry Tool for Cities
- Training Materials
  - (10) TAMC User Guide for Updatable Workbook and Reporting Tool
  - (11) TAMC Updatable Workbook Training Presentation
- (12) TAMC Marketing Presentation
- (13) TAMC Implementation Recommendations Presentation

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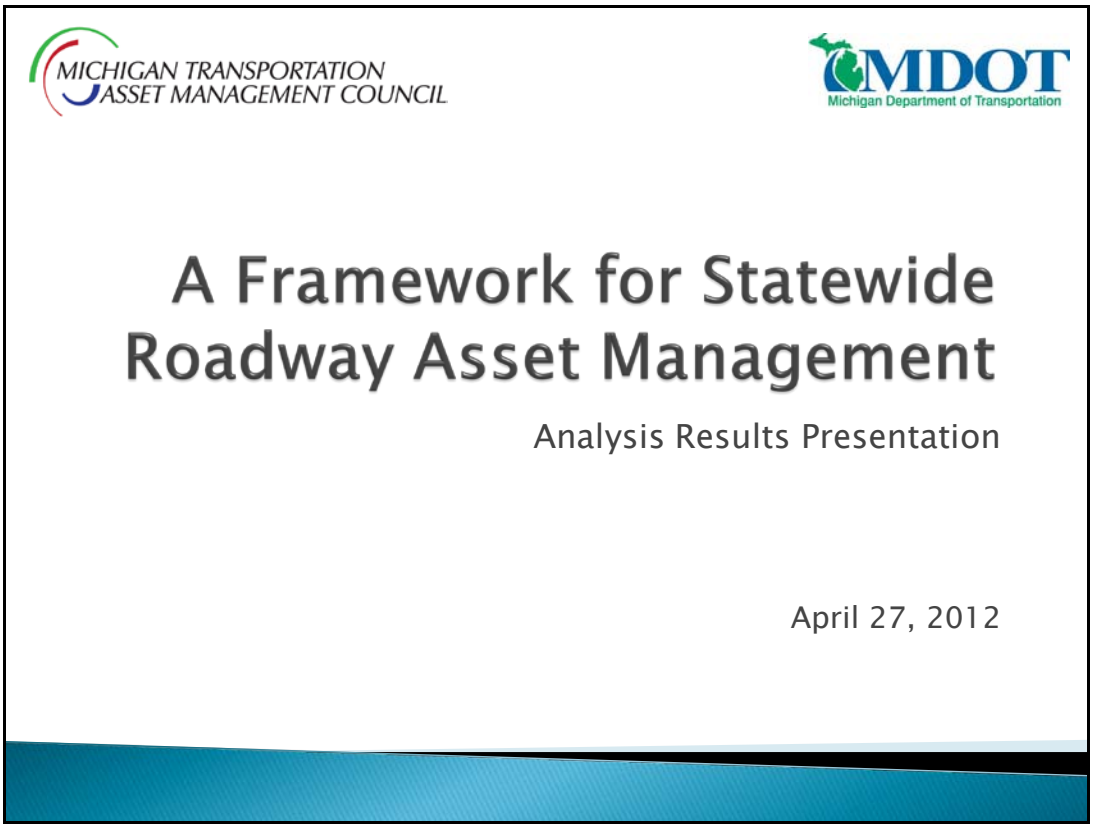
Appendix B: Analysis Results



Agenda

- Goals of Asset Management Framework Analysis
- Overview of Research Methodology Used
- Projected Needs to Bring All Assets to Fair-to-Good Condition
- Assessment of Current Asset Funding Levels
- Appendix—Recommendations for Data and Process Reconciliation Improvements

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Goals of Asset Management Framework Analysis

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Overview of Goals of Analysis

Twenty-year forecasts have been developed to project annual expenditures needed to bring all local agency assets up from current levels to fair-to-good condition, and to maintain them at this level.

- Dye Management Group, Inc. (DMG) has collected and analyzed local agency inventory, cost, and condition assessment information in order to provide the Michigan Transportation Asset Management Council (TAMC) with:
  - The costs expended by local agencies to maintain the local agency roadway system on a per mile basis
  - The projected dollars per lane mile that need to be spent in order to bring 100 percent of the local agency roadway system into fair to good condition, and to maintain it at that level over the next twenty years*
- DMG intends for this information to serve as a tool for communicating the longer-term impact to the roadway system of budget decisions to the Michigan Transportation Commission and the Michigan Legislature

* *The annual costs per lane mile required to bring all roadway assets to a fair to good condition level and to maintain them at this level do not include possible costs associated with the paving of what are currently maintained as unpaved roads or any costs associated with system expansion.*

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Structure of Asset Management Analysis

This analysis presents cost and projection data in terms of asset type, agency type, Michigan Department of Transportation (MDOT) region, and roadway type.

- The structure of this analysis provides cost details for several general maintenance activity categories:
  - Pavement
  - Bridges
  - Roadside Assets*
  - Winter Maintenance
- It also provides costs per mile by:
  - Agency type (county vs. city)
  - Michigan DOT region
  - Roadway type (county primary or local; city major or local)

* *We used the following "roadside asset" categories for the purposes of this analysis: drainage, traffic and safety, roadside, facilities, winter maintenance, and "other." "Other" is comprised primarily of general overhead, leave time, clerical, equipment purchase and repair, and supervision costs. Indirect costs associated with all asset types have also been included in this category.*

‡ *"County Primary" and "City Major" roads generally correspond to National Function Classes (NFCs) one through five, while "County Local" and "City Local" roads generally correspond to NFCs six and seven.*

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Structure of Asset Management Analysis (cont'd)

The outputs of this analysis are intended to assist the TAMC in providing informed guidance on the most appropriate local agency asset management strategy based on actual vs. projected cost-per-lane-mile expenditure levels.

- This structure should enable the TAMC to provide additional guidance on the most appropriate local agency asset management strategy to the Michigan Transportation Commission and Michigan Legislature
- More specifically, this analysis has been structured to:
  - Facilitate a comparison of the cost-per-lane-mile need projections to cost-per-lane-mile dollars spent each fiscal year over a twenty-year time span
  - Enable a comparison of the pavement and bridge conditions that result from actual expenditures to those that would result from the projected expenditures needed

* *The annual costs per lane mile required to bring all roadway assets to a fair to good condition level and to maintain them at this level do not include possible costs associated with the paving of what are currently maintained as unpaved roads or any costs associated with system expansion.*

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Overview of Research Methodology Used

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Information Sources for Analysis

DMG relied on information from RoadSoft, Pontis, Act 51 Reports, and the BCFS to develop this analysis; MDOT and participating local agencies supplied condition and expenditure data for 2008 to 2010.

- Participating local agencies provided pavement inventory and condition information from RoadSoft (the pavement asset management system in use by most Michigan local agencies) for 2008 to 2010
- MDOT supplied comprehensive bridge inventory and condition information from Pontis (a bridge inspection and inventory database system widely used across the U.S.) for 2008 to 2010
- Participating local agencies were unable to provide inventory or condition information that could be aggregated for roadside assets, since this information is not currently collected in a standardized format*
- MDOT supplied Act 51 Report expenditure data for 2008 to 2010
- RoadSoft's default settings and BCFS (the Bridge Condition Forecasting System in use by MDOT) deterioration and cost models were used for bridge projections‡

* *As a result of this absence of roadside asset data, the projections maintain the current level of spending for roadside assets, adjusted only for inflation.*

‡ *BCFS uses average deterioration rates and costs, relying on current National Bridge Inventory (NBI) data*

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Partipating Local Agencies

Nine local agencies provided pavement inventory and condition data, representing all seven MDOT regions and both county road commissions and cities.

DMG collected and analyzed pavement inventory and condition data provided by nine diverse local agencies; we obtained data from at least one agency in each of MDOT's seven regions, and from several county road commissions and several cities:

Participating Counties:	Participating Cities:
Alcona County Road Commission	The City of Alpena
Cass County Road Commission	The City of Lansing
Genesee County Road Commission	The City of Marquette
Kalamazoo County Road Commission	The City of Port Huron
Kent County Road Commission	–

* *DMG initially attempted to obtain data from eleven county road commissions and seven cities. However, we reduced our target number to five counties and four cities, since a number of agencies we reached out to either provided us with no data or provided incomplete or inaccurate data.*

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Analysis Assumptions

Annual cost-per-lane-mile projections assume a twenty-year planning horizon for all pavement and bridge assets to be maintained in fair-to-good condition, rely on pavement condition data from nine agencies, and use steady-state costs for roadside assets and winter maintenance.

- Projections are based on achieving a target of 100 percent of pavement and bridge assets being maintained at a fair-to-good condition level
- DMG used a twenty-year planning horizon, since this length of time will facilitate roadway system work being done without undue stress being placed on Michigan's drivers
- Pavement condition data for the nine participating local agencies was treated as representative of statewide pavement conditions (which may not be the case)
- Roadside asset and winter maintenance costs were kept at a steady-state level, using averaged annual expenditures from 2008 and 2010, adjusted only for inflation

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Assessment Approach

Condition data served as the source for pavement and bridge need projections, while historic expenditure levels drove roadside asset and winter maintenance projections; these projections should be considered approximations.

- DMG developed need forecasts based on the condition data obtained throughout this project, using this data to make projections on pavement and bridge needs and conditions
- We relied on current expenditure levels to develop roadside asset and winter maintenance projections
- The expenditures needed to bring local agency assets to a fair-to-good condition level, and to maintain them at this level, should be considered approximations
- Projections can serve as a reasonable bar against which to compare future expenditures and condition levels

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Current and Target Asset Conditions

Current condition levels indicate roughly 87 percent of bridges and 62 percent of pavement are in fair to good condition; projections provide forecasts for annual expenditures over a twenty-year period, at the end of which all bridges and pavement would be in fair to good conditon.

- Based on complete condition data for bridges, as exported from Pontis, 87.1 percent of bridges (measured as a percentage of deck area) appear to be in fair-to-good condition
- Based on RoadSoft condition data collected from nine participating local agencies, approximately 62.0 percent of pavement (measured as a percentage of lane-miles) appears to be in fair-to-good condition
- Projections have been made with a target of 100 percent of pavement and bridge assets being maintained at fair-to-good condition levels
- Projections for roadside asset and winter maintenance costs assume a steady-state of expenditure levels, adjusted only for inflation, since standardized roadside asset condition data was not available to be projected forward

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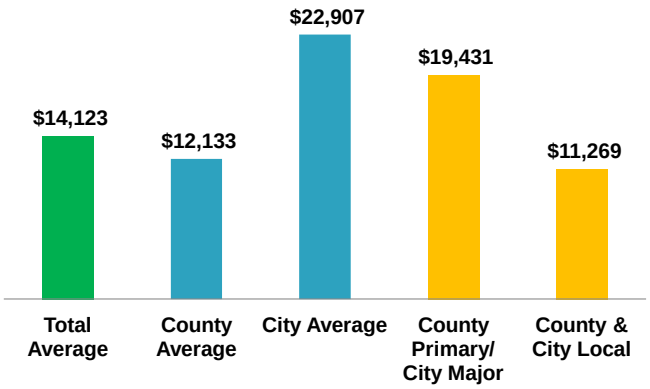
Overall Per-Lane-Mile Expenditure Projected Needs

Michigan's local agencies require $14,123 per year per lane mile (in 2011 dollars) to bring all assets to fair-to-good condition (assuming a static state for roadside asset conditions); average costs per lane mile are highest for cities and for county primary and city major roads.

Overall Cost Needs per Lane-Mile (in 2011 Dollars)



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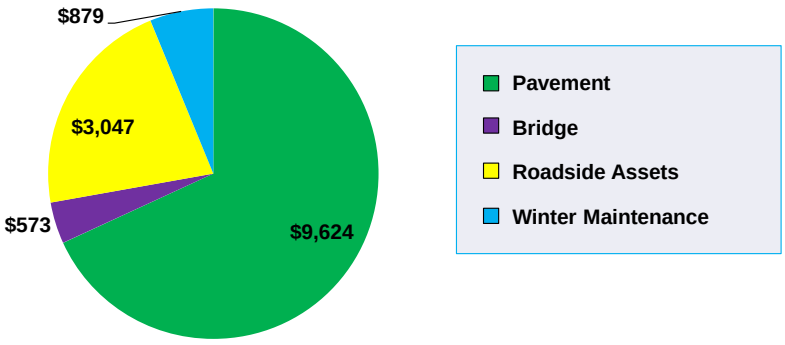
Per-Lane-Mile Expenditure Projected Needs by Asset Type

Pavement needs make up the largest share of local agency needs, at approximately 68 percent of the total; roadside assets require approximately 22 percent, while winter maintenance activities require roughly six percent and bridge activities require approximately four percent.

Cost Needs per Lane-Mile by Asset Type (in 2011 Dollars)



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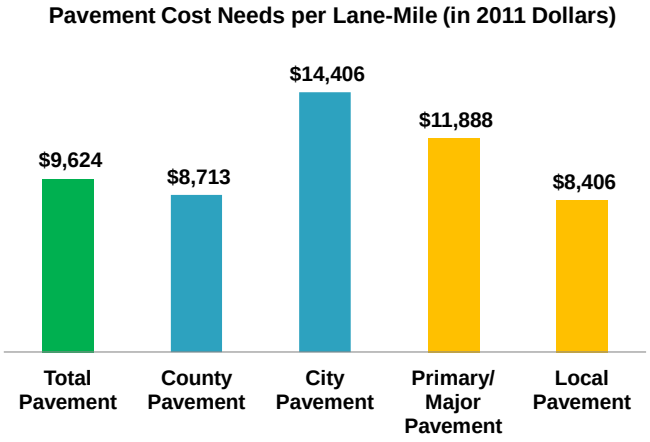
Pavement Per-Lane-Mile Expenditure Projected Needs

On average, per-lane-mile road maintenance* cost needs are significantly higher for cities than for counties, and are higher along primary/ major roadways than along local roadways.



* *'Maintenance', as the term is used throughout this document, includes preservation/structural improvement activities and general maintenance activities. In other words, it refers to all work performed on existing roadways except for work that increases the roadway system's capacity or the paving of unpaved roads.*

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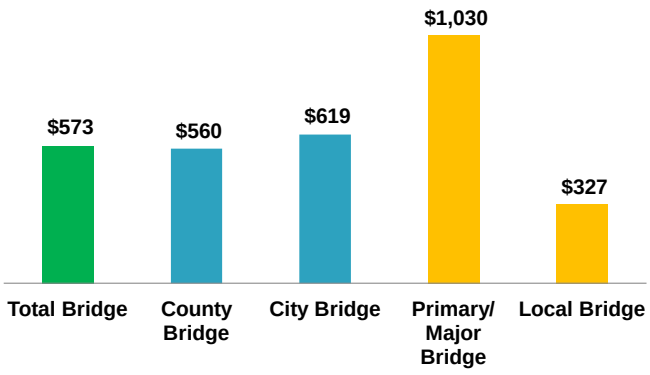
Bridge Per-Lane-Mile Expenditure Projected Needs

Bridge maintenance per-lane-mile needs do not vary dramatically based on local agency type; however, per-lane-miles costs are significantly higher for bridges on or above primary and major roadways than they are for bridges on or above local roadways.



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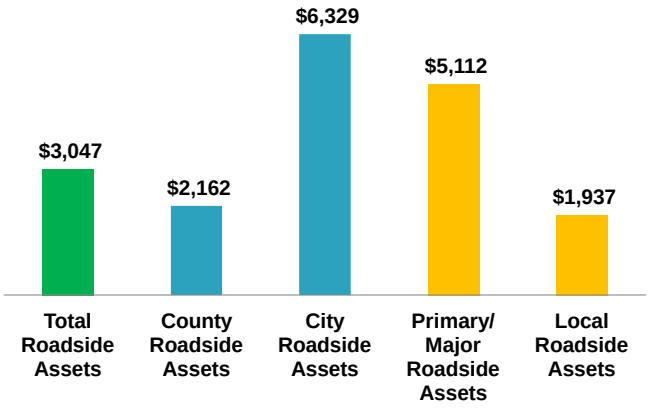
Roadside Asset Per-Lane-Mile Expenditure Projected Needs

Roadside asset projections assume a steady-state level of expenditure from average annual 2008 to 2010 levels, adjusted only for inflation. On average, $3,047 per lane mile will be needed on an annual basis to maintain roadside assets at their 2008 to 2010 condition levels.*

Roadside Asset Cost Needs per Lane-Mile (in 2011 Dollars)



* *A needs-driven assessment of roadside asset costs has not been conducted, since no standardized inventory or condition data was available for analysis.*

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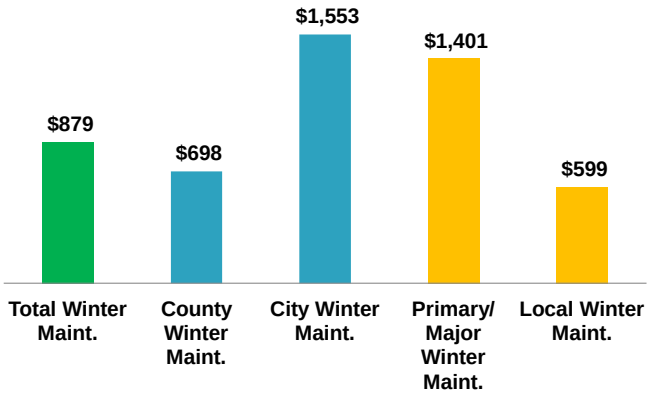
Winter Maintenance Per-Lane-Mile Expenditure Projected Needs

Winter maintenance expenditure needs are driven by 2008 to 2010 average expenditure levels; they are highest for cities and for primary and major roadways.*

Winter Maintenance Cost Needs per Lane-Mile (in 2011 Dollars)



* *A needs-driven assessment of winter maintenance costs has not been conducted, since no data on winter maintenance performance standards or achieved levels of service was available.*

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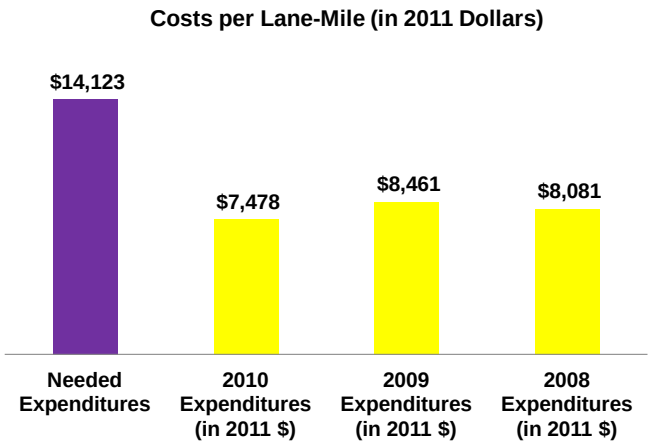
Assessment of Current Asset Funding Levels

MICHIGAN TRANSPORTATION ASSET MANAGEMENT COUNCIL

MDOT Michigan Department of Transportation

Current vs. Projected Need Expenditures

Recent annual cost-per-lane-mile expenditures fall between 40 and 47 percent below the expenditure amounts needed, as provided by the twenty-year forecasts (which target all system assets being maintained in fair-to-good condition).



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Assessment of Current Funding Levels

Pavement assets require the greatest cost-per-lane-mile increase in funding, while bridges require a significant but lower percentage increase; roadside assets also likely require increased funding, though this could not be assessed using a standardized-data driven approach.

- Close to a three-fold increase in per-lane-mile funding of pavement-related activities at the local-agency level would be required to bring all pavement assets to a fair-to-good condition level, and to maintain them at this level
- Bridge funding would need to be increased 35 percent in order for Michigan local agencies to bring all local agency bridges to a fair-to-good condition level, and to maintain them at this level
- It is likely that roadside assets would also beneift from an increase in per-lane-mile funding, though this need cannot be quantified at this time

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Key Findings of Cost Analysis

A significant increase in the funding of pavement activities will be required to prevent overall local agency pavement conditions from deteriorating; roadside asset activities may require a significant increase as well, and further review of these assets is recommended.

- If Michigan local agencies cannot spend close to three times as much annually per lane mile as they spent in 2010 on pavement activities, then they will not be able to achieve target condition levels and the amount of pavement in poor condition will continue to rise
- Roadside assets may also be suffering from a deficit in funding; additional efforts should be undertaken to fully evaluate whether expenditure levels need to increase to maintain roadside assets at a fair-to-good condition level
- If local agencies target maintaining all bridges at a fair-to-good condition level, then bridge activity funding will need to be increased by approximately a third

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Data-Driven Analysis Constraints

Centralized data sources that contain data that can easily be combined and compared for pavement and roadside asset cost analysis would assist in future efforts to estimate local agency roadway system needs.

- The absence of centralized and consistent data sources was a significant obstacle to developing a more rigorous analysis methodology
- Ideally, a wider range of data would have been more accessible, as well as more readily able to be synthesized
- The absence of standardized roadside asset data proved the most significant limiting factor for this analysis; without it, we could not develop forecasts for future spending needs based on anything other than past expenditure amounts

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Recommendation for Further Data Integration

A great deal of information is currently collected by local agencies; its integration and augmentation should continue to achieve asset management goals.

- DMG recommends that the TAMC and local agencies continue to bring together asset information from various sources for more integrated assessments of conditions, expenditures, and needs across, as well as within, Michigan's roadway agencies
- Management-level assessments of conditions across the state would benefit greatly from the availability of comprehensive information capable of being integrated and summarized without a prohibitive amount of coordination and synthesis required

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Data Integration Needs by Asset Type

A centralized bridge database currently aggregates bridge information; however, the current pavement database does not yet include all pavement data, nor is roadside asset information collected and compiled in a standardized format.

- While a centralized bridge database exists, pavement activity planning cannot currently rely on a comparable centralized data source, since none includes complete information on non-federal-aid-eligible local agency roads
- Integrated asset management planning efforts would benefit from a more centralized and accessible, comprehensive pavement data repository
- Roadside asset need assessments cannot currently be based on actual roadside asset condition levels, since local agencies do not collect roadside asset inventory or condition information in a standardized format
- Without standardized roadside asset data, comprehensive need and condition level assessments cannot drive roadside asset budgets; evaluation and recording standards should be developed to improve awareness of the impact of roadside asset funding levels on conditions

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Updatable Workbook as Data Centralization and Evaluation Tool

As a first step, use of the *TAMC Updatable Workbook for Local Agency Data* can provide the TAMC and local agencies with better-integrated inventory, condition, and expenditure tracking and analysis, which can improve local agency asset management capabilities.

- The *TAMC Updatable Workbook for Local Agency Data* can serve as a tool for centralizing local agency inventory, condition, and expenditure information—both for tracking and planning purposes
- The *Updatable Workbook* can provide the TAMC and local agencies with data that can be used to drive roadway system condition tracking and budget development
- The *Updatable Workbook* should help increase accurate inventory, condition, and expenditure data tracking and analysis to enable improved asset management capabilities and to further drive improvements in these areas
- Additional efforts to increase the availability of asset management data should be pursued to further increase the accessibility of this information for planning and budgeting purposes

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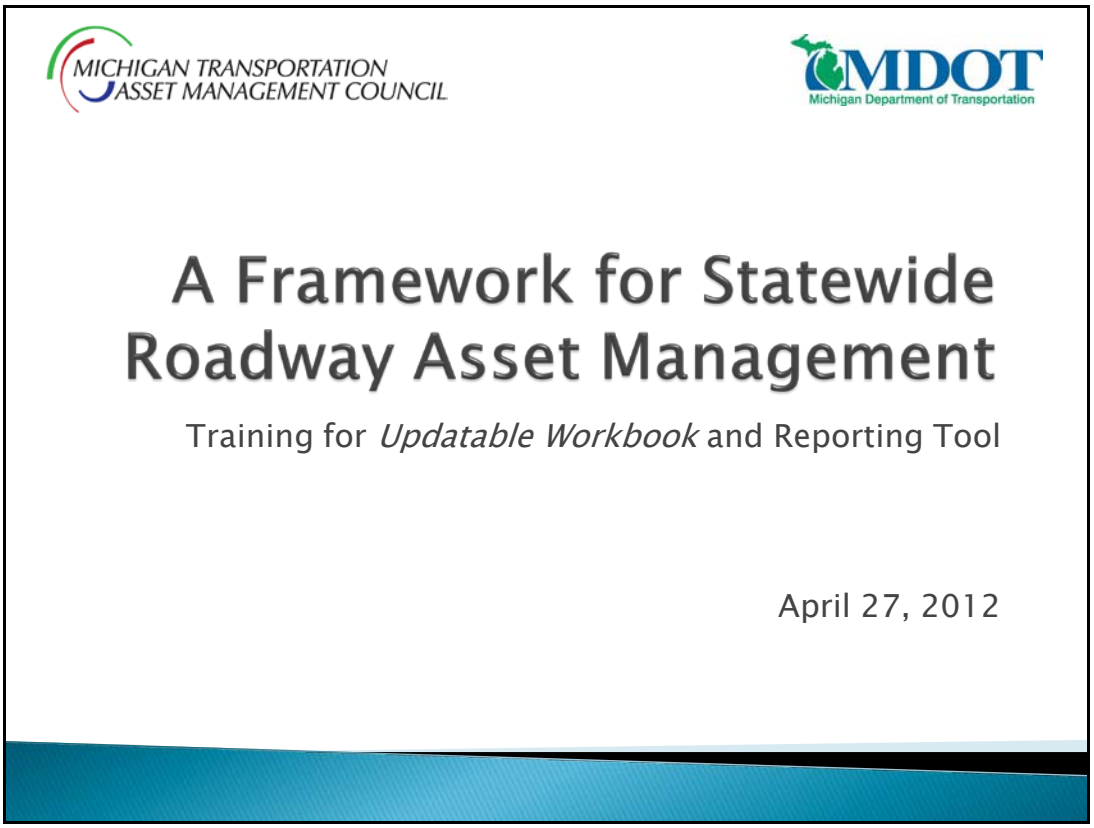
Appendix C: *Updatable Workbook* Training Presentation



Agenda

- Overview of the *TAMC Updatable Workbook for Local Agency Data*
- Updatable Local Agency Data Collection Worksheets
- Populating the *TAMC Updatable Workbook for Local Agency Data*
- Outputs of the *TAMC Updatable Workbook for Local Agency Data*
- Appendix A—Glossary of Terms
- Appendix B—*Updatable Workbook Data Entry Tool* Tables

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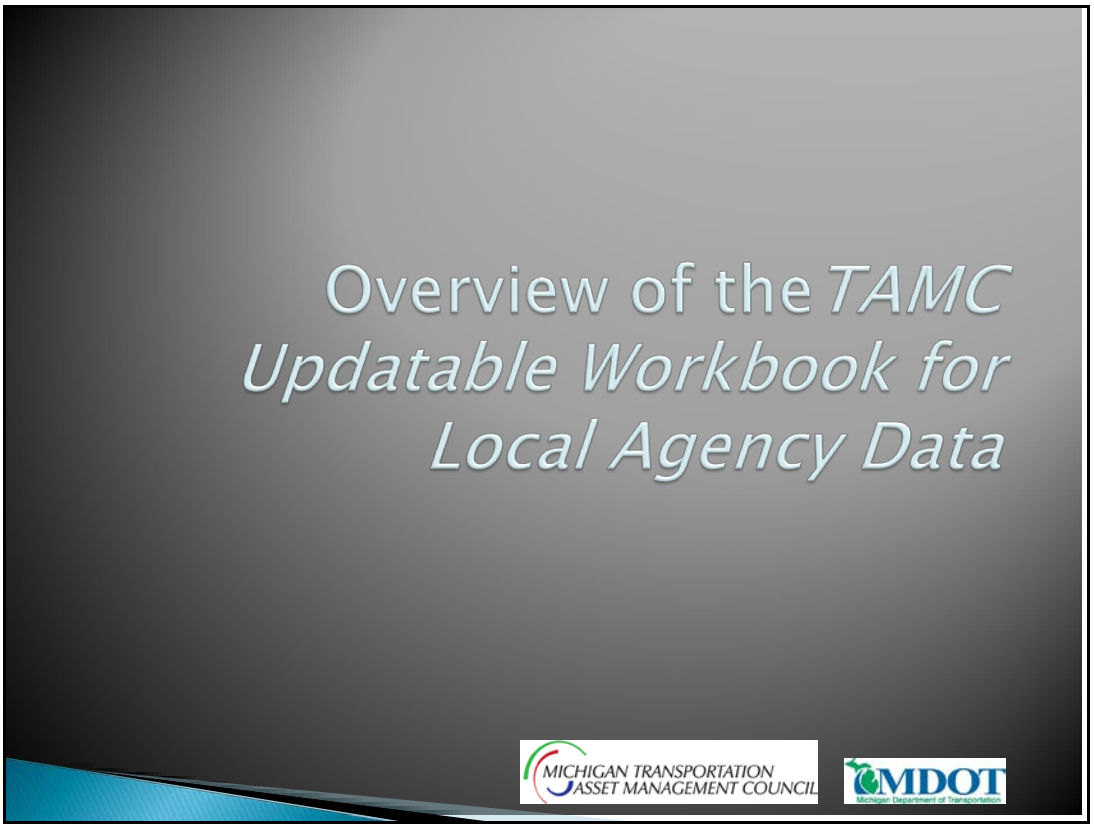

Purpose of *Updatable Workbook*

The *Updatable Workbook* will perform the following functions:

1) Track inventory, cost, and condition information to determine current per-lane-mile costs
2) Provide summary rollups of this information at the MDOT regional, agency-type (county road commission or city), and road-class level
3) Generate estimated per-lane-mile costs for bringing all local agency assets to a fair-to-good condition in a twenty-year period
4) Compare actual expenditures and conditions to those projected in the twenty-year, needs-based projections

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Updatable Workbook Participants

- All MDOT regions will be represented by at least three county road commissions and at least three cities each
- The 122 local agencies with at least 100 centerline miles of roadway will provide data for the workbook—this includes all 83 counties in Michigan and 45 of Michigan's cities
- Six additional cities will provide data for the workbook (three in the Superior region and three in the North region), since no city in either region has over 100 centerline miles of roadway

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Data Updating Process

- The TAMC will provide each participating local agency with an *Updatable Workbook Data Entry Tool* in the form of an Excel workbook each year (one is available for counties and one for cities), or may use this tool internally
- Each local agency or TAMC staff will enter up-to-date inventory, condition, and expenditure information in the Excel workbook tool
- When completed and if applicable, local agencies will submit these workbook tools to the TAMC; the TAMC will compile this information in the *Updatable Workbook*
- If TAMC staff have compiled the local agency data, they will provide it to each local agency for verification of the data's accuracy
- The TAMC GIS Coordinator will manage the updating of the centralized workbook, and will assess the workbook's outputs

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Workbook Data Inputs and Outputs

- Local agencies will provide or validate (if the TAMC already has entered) the following information in the *Data Entry Tool* annually:
  - Pavement and bridge inventories
  - Pavement and bridge condition data
  - Expenditure data for all asset types
- Once this information has been transferred by the TAMC, the *Updatable Workbook* will auto-calculate rollups of the above information by MDOT region, agency type, and road class
- The *Updatable Workbook* will track twenty-years of data and show each year's condition and expenditure information alongside the need projections for this period

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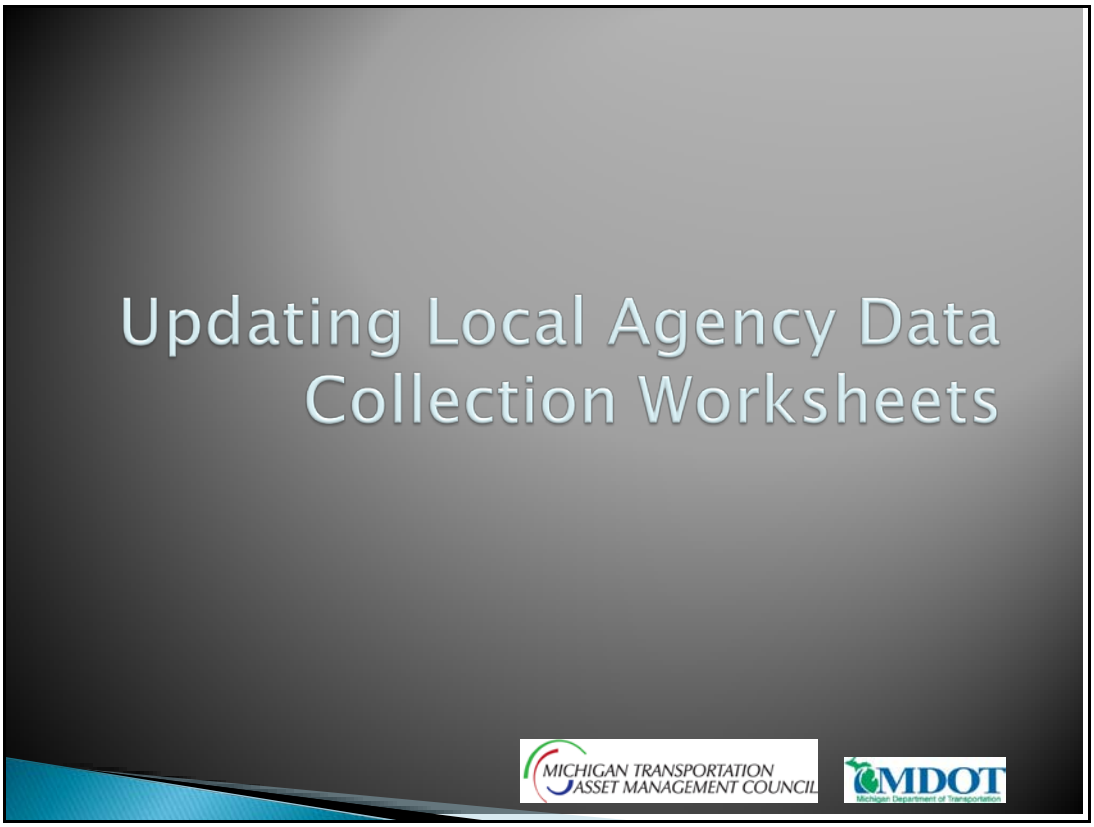

Data Entry Tool— Pavement Inventory Entry

- Local agencies will populate their agency's pavement inventory using information from their pavement management system (generally RoadSoft) or the TAMC will populate it using this information
- At a minimum, total lane miles of pavement should be entered in the inventory worksheet
- If a local agency tracks its pavement inventory by pavement type, pavement inventory information should be entered at this level of detail; otherwise, totals can be entered
- Inventory information should be entered according to road NFC; the worksheet will then automatically translate this information into Act 51 Report road categories (e.g., county primary, county local, city major, or city local)

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Data Entry Tool— Pavement Inventory Entry (cont'd)

- Pavement inventory information should be entered in terms of lane miles
- The inventory worksheet will include a table for centerline miles (which can be populated, but is optional)
- Step-by-step instructions for generating the RoadSoft reports needed can be found in the *Updatable Workbook User Guide*
- If a local agency has more accurate inventory information available from another source, RoadSoft does not need to be used

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Data Entry Tool— Bridge Inventory Entry

- Bridge inventory information should be entered in terms of square feet of bridge deck area
- Local agencies or the TAMC can obtain bridge inventory information using an SQL query performed on the Pontis database—the SQL query needed can be found in the *Updatable Workbook User Guide*
- Alternatively, each bridge owned by a local agency can be accessed individually in Pontis or the Michigan Bridge Information System (which uses the same database) to obtain its length and width, and can then be summed
- If deck area is obtained in square meters, it must be converted to square feet before being entered
- As with pavement, inventory information can be entered according to road NFC; the worksheet will then automatically translate this information into Act 51 Report road categories

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Data Entry Tool— Pavement Condition Entry

- Local agencies or the TAMC should obtain pavement condition information extracted from RoadSoft (or from their pavement management system, if it is not RoadSoft)
- Pavement condition information should be entered as percentage of lane miles in a certain condition for each pavement type (by lane miles) as follows:
  - "Good" = pavement with a PASER rating of 8 or higher
  - "Fair" = pavement with a PASER rating of 5 to 7
  - "Poor" = pavement with a PASER rating of 1 to 4
- If inventory information has been entered for total pavement only, then condition information should only be entered for total pavement

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Data Entry Tool— Bridge Condition Entry

- Local agencies or the TAMC can obtain bridge condition information from the Pontis database by using the SQL query provided in the *Updatable Workbook User Guide*
- Alternatively, bridges can be accessed individually in Pontis or in the MBIS to obtain their condition
- If obtained from the MBIS, bridge condition information should be entered as a percentage of deck area in the following conditions:
  - "Fair to Good" = a bridge with an NBI rating of 5 or above assessed for all of the following: its deck, superstructure, substructure, and culvert
  - "Poor" = a bridge with an NBI rating below 5 for its deck, superstructure, substructure, or culvert (one or more)

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Data Entry Tool— Overview of Expenditures

- A local agency or the TAMC should obtain the expenditure information needed for the expenditure worksheet from its Act 51 Report or the Act 51 database
- Expenditures associated with trunkline work should not be included in the worksheet, since the state reimburses local agencies for these costs
- Act 51 Report expenditures entered in the worksheet will automatically be assigned to activities related to pavement, bridges, roadside assets, or winter maintenance, based on approximate ratios
- Expenditures will also be assigned to more discrete expenditure categories for pavement and roadside assets (such as rehabilitation and reconstruction) based on approximate ratios
- If an agency would like to provide more precise data for each expenditure category (rather than have them auto-calculated by the *Data Entry Tool*), it can do so, but should verify that the total dollar value entered equals the total Act 51 Report expenditures (less trunkline costs)

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Data Entry Tool— County Expenditure Formulas

- County expenditures from the Act 51 Report will be allocated automatically across asset types by the expenditure worksheet using the percentages in the table below (continued on next slide)
- Additionally, "Other/work for others" costs will be split evenly between the Primary and Local Road funds

Expenditure Type	Expenditure Subtype	Pavement	Roadside Assets	Winter Maint.	Bridge
Construction/ Capacity Improvement	Roads	90%	10%	–	–
	Structures	–	–	–	100%
	All other Construction/ Capacity Improvement categories	–	100%	–	–

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Data Entry Tool— County Expenditure Formulas (cont'd)

Expenditure Type	Expenditure Subtype	Pavement	Roadside Assets	Winter Maint.	Bridge
Preservation—Structural Improvements	Roads	90%	10%	–	–
	Structures	–	–	–	100%
	All other Preservation/ Struct. Improv. categories	–	100%	–	–
Maintenance	Roads	50%	50%	–	–
	Structures	–	–	–	100%
	Winter Maintenance	–	–	100%	–
	All other Maintenance categories	–	100%	–	–
Other	All other categories (except trunkline)	–	100%	–	–

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Data Entry Tool— City Expenditure Formulas

- City expenditures from the Act 51 Report will be allocated similarly to county expenditures, with minor differences, using the percentages in the table below

Expenditure Type	Expenditure Subtype	Pavement	Roadside Assets	Winter Maint.	Bridge
Construction	Streets (Incl. Eng. & R.O.W.)	90%	10%	–	–
	Structures (Incl. Eng. & R.O.W.)	–	–	–	100%
Preservation	Streets	60%	40%	–	–
	Structures	–	–	–	100%
Traffic Services	Streets and Structures	–	100%	–	–
Winter Maintenance	Streets and Structures	–	–	100%	–
All Others	Other	–	100%	–	–

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Data Entry Tool— City Expenditure Formulas (cont'd)

- Since city Act 51 Reports do not currently distinguish between preservation/structural improvement costs and maintenance costs, the worksheet will also apply factors to allocate "Preservation—Street" costs between the two
- "Preservation—Street" costs have been divided based on a review of MDOT's trunkline expenditure composition between 2008 and 2010 (see table below for details)

Asset Type	Preservation Allocation	Maintenance Allocation
Pavement's 60% Preservation—Street Costs	33% for Primary & Local	67% for Primary & Local
Roadside Asset's 40% Preservation—Street Costs	30% for Primary/ 20% for Local	70% for Primary/ 80% for Local

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Populating the *TAMC Updatable Workbook for Local Agency Data*

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TAMC Updatable Workbook Overview

- Once local agencies have submitted their worksheets or TAMC staff has compiled this information, the TAMC GIS Coordinator will incorporate the information in the *Updatable Workbook for Local Agency Data*
- While the *Local Agency Data Entry Tool* can be reused each year, the *Updatable Workbook for Local Agency Data* will serve as a repository for information tracking and analysis
- All cells that require annual updating are shaded in bright yellow in the *Updatable Workbook*:
  - Nine worksheets total require data entry in it—four for counties, four for cities, and one for inflation rates
  - The remaining data cells will auto-populate based on the data entered in these nine worksheets

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TAMC Updatable Workbook— Inventory Data Transfer

- Pavement inventory data provided by local agencies will need to be entered in the *Updatable Workbook*'s county and city inventory worksheets and/or verified annually
- Lane miles must be updated; centerline miles will auto-calculate based on the lane-mile entries; however, if a local agency provides its centerline miles, these can be entered manually to override the approximations
- Should a local agency not have access to its pavement inventory data by pavement type, total inventory levels for pavement can be entered manually (overriding the formulas)
- Bridge deck area will need to be entered in the workbook in square feet (this unit of measure should be verified if the SQL query for the Pontis database provided in the *User Guide* has not been used by a local agency or TAMC staff)

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TAMC Updatable Workbook— Condition Data Transfer

- Pavement condition data should be entered for all pavement types (if available), and by road class as percentage in good, fair, and poor condition
- Once this information has been entered in the county and city condition worksheets, they will auto-calculate the overall pavement conditions for a county or city
- If a local agency has only provided inventory information by total (instead of by pavement type), then only total condition information should be entered (overriding the formulas)
- Bridge condition data should be provided as percentage of bridges in "fair to good" or in "poor" condition; once entered for each road type, the worksheets will auto-calculate totals for counties and cities

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TAMC Updatable Workbook— Cost Data Transfer

- Each local agency or TAMC staff should enter annual expenditures using the *Data Entry Tool*, which will classify entered costs in terms of specific expenditure categories
- For pavement costs:
  - Routine maintenance and capital preventative maintenance will be combined as a single expenditure value
  - Rehabilitation/ reconstruction and construction/ capacity improvement costs will each be entered separately
  - The worksheets will auto-calculate total pavement costs based on these entries
- Bridge costs should be entered as a single line-item in the same cost data worksheets used for pavement costs

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TAMC Updatable Workbook— Cost Data Transfer (cont'd)

- For roadside asset costs:
  - Costs will be classified as winter maintenance, non-winter maintenance, construction/ capacity improvements, and other expenditures
  - The worksheets will auto-calculate total roadside asset costs based on these entries

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TAMC Updatable Workbook— Need Projections

- Forecast costs should populate automatically once a year's inventory data has been entered in the relevant worksheets
- However, inflation rates will need to be updated based on the actual inflation that has occurred in a given year
  - Year-over-year inflation rates have been set to "5%" as a default for projections; these should be adjusted for accuracy each year
  - Inflation rates can be updated in the "Forecast costs" worksheet (in row 6) on an annual basis and should reflect a twelve-month adjustment in costs, based on MDOT indices used

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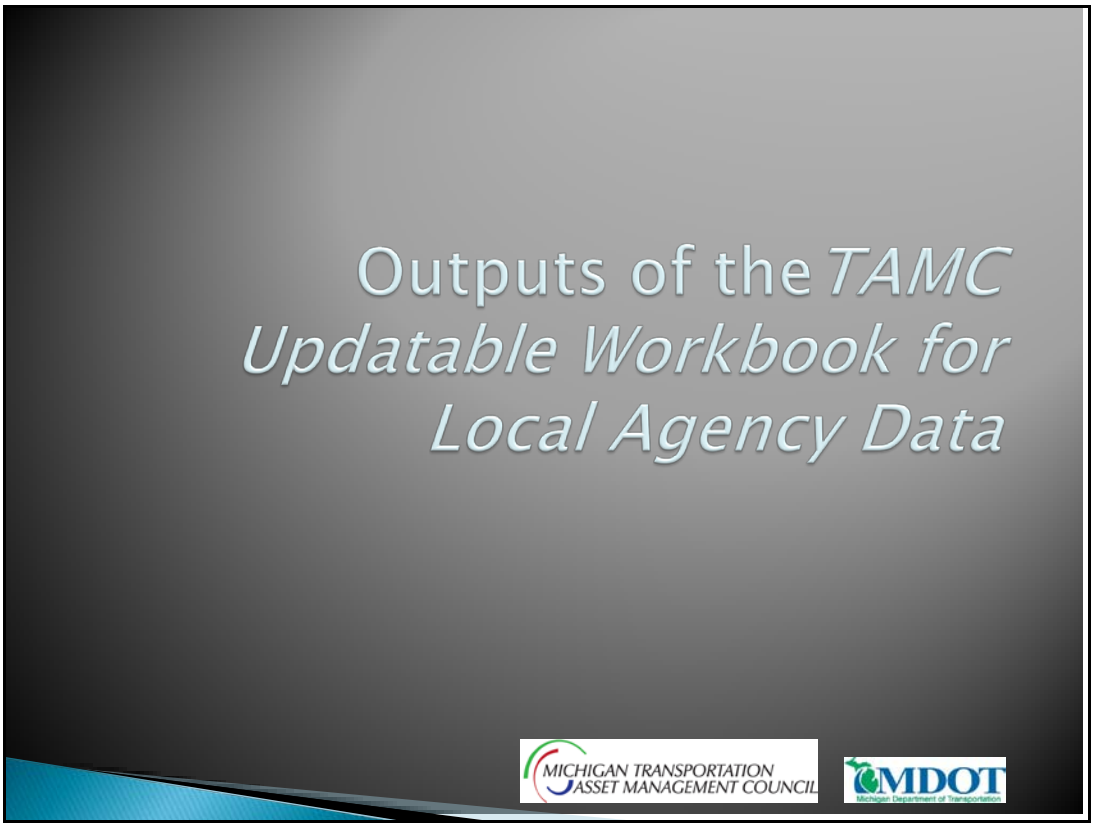

TAMC Updatable Workbook— Summary Inventory Outputs

- The "SUM INV" worksheet summarizes all entered lane-mile, centerline-mile, and bridge deck area inventory by MDOT region, road class, and federal aid vs. non-federal aid roads:
  - County primary and city major roads are combined to estimate federal aid road inventory
  - County local and city local roads are combined to estimate non-federal aid road inventory
- This worksheet also provides total lane-mile inventory information for each type of road listed (e.g., asphalt, concrete, composite, seal coat, unpaved), provided local agencies submit inventory information at this level of detail; otherwise, only pavement inventory totals are listed here

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TAMC Updatable Workbook— Summary Condition Outputs

- The "SUM COND" worksheet provides overall pavement and bridge condition information for each MDOT region by:
  - Road type
  - County primary and city major roads combined (federal aid roads, approximately)
  - County and city local road combined (non-federal aid roads, approximately)
  - Overall MDOT region averages
- Overall statewide averages are also generated

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TAMC Updatable Workbook— Summary Actual Expenditure Outputs

- The "Co Cost Summary" and "Ci Cost Summary" worksheets summarize asset type cost information entered
- The "SUM COST" worksheet provides cost rollups by MDOT region, agency type, and road class for all counties and cities participating; this worksheet includes totals by expenditure type and for each asset type
- The "Real Costs per Mi" worksheet provides cost information in a similar format to the "SUM COST" worksheet, but does so by lane mile (based on the inventory information entered for the year the local agencies incurred the expense)
  - This information can readily be compared across MDOT regions, agency types, and road classes in this worksheet, since variations in inventory levels will not impact these costs per lane mile

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TAMC Updatable Workbook— Forecast Cost Outputs

- The "Forecast Costs" worksheet will auto-populate for each year, as inventory data is entered over time; however, inflation rates will need to be updated manually
- Forecast costs per mile, located in the "Forecast Costs per Mi" worksheets, will drive all forecast need expenditures based on the pavement lane-mile inventory amounts entered in the workbook each year

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TAMC Updatable Workbook— Forecast Condition Outputs

- With the exception of the "total" and "subtotal" rows and columns in the "Forecast Conditions" worksheet, this worksheet includes fixed projections of twenty-year forecasts
  - No data entry will be needed for this worksheet
  - Totals and subtotals will be based on the inventory amounts entered annually in the inventory worksheets
- The Bridge Condition Forecasting System (BCFS) forecasts are most accurate the more generally they forecast; the bridge forecast worksheet relies on BCFS forecasts, and as a result, provides bridge condition forecasts by agency type, but not by MDOT region
- While this worksheet provides more detailed condition forecasts for pavement—by agency type, MDOT region, and road class—these forecasts are based on pavement condition data for only nine agencies, and should be evaluated as approximations

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TAMC Updatable Workbook— Actual vs. Forecast Outputs

- The "Real vs Forecast Costs per Mi," "Real vs Forecast Cost Summary," and "Real vs Fcst Costs—CUMULAT" worksheets auto-populate
- The "Real vs Forecast Costs" worksheet subtracts the totals in the forecast costs worksheet from those in the real costs worksheet
  - If the amount expended in a given year exceeds the forecast needs, the numbers listed will be positive
  - If the amount expended in a given year is less than the forecast needs, the numbers will be negative
- The "Real vs Forecast Cost Summary" will show both actual and forecast costs alongside one another
- The "Real vs Fcst Costs—CUMULAT" worksheet will provide a running total of the difference in actual expenditures from forecast needed expenditures

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TAMC Updatable Workbook— Actual vs. Forecast Outputs (cont'd)

- The "Real vs Forecast Cond Summary" worksheet provides a comparison of actual to forecast twenty-year conditions, which correspond to the projected level of needed expenditures
- The comparison tables auto-populate to display the differences between actual and forecast conditions by providing both sets of condition data side by side
- The "Summary Charts" worksheet displays the following information in graphical form, by MDOT region and statewide:
  - Actual and forecast cost and condition information for pavement and bridges
  - Actual and forecast cost information for roadside assets and winter maintenance

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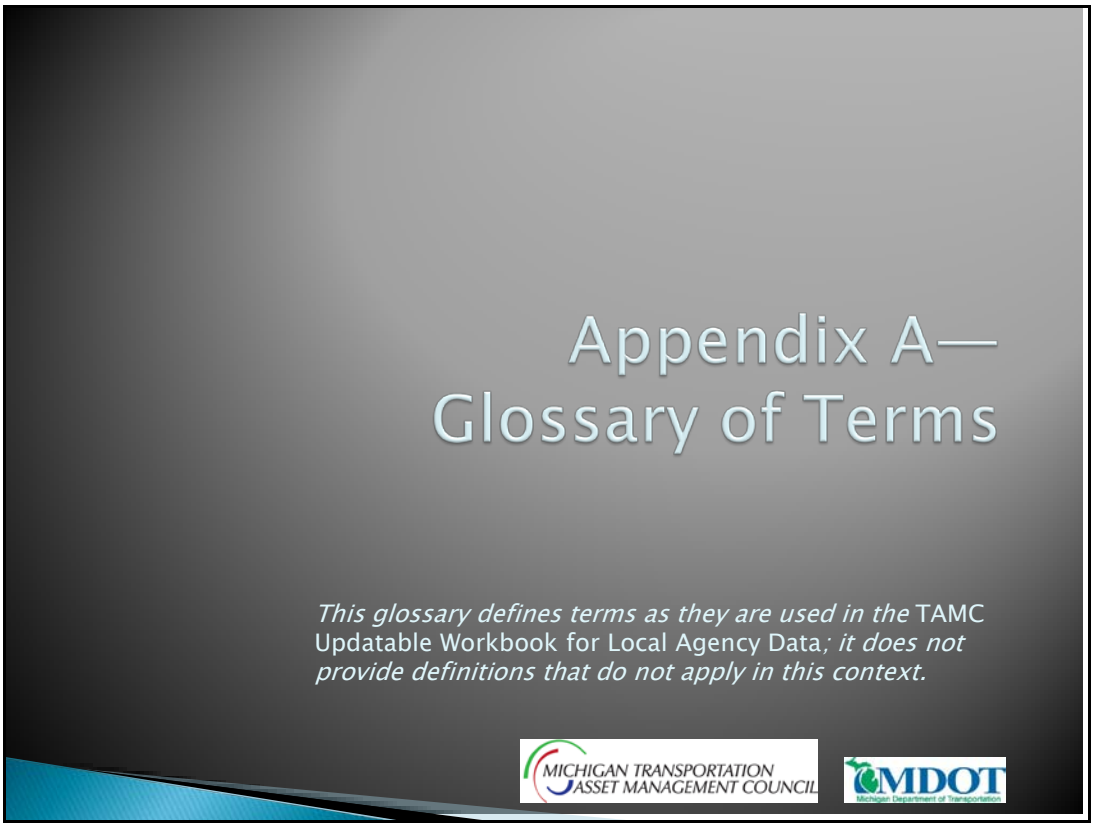
Appendix A—
Glossary of Terms
This glossary defines terms as they are used in the TAMC Updatable Workbook for Local Agency Data; it does not provide definitions that do not apply in this context.
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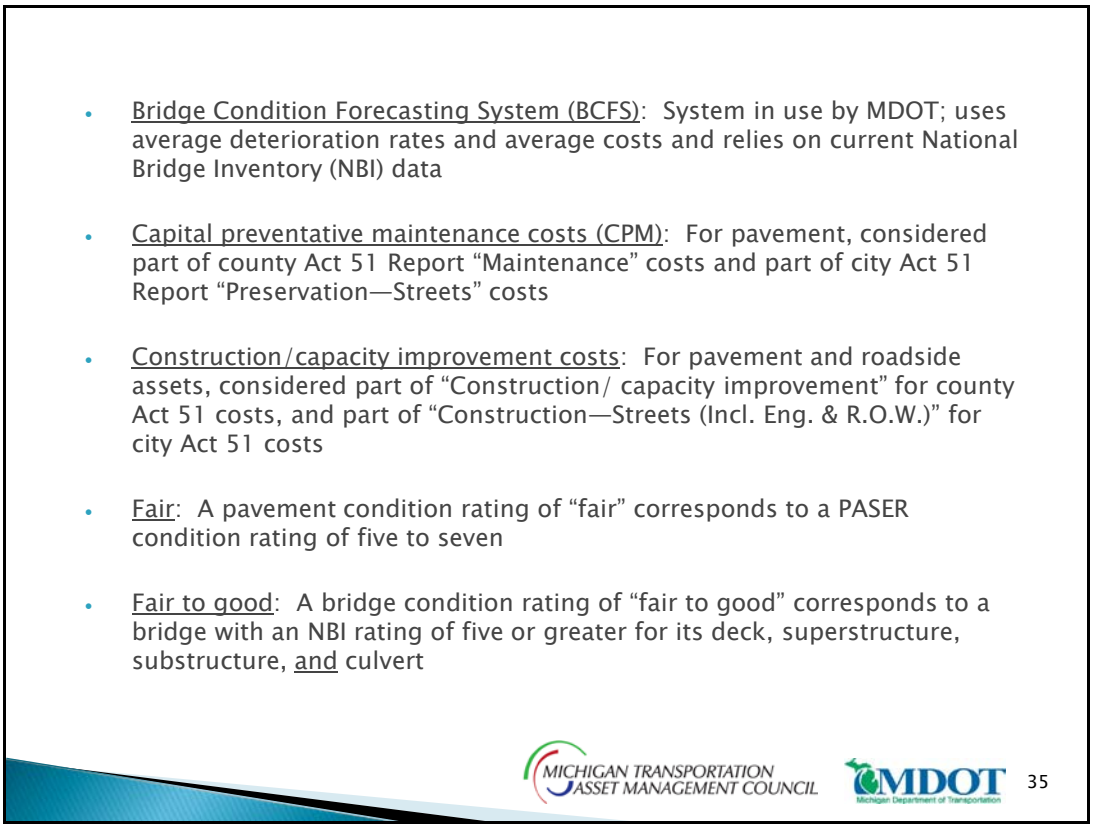
Bridge Condition Forecasting System (BCFS): System in use by MDOT; uses average deterioration rates and average costs and relies on current National Bridge Inventory (NBI) data
Capital preventative maintenance costs (CPM): For pavement, considered part of county Act 51 Report "Maintenance" costs and part of city Act 51 Report "Preservation—Streets" costs
Construction/capacity improvement costs: For pavement and roadside assets, considered part of "Construction/ capacity improvement" for county Act 51 costs, and part of "Construction—Streets (Incl. Eng. & R.O.W.)" for city Act 51 costs
Fair: A pavement condition rating of "fair" corresponds to a PASER condition rating of five to seven
Fair to good: A bridge condition rating of "fair to good" corresponds to a bridge with an NBI rating of five or greater for its deck, superstructure, substructure, and culvert
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- Good: A pavement condition rating of "good" corresponds to a PASER condition rating of eight to ten
- Local city roads: City roads identified as roughly corresponding to National Functional Classes (NFCs) six and seven
- Local county roads: County roads identified as roughly corresponding to National Functional Classes (NFCs) six and seven
- Major city roads: City roads identified as roughly corresponding to National Functional Classes (NFCs) one through five
- *TAMC Updatable Workbook for Local Agency Data*: Excel workbook that tracks inventory, condition, and cost information for 128 local agencies; provides rollups of this information by MDOT region, agency, and road type, and then compares these rollups to twenty-year cost and condition forecasts

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- National Bridge Inventory (NBI): A database compiled by the Federal Highway Administration that includes information on all bridges and tunnels in the United States that have roads above or below them; for bridges, some examples of the information recorded include bridge type and specification, condition, geometric data, and functional descriptions
- Non-winter maintenance costs: When used in the context of roadside assets, all maintenance costs not associated with winter maintenance in Act 51 Reports
- Other expenditures: For roadside assets, all non-trunkline costs included in the "Other" category of county Act 51 Reports; for cities, this category corresponds to rows 31 to 33, and 35 to 37 of Act 51 Reports (based on 2008 to 2010 Reports)
- Pavement Surface Evaluation and Rating System (PASER): A system for visually rating the surface condition of pavement on a scale of one to ten; ratings correspond to the type of work that should be performed on pavement (e.g., crack sealing or minor patching, preservation treatments, structural improvements, reconstruction)

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- Poor: A pavement condition rating of "poor" corresponds to a PASER rating of one to four; a bridge condition rating of "poor" corresponds to a bridge with an NBI rating below five for its deck, superstructure, substructure, or culvert
- Preservation costs: For roadside assets, considered part of "Preservation—Structural Improvement" costs in county Act 51 Reports and part of "Preservation—Streets" costs in city Act 51 Reports
- Primary county roads: County roads identified as roughly corresponding to National Functional Classes (NFCs) one through five
- Rehabilitation and reconstruction costs (R&R): For pavement, considered part of "Preservation—Structural Improvement" Act 51 costs for counties and part of "Preservation—Streets" Act 51 costs for cities
- Roadside assets: Assets associated with drainage, traffic and safety, roadside, facilities, winter maintenance, and "other" ("other" is comprised primarily of general overhead, leave time, clerical, equipment purchase and repair, and supervision costs); indirect expenditures related to work on all assets are included in this category

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- RoadSoft: A pavement asset management system in use by most roadway agencies in Michigan, developed by the Center for Technology & Training at the Michigan Technological University
- Routine maintenance costs (RM): For pavement, considered part of county Act 51 Report "Maintenance" costs and part of city Act 51 Report "Preservation—Streets" costs
- *Updatable Workbook Data Entry Tool*: An Excel workbook that local agencies can use to enter their inventory, condition, and cost data annually; the TAMC will update the *TAMC Updatable Workbook for Local Agency Data* with this information
- Winter maintenance costs: For roadside assets, line-item cost listed in county and city Act 51 Reports

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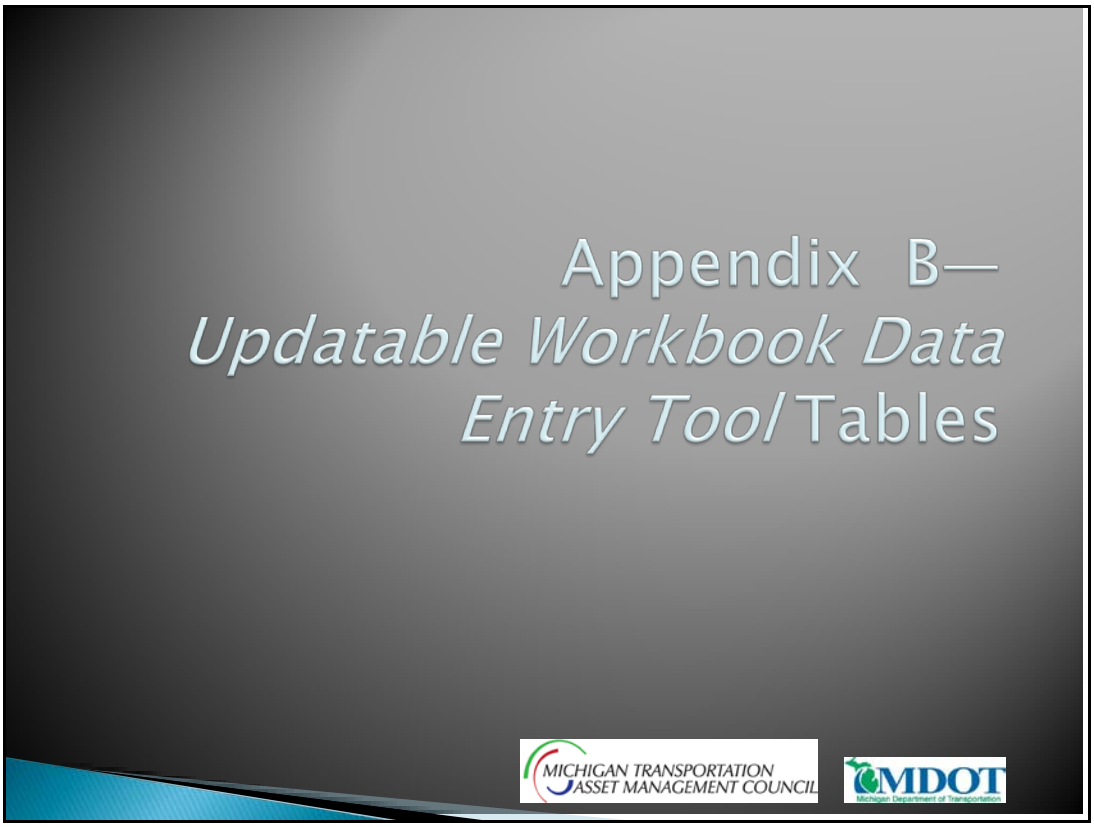

Inventory Data Worksheet—Inventory Tables

3 Pavement Inventory - Lane Miles

Pavement Type	National Functional Class (NFC)							County Road Class		
	NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Asphalt								0	0	0
Concrete								0	0	0
Composite								0	0	0
Seal Coat								0	0	0
Unpaved								0	0	0
Total Pavement	0	0	0	0	0	0	0	0	0	0

4 Pavement Inventory - Centerline Miles

Pavement Type	National Functional Class							County Road Class		
	NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Asphalt								0	0	0
Concrete								0	0	0
Composite								0	0	0
Seal Coat								0	0	0
Unpaved								0	0	0
Total Pavement	0	0	0	0	0	0	0	0	0	0

5 Bridge Inventory - Square Feet of Deck Area

Bridge Deck Area	National Functional Class							County Road Class		
	NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Total Bridge								0	0	0

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Condition Data Worksheet—Condition Tables

3 Pavement Conditions (as % of lane-miles at each condition level)

Pavement Type	Condition	National Functional Class							County Road Class		
		NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Asphalt	Good										
	Fair										
	Poor										
Concrete	Good										
	Fair										
	Poor										
Composite	Good										
	Fair										
	Poor										
Seal Coat	Good										
	Fair										
	Poor										
Unpaved	Good										
	Fair										
	Poor										
Total Pavement	Good										
	Fair										
	Poor										

4 Bridge Conditions (as % of bridge deck area at each condition level)

Bridge Deck Area	Condition	National Functional Class							County Road Class		
		NFC 1	NFC 2	NFC 3	NFC 4	NFC 5	NFC 6	NFC 7	County Primary	County Local	Total
Total Bridge	Fair to Good										
	Poor										

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Expenditure Data Worksheet—Expenditure Tables

2 Expense Act 51 Category	Primary Road Fund	Local Road Fund	Co. Road Commission Road Fund
Construction/Capacity Improvement			
Roads			-
Structures			-
Roadside Parks			-
Special Assessments			-
Other (please specify):			-
Total Construction/Capacity Improvement	$0.00	$0.00	-
Preservation - Structural Improvements			
Roads			-
Structures			-
Safety Projects			-
Roadside Parks			-
Special Assessments			-
Other (please specify):			-
Total Preservation - Structural Improvement	$0.00	$0.00	-
Maintenance			
Roads			-
Structures			-
Roadside Parks			-
Winter Maintenance			-
Traffic Control			-
Total Maintenance	$0.00	$0.00	-
Other (i.e., miscellaneous)			
Administrative Expense			
Equipment Expense - Net			
Capital Outlay - Net			
Debt Principal Payment			
Interest Expense			
Drain Assessment			
Other (please specify):			
Other (please specify):			
Total Other (i.e., miscellaneous)	$0.00	$0.00	$0.00
Total - All Expenditures	$0.00	$0.00	$0.00
Total - All Road Classes	$0.00		

Expense Asset & Work Type	County Primary	County Local	Total
Pavement			
Routine Maint (RM) & Cap Prev Maint (CPM)	$0.00	$0.00	$0.00
Rehab & Reconst (R&R)	$0.00	$0.00	$0.00
Const/ Capac Improv	$0.00	$0.00	$0.00
Total Pavement	$0.00	$0.00	$0.00
Total Bridges	**$0.00**	**$0.00**	**$0.00**
Roadside Assets			
Winter Maint (WM)	$0.00	$0.00	$0.00
Maintenance (Non-WM)	$0.00	$0.00	$0.00
Preservation	$0.00	$0.00	$0.00
Constr/ Capac Improv	$0.00	$0.00	$0.00
Other Expenditures	$0.00	$0.00	$0.00
Total Roadside Assets	**$0.00**	**$0.00**	**$0.00**
Total - All Assets	**$0.00**	**$0.00**	**$0.00**

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Appendix D: Marketing Presentation

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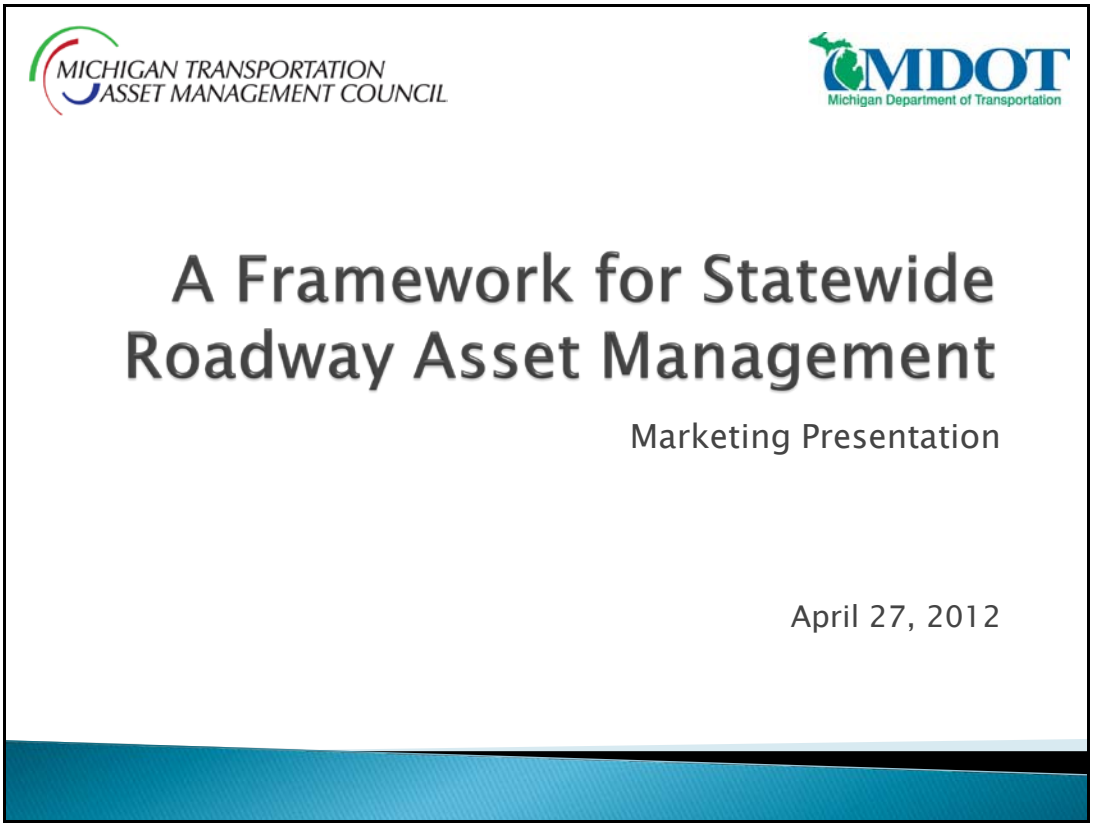

Agenda

- Overview of the *TAMC Updatable Workbook for Local Agency Data*
- Uses of the *TAMC Updatable Workbook for Local Agency Data*
- Performance-Based Planning and the *Updatable Workbook*
- Implemention of Framework Recommendations

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Overview of the *TAMC Updatable Workbook for Local Agency Data*

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Updatable Workbook as Asset Management Framework Tool

The *Updatable Workbook* has been developed to help centralize local agency data and to serve as a tool by which to compare actual and needed cost/mile expenditures.

The *Updatable Workbook* will perform the following functions:

1) Track inventory, cost, and condition information to determine current per-lane-mile costs
2) Provide summary rollups of this information at the regional, agency type (county road commission or city), and road-class level
3) Generate estimated per-lane-mile costs for bringing all local agency assets to fair-to-good condition in a twenty-year period
4) Compare actual expenditures and conditions to costs and conditions projected in the twenty-year, needs-based forecast

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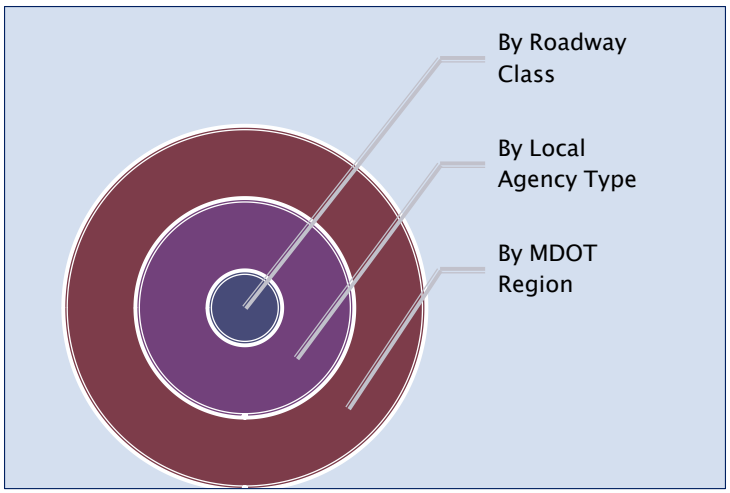
Selected Categories of Information Tracking

To provide the most useful level of detail, the TAMC has recommended that expenditure information in the workbook be tracked by roadway class (primary/major or local), by local agency type (city or county), and by MDOT region.



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Workbook Inputs and Outputs for Managing Roadway System

Inventory, condition, and expenditure data will be compiled and entered into the *Updatable Workbook*, which will then track twenty-years of data against forecast needs.

- The following select local agency data will be entered in the *Data Entry Tool* annually:
  - Pavement and bridge inventories
  - Pavement and bridge condition data
  - Expenditure data for all asset types
- Once this information has been transferred into the *Updatable Workbook*, it will auto-calculate rollups by MDOT region, agency-type, and road class
- The *Updatable Workbook* will track twenty-years of data and show each year's condition and expenditure information alongside need projections over this period

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Updatable Workbook Local Agency Participation

The majority (as measured in centerline miles) of each of MDOT region's roadway systems will be represented in the workbook.

- All MDOT regions will be represented by at least three county road commissions and at least three cities each
- Data from 122 local agencies with at least 100 centerline miles of roadway will be input into the workbook—this includes all 83 counties in Michigan and 45 of Michigan's cities
- Data from six additional cities will be used in the workbook (three in the Superior region and three in the North region), since no city in either region has over 100 centerline miles of roadway

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Questions Answered by *Updatable Workbook*

The *Updatable Workbook* will provide information regarding agency cost/lane-mile expenditure levels, pavement and bridge condition changes, and forecast cost and condition comparisons.

What have local agencies spent?	What has been achieved?	What else could be achieved?
• Costs per lane mile by MDOT region, road type, and agency type • Costs per lane mile for each asset type • Each local agency's costs per lane mile	• Condition data for pavement and bridges • Condition data by MDOT region, road type, and agency type • Each participating local agency's condition data	• Twenty-year forecast annual expenditure needs • Twenty-year forecast annual conditions • Comparison of annual forecasts to actual costs and conditions

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Uses of the *TAMC Updatable Workbook for Local Agency Data*

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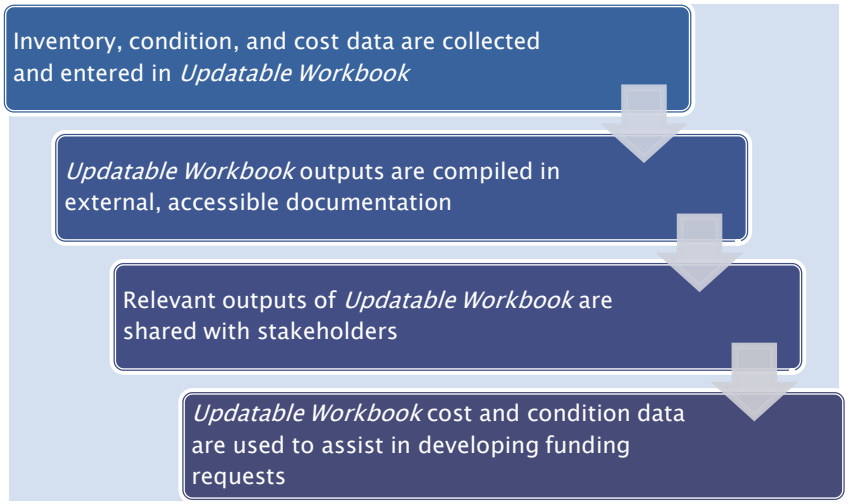
Updatable Workbook Usage—Process Flow

Once data has been entered into the *Updatable Workbook*, its outputs will be compiled and shared, and can be used to assist in the development of funding requests.



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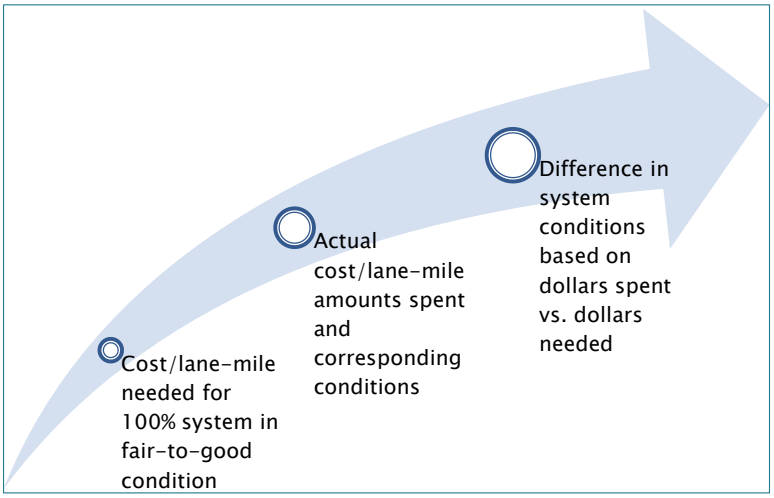
Updatable Workbook Cost to Asset Condition Analysis

Costs/lane mile needed for 100 percent of pavement and bridge assets to be maintained in fair-to-good condition will be compared to actual costs/lane mile and associated condition levels.



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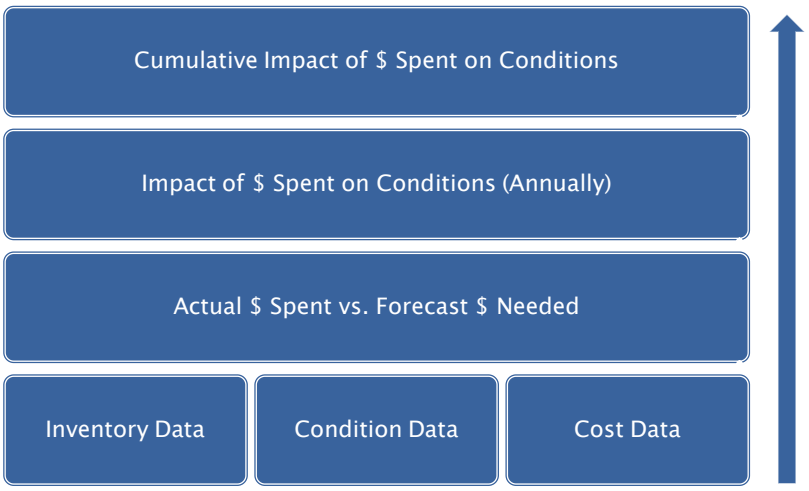
Workbook Inputs and Outputs

After inventory, condition, and cost data have been entered into the *Updatable Workbook*, the workbook will compare annual and cumulative dollars spent and current conditions with forecast values.



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Obstacles Addressed by *Updatable Workbook*

The *Updatable Workbook* has been developed to help address limitations in quantifying needs, demonstrating impacts of current expenditures, and communicating asset conditions.

Current hurdles to securing the revenues needed to maintain Michigan's roadway system include:

- Limitations on quantifying needs in a systematized, centralized manner
- Limitations on demonstrating the positive impacts of current expenditure levels
- Limitations on the ability to communicate conditions of local agency roadway system assets
  - Pavement conditions for most non-federal aid roads are not yet available in a centralized location
  - Roadside asset conditions have not been collected in a standardized format

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Performance-Based Planning and the *Updatable Workbook*

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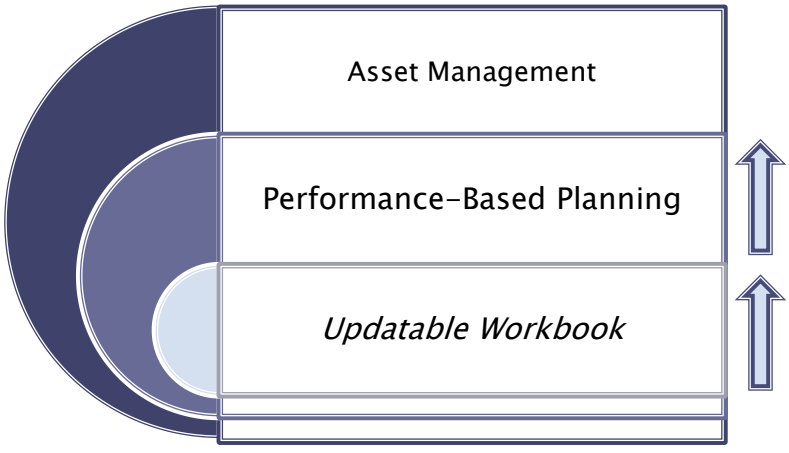
Performance-Based Planning and an Asset Management Framework

The *Updatable Workbook* should be considered a tool for performance-based planning. Asset management can be structured, in part, to meet performance-based planning goals.



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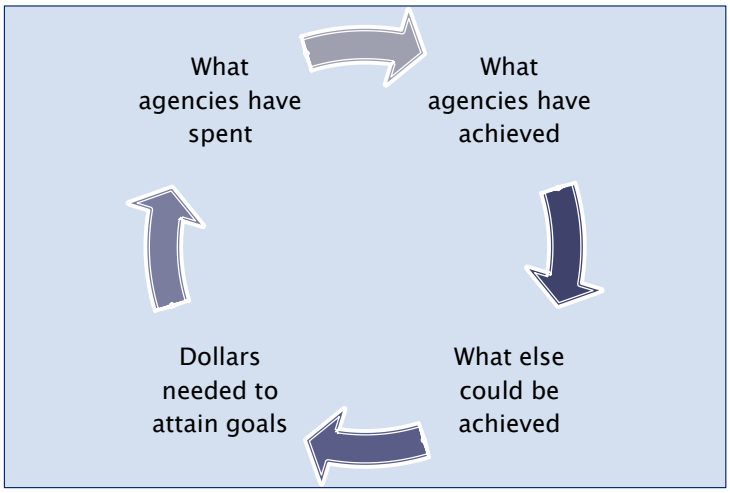
Measures of Performance-Based Planning

In general terms, performance-based planning strives to track what agencies spend and achieve, and to project what could be achieved using a specific future expenditure level.



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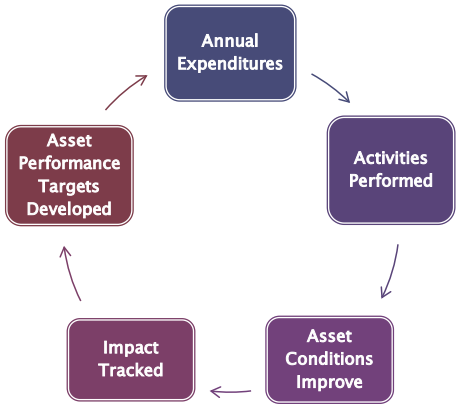
Performance-Based Planning Assessment Cycle

A performance-based planning framework tracks annual expenditures, activities performed, and asset condition improvements against asset performance targets.

Performance-Based Planning Cycle

- Annual expenditures set
- Roadway asset activities performed
- Asset conditions improve
- Impact of $ on asset work tracked
- Asset performance targets developed



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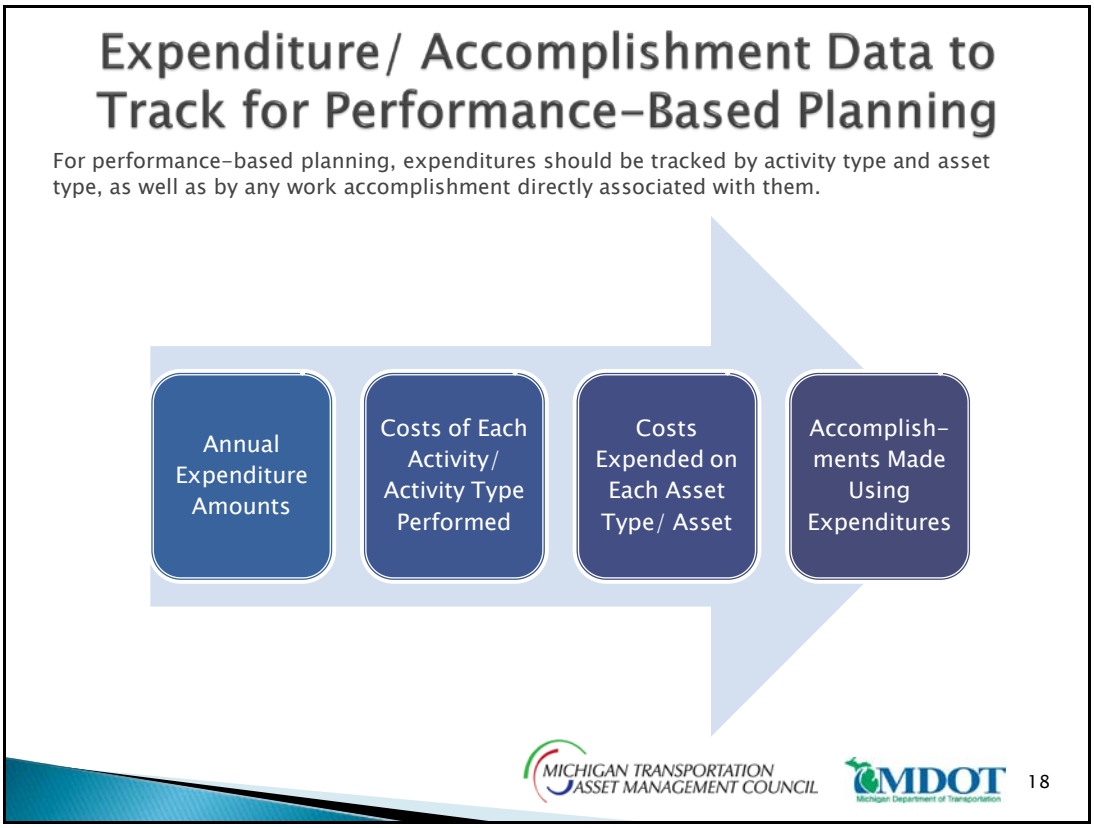
Expenditure/ Accomplishment Data to Track for Performance-Based Planning
For performance-based planning, expenditures should be tracked by activity type and asset type, as well as by any work accomplishment directly associated with them.
Annual Expenditure Amounts
Costs of Each Activity/ Activity Type Performed
Costs Expended on Each Asset Type/ Asset
Accomplish-ments Made Using Expenditures
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Implementation of Framework Recommendations
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How Will Using the *Updatable Workbook* Help?

The *Updatable Workbook* will provide outputs to assist in developing funding requests, in coordinating pavement and bridge condition improvement efforts, and in obtaining a more comprehensive view of the local agency roadway system.

Funding Request Development and Justification	Coordination of Condition Improvement Efforts	Comprehensive View of Local Agency Roadway System
Improved ability to develop and justify $ needs through standardized measures	Improved system-wide understanding of pavement and bridge conditions	Enhanced system-wide information on road inventory by road class
Better tracking of results achieved using funding obtained	Better-coordinated view of improvement efforts across agency lines	Improved tracking of expenditures to asset and activity types

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Goals of Implementing Asset Management Framework

In the short term, the *Updatable Workbook* should provide roadway agencies with an improved understanding of expended and needed costs per lane mile; in the long term, the adoption of additional processes and tools can further assist in these efforts.

Near-Term Goals

Advanced via Updatable Workbook

- Improved understanding of costs/lane-mile needed to maintain local agency roadway system
- Measured impact of annual costs/lane-mile on pavement and bridge conditions
- Comparison of $ spent and condition levels to target $ and condition levels

Long-Term Goals

Achieved via additional processes and tools

- Tracking of expenditure data against activity/ activity type and asset/ asset type
- Tracking of roadside asset data in standardized format
- Automated population of *Updatable Workbook*
- Increased use of local agency inventory, condition, and cost data centralizing tools

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Annual Workbook Updating Process: Next Steps

To ensure the *Updatable Workbook* is updated annually, the TAMC should put certain processes in place; cooperation of local agencies will be needed.

Transportation Asset Management Council

- Select annual calendar for data collection
- Develop business processes for data population and workbook output review
- Recommend workbook updating and review process to local agencies

County Road Commissions/ Cities

- Provide the TAMC with data needed to complete collection efforts
- Verify data populated in the *Updatable Workbook* by the TAMC is accurate
- Review summary analysis provided by the TAMC once the workbook has been populated each year

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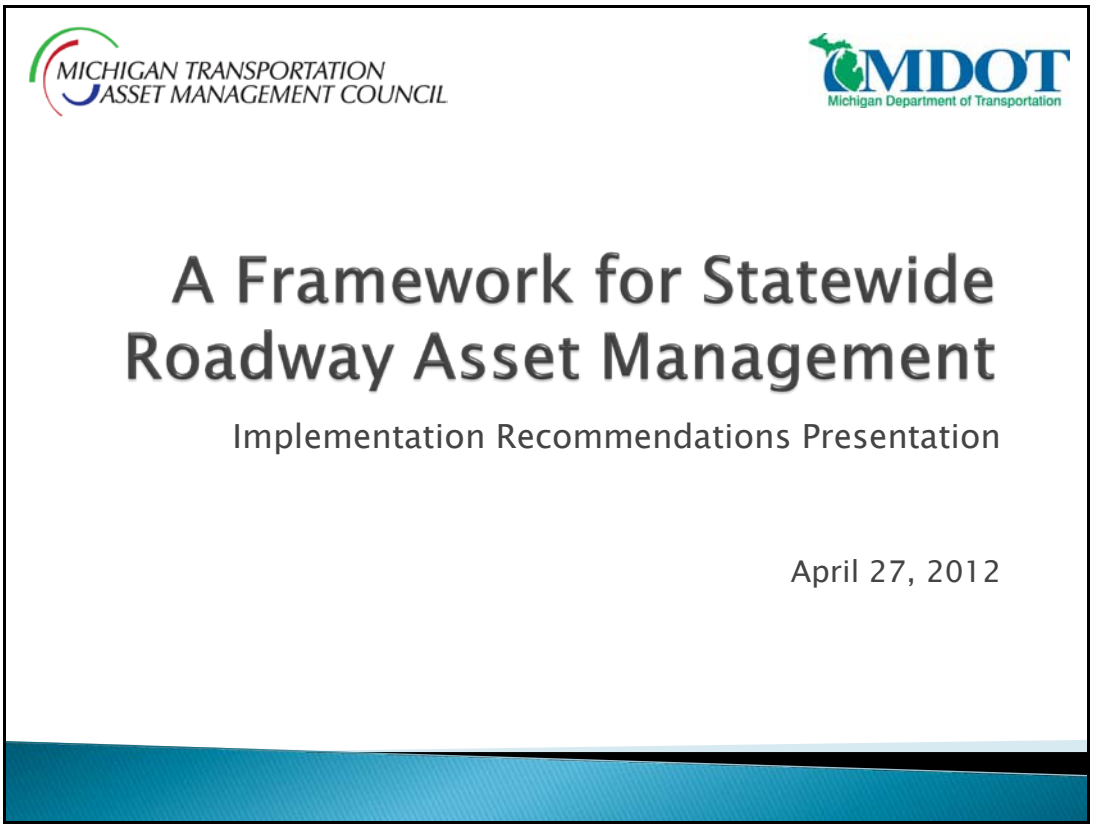
Appendix E: Implementation Presentation



Agenda

- *Updatable Workbook* Data Collection: Implementation Plan Development
- Data Needed for *Updatable Workbook*
- Annual *Updatable Workbook* Outputs and Recommended Uses
- Implementation Next Steps

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Updatable Workbook Data Collection: Implementation Plan Development

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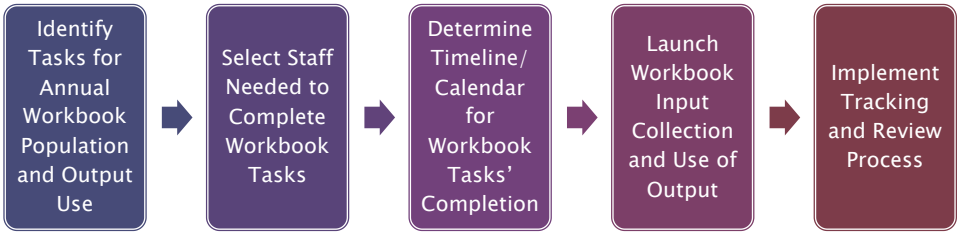
Implementation Plan Components

In order to implement the *Updatable Workbook*, the TAMC will need to identify all workbook input and output tasks, select staff that can complete them, and determine the appropriate annual timeline for the effort.



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Tasks Required for *Updatable Workbook* Usage

Five core tasks will need to be completed annually for the *Updatable Workbook* to be usable.

1. Inventory, condition, and expenditure annual data collection
2. Validation of data to be entered in workbook
3. Entry of collected data in workbook
4. Verification of workbook outputs
5. Use of workbook outputs for annual budget and planning guidance

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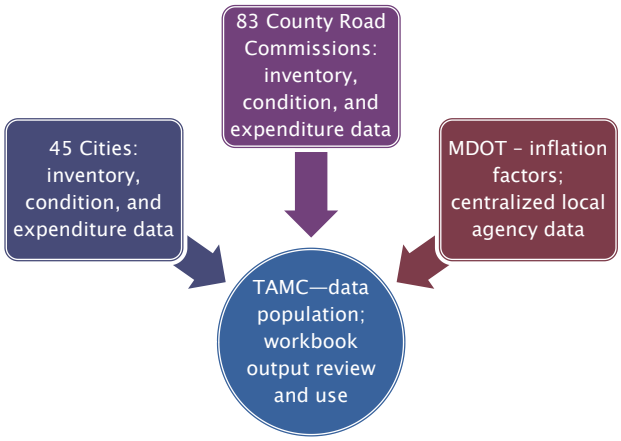
Input Required/ Participant Selection

The TAMC will use data provided by local agencies (during independent data collection efforts and/or during a specific annual collection process), as well as updated inflation factors and any centralized local agency data provided by MDOT, to populate the *Updatable Workbook*.



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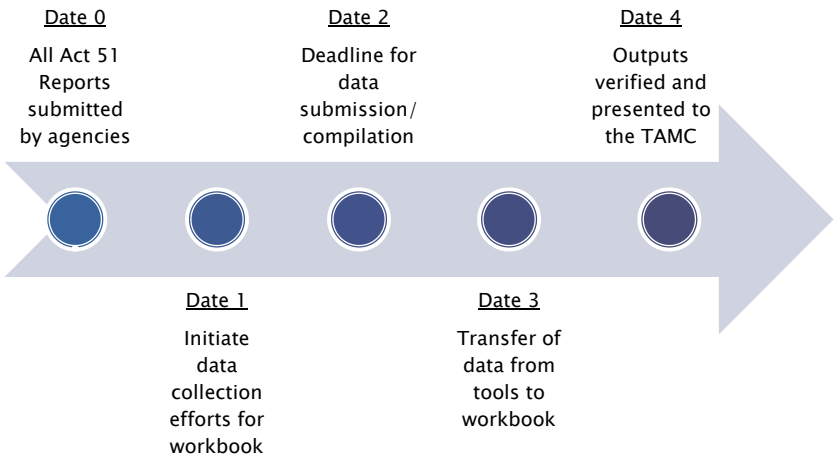
TAMC Timeline/ Calendar Development

The TAMC should determine each year's workbook updating calendar once the relevant Act 51 Reports have been submitted by local agencies, setting four key dates in the updating process.



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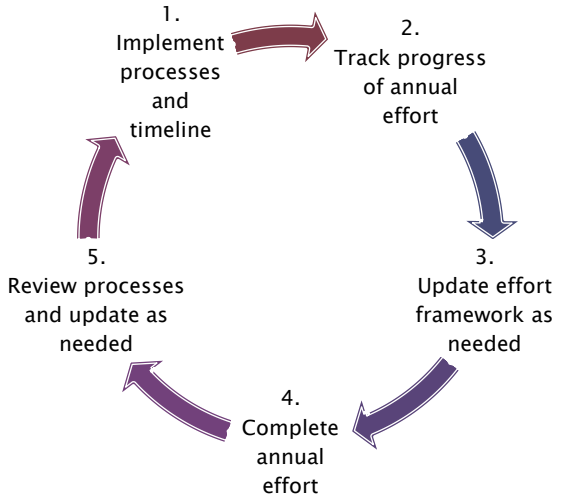
Implement Tracking and Review Process

After launching the first workbook updating and output review effort, the TAMC can update the effort framework as needed, and once the annual effort has been completed, can review its effectiveness and make any necessary updates to the process.



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Data Needed for *Updatable Workbook*

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Overview of Data for *Updatable Workbook*

Data needs of the *Updatable Workbook* have been organized by asset type; inventory and condition data for pavement and bridges, as well as expenditure data for all asset types, will be needed.*

Asset Type	Inventory Data	Condition Data	Expenditure Data
Pavement	Yes	Yes	Yes
Bridges	Yes	Yes	Yes
Roadside Assets	No	No	Yes
Winter Maintenance	N/A	No	Yes

* *Act 51 Report expenditure categories will automatically be re-allocated by asset type.*

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Sources for *Updatable Workbook* Data

Data from RoadSoft, Pontis (or the Michigan Bridge Information System), and Act 51 Reports will be needed to populate the workbook.

Asset Type	Inventory Data Sources	Condition Data Sources	Expenditure Data Sources
Pavement	RoadSoft	RoadSoft	Act 51 Reports
Bridges	Pontis or Michigan Bridge Information System (MBIS)	Pontis or Michigan Bridge Information System (MBIS)	Act 51 Reports
Roadside Assets	N/A	N/A	Act 51 Reports
Winter Maintenance	N/A	N/A	Act 51 Reports

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Workbook Data Inputs

Data can be input directly into the workbook or into the *Updatable Workbook Data Entry Tool* (which has been developed to assist local agencies) and then transferred into the workbook; a user manual and training presentation are available to provide assistance in data collection.

- Local agencies can provide or validate (if the TAMC already has) the following information in the *Updatable Workbook Data Entry Tool* annually:
  - Pavement and bridge inventories
  - Pavement and bridge condition data
  - Expenditure data for all asset types
- Once this information has been transferred to the *Updatable Workbook* by the TAMC, the workbook will auto-calculate rollups by MDOT region, agency-type, and road class
- The *TAMC User Guide for Updatable Workbook and Reportion Tool* and the *Updatable Workbook Training Presentation* have been developed to help participants effectively utilize the workbook and reporting tool

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Annual *Updatable Workbook* Outputs and Recommended Uses

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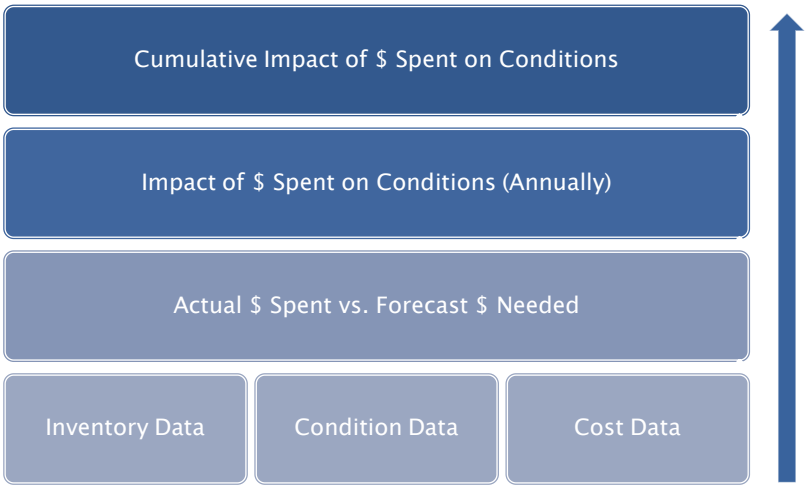
Workbook Inputs and Outputs

Once inventory, condition, and cost data have been entered into the *Updatable Workbook*, the workbook's outputs will compare annual and cumulative dollars spent and current conditions to forecast values.



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Overview of Workbook Outputs

The *Updatable Workbook* will produce a variety of summary and analysis outputs for the TAMC's use, including rollups of inventory, condition, and expenditure data.

Output Type	Output Details
Inventory Data	Summary of all entered lane-mile, centerline-mile, and bridge deck area inventory by region, road class, and federal aid vs. non-federal aid roads (approximated, based on road type)
	Total lane-mile inventory information for each type of pavement listed (e.g., asphalt, concrete, composite, seal coat, unpaved), provided local agencies submit inventory information at this level of detail; otherwise total pavement inventories only
Condition Data	Overall pavement and bridge condition information for each region by road type, county primary and city major roads combined (federal-aid roads, approximately), county and city local road combined (non-federal-aid roads, approximately); overall local agency MDOT regional and statewide averages
Expenditure Data	Total and per-lane-mile cost rollups by MDOT region, agency type, and road class for all counties and cities participating; totals by expenditure type and for all asset types

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Overview of Workbook Outputs (cont'd)

The workbook will also provide comparisons of actual to forecast expenditures and conditions, both in tablular and in graphical formats.

Output Type	Output Details
Actual Expenditures vs. Forecast Expenditure Needs	Actual vs. forecast annual expenditure per-lane-mile needs alongside one another, as well as cumulative difference
	Graphs showing actual and forecast cost information for each asset type, by MDOT region and statewide
Actual vs. Forecast Conditions	Comparison of actual to forecast conditions for the next twenty yeara (which correspond to the projected level of needed expenditures)
	Graphs showing actual and forecast condition information for pavement and bridges, by MDOT region and statewide

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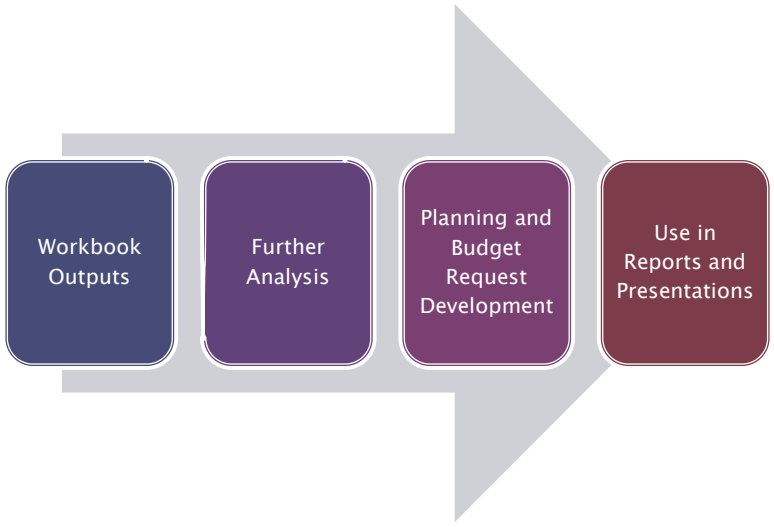
Workbook Output Recommended Uses

The workbook outputs can be extracted as needed for further analysis, for use in planning and budget request development, and for use in related reports and presentations.



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Updatable Workbook Implementation—Next Steps

The TAMC will need to select staff member(s) who can oversee the use of the *Updatable Workbook*; once additional participants have been selected, progress should be monitored and tracked against the first annual calender set.

1) Select TAMC "owner" or "owners" of *Updatable Workbook* to provide oversight and direction to staff
2) Determine party or parties responsible for the following components of the updating process:
   - Participant guidance and instruction
   - Data collection
   - Data inputting
   - Output verification and analysis
3) Select start date for implementation and first annual calendar for workbook completion
4) Monitor progress of workbook's completion and utilize first set of annual outputs

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