City of Muskegon
2022 Transportation Asset Management Plan

A plan describing the City of Muskegon's transportation assets and conditions

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ASSET MANAGEMENT PLAN SUMMARY

As conduits for commerce and connections to vital services, roads and bridges are among the most important assets in any community. Other assets like culverts, traffic signs, traffic signals, and utilities support and affect roads and bridges. The City of Muskegon's roads, bridges, and support systems are also some of the most valuable and extensive public assets, all of which are paid for with taxes collected from citizens and businesses. The cost of building and maintaining these assets, their importance to society, and the investment made by taxpayers all place a high level of responsibility on local agencies to plan, build, and maintain roads, bridges, and support assets in an efficient and effective manner.

An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of the City's obligations towards meeting these requirements. However, this plan and its supporting documents are intended to be much more than a fulfillment of required reporting. This asset management plan helps to demonstrate the City's responsible use of public funds by providing elected and appointed officials as well as the general public with the inventory and condition information of the City's road and bridge assets, and gives taxpayers the information they need to make informed decisions about investing in the City's essential transportation infrastructure.

INTRODUCTION

Asset management is defined by Public Act 325 of 2018 as "an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals". In other words, asset management is a process that uses data to manage and track assets, like roads and bridges, in a cost-effective manner using a combination of engineering and business principles. This process is endorsed by leaders in municipal planning and transportation infrastructure, including the Michigan Municipal League, County Road Association of Michigan, the Michigan Department of Transportation (MDOT), and the Federal Highway Administration (FHWA). The City of Muskegon is supported in its use of asset management principles and processes by the Michigan Transportation Asset Management Council (TAMC), formed by the State of Michigan.

Asset management, in the context of this plan, ensures that public funds are spent as effectively as possible to maximize the condition of the road and bridge network. Asset management also provides a transparent decision-making process that allows the public to understand the technical and financial challenges of managing transportation infrastructure with a limited budget.

The City of Muskegon has adopted an "asset management" business process to begin to address the challenges presented by having limited financial, staffing, and other resources while needing to meet road users' expectations. The City is responsible for maintaining and operating over 184.70 centerline miles of roads and 3 bridge structures. The City is responsible for 29 separated storm culverts. Culvert data was collected during the EGLE Stormwater, Asset Management, and Wastewater (SAW) Grant Program between 2015-2017. The City owns and is responsible for maintaining 25 signals.

This 2022 plan identifies the City's transportation assets and their condition as well as the strategy that the City of Muskegon uses to maintain and upgrade particular assets given the City's condition goals, priorities of network's road users, and resources. An updated plan is to be released approximately every three years both to comply with Public Act 325 and to reflect changes in road and bridge conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to Dan VanderHeide at 1350 E. Keating Avenue, Muskegon, MI 49442, dan.vanderheide@shorelinecity.com, or at (231) 724-4100.

1. PAVEMENT ASSETS

The City of Muskegon is responsible for 184.70 centerline miles of public roads. An inventory of these miles divides them into different network classes based on road purpose/use and funding priorities as identified at the state level: city major road network, which is prioritized for state-level funding, and city local road network.

Inventory of Assets

Of the City's 184.70 miles of road, 73.88 miles are classified as city major and 110.82 miles are classified as city local. Figure 1 identifies these paved roads in green, yellow, and red with the colors being determined based on the road segment's condition. Figure 1 shows unrated roads in blue. The City also manages 11.20 miles that are classified as part of the National Highway System (NHS); the NHS is subject to special rules and regulations and has its own performance metrics dictated by the FHWA. In addition, the City has 7.175 miles of unpaved roads.

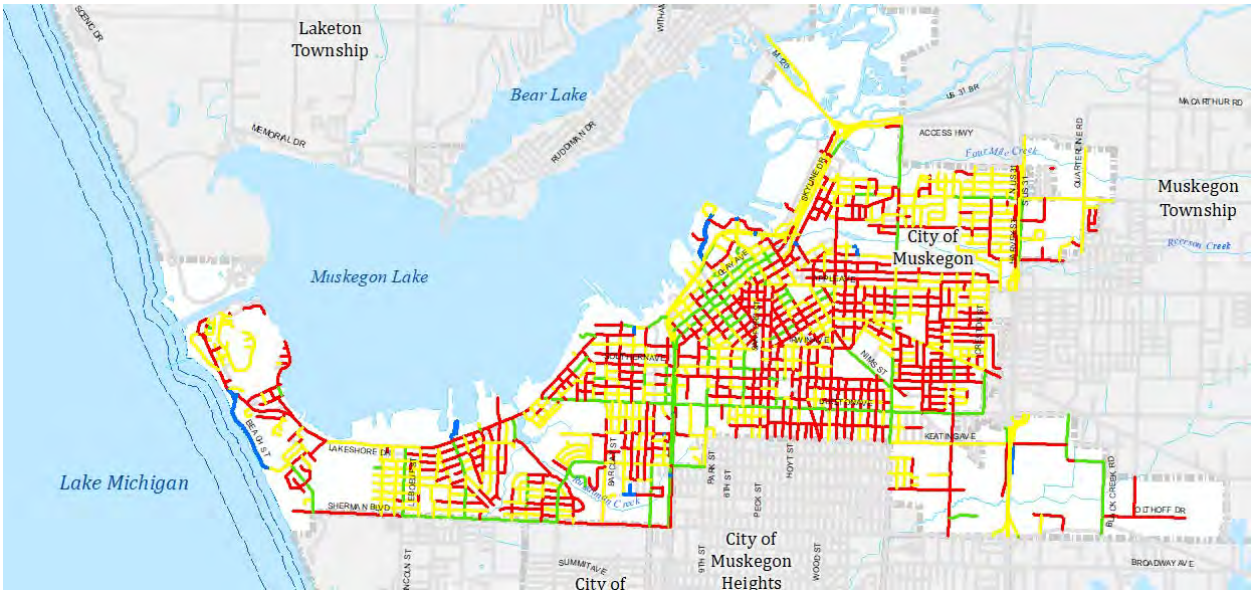

Figure 1: Map showing location or roads managed by the City and PASER Rating

Please refer to Appendix F which shows a more detailed map of roads managed by the City and their current PASER Rating condition.

Additional detail about these road assets can be found in Appendix A, the City's Roadsoft database, or by contacting the City.

Types

The City of Muskegon has multiple types of pavements in its jurisdiction, including asphalt and concrete; it also has unpaved roads (i.e., gravel and earth). Figure 2 shows a breakdown of these pavement types for all of the City's road assets.

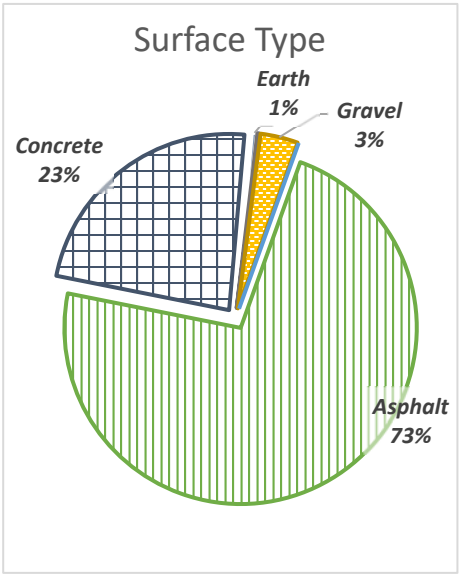

Figure 2: Pavement type by percentage maintained by the City of Muskegon.

Condition, Goals, and Trend

Paved Roads

Paved roads in Michigan are rated using the Pavement Surface Evaluation and Rating (PASER) system, which is a 1 to 10 scale with 10 being a newly constructed surface and 1 being a completely failed surface. PASER scores are grouped into TAMC definition categories of good (8-10), fair (5-7), and poor (1-4) categories. The City collects PASER data every two years on 100 percent of those portions of its city major and city local networks that are eligible for federal funding and plan to rate pavements every three years on the non-federal aid roads. The non-federal aid roads will be rated again in 2023.

Of the city major roads that are PASER rated, the city has been consistently maintaining approximately 25% of its roads in good condition, 30% in fair condition, and 45% in poor condition, and the city local network in 2019 has 3% of its roads in good condition, 46% in fair condition, and 51% in poor condition (Figure 3 and Figure 4).

The City's long-range goal is to continue to maintain the current condition of the city major network by having at least 55% of roads in good and fair condition (shown below in Figure 3). The long-range goal for the city local network is to stabilize the network by maintaining current PASER rating trends. (Figure 4). Figure 3 and Figure 4 illustrate the historical and current condition (solid bars) of the City's major and local networks, respectively; they also illustrate the projected trend (shaded bars), the overall trend in condition (trendlines), and the City's goal (final solid bar). Additional information and goals for the City of Muskegon's roads are included in the Pavement Asset Management Plan in Appendix A.

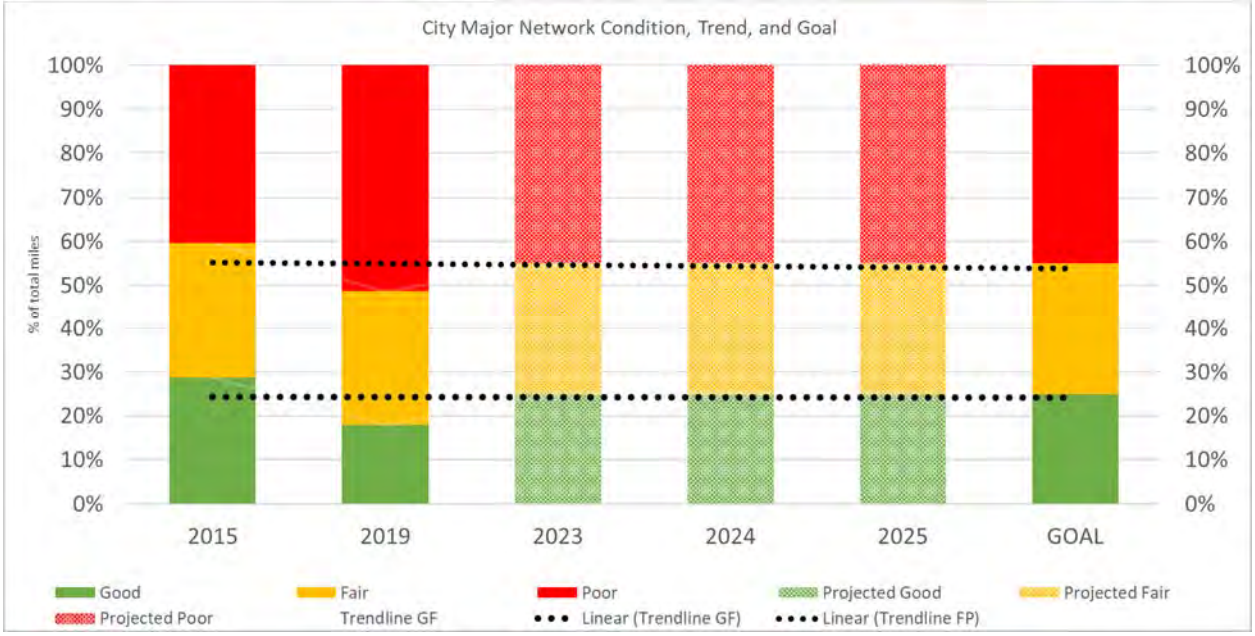

Figure 3: City major network condition, goals, and trend

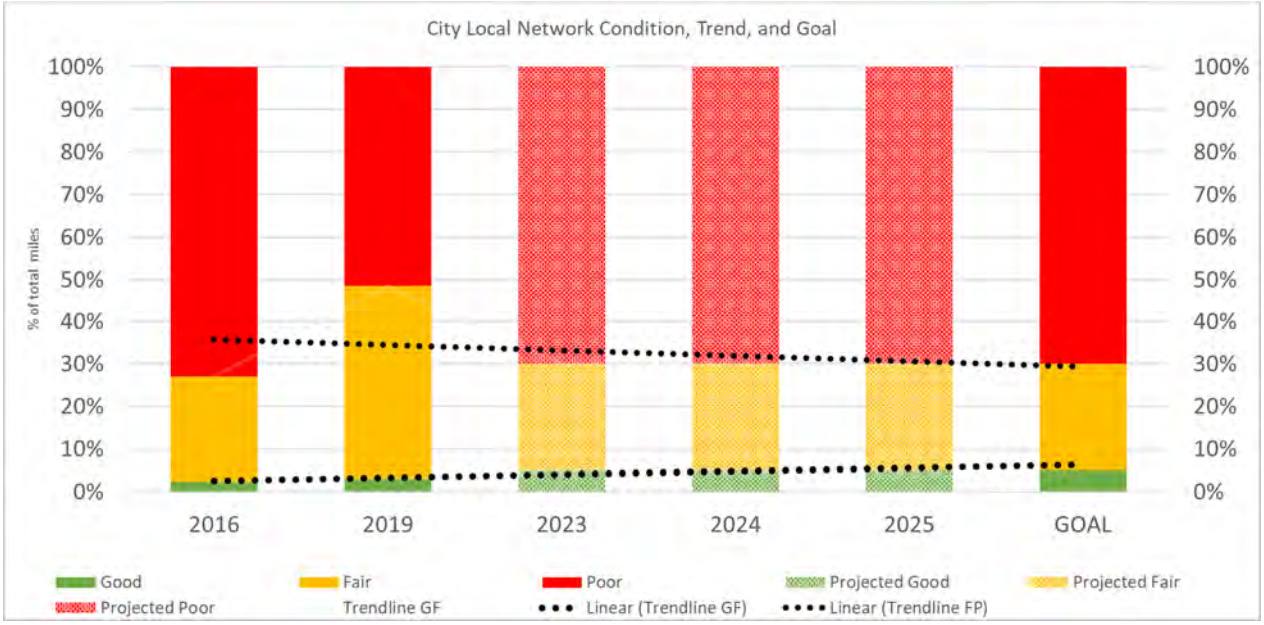

Figure 4: City local network condition, goals, and trend

Unpaved Roads

The condition of unpaved roads rapidly change which makes it difficult to obtain a consistent surface condition rating over the course of a season or even weeks. The City of Muskegon highway supervisor visually assesses their gravel roadways at various times of the year and schedules required maintenance and work as needed.

If the City ever decided to rate their unpaved roads, they would rate them with the Inventory-based Rating System™ receive an IBR number ranging from 1 to 10, with a 9 or 10 (less than one year old) having good surface width, good or fair drainage, and good structural adequacy and a 1 having poor surface width, poor drainage, and poor structural adequacy. IBR numbers can be grouped in a similar fashion as the TAMC definitions into good (8-10), fair (5-7), and poor (1-4) categories. Refer to Figure 5 below which shows the locations of unpaved roads in blue. Please refer to Appendix F for more detailed maps which show unpaved roads.

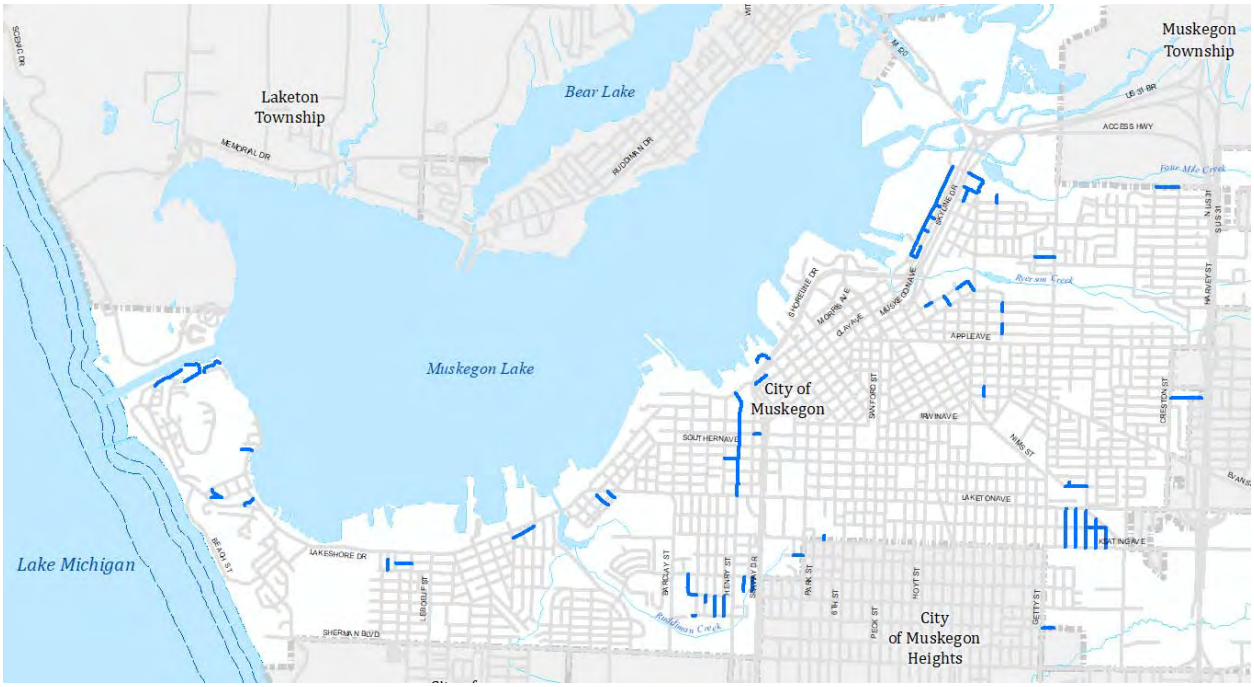

Figure 5: Map showing locations of City of Muskegon unpaved roads

Modelled Trends, Gap Analysis, and Planned Projects

Table 1: Roadsoft Modelled Trends, Planned Projects, and Gap Analysis for City's Road Assets

Network 1 – City Majors (73.88 miles)

Treatment	Average Yearly Miles of Treatment	Years of Life	Mile-Years	Min. Trigger Reset	Max. Trigger Reset	Reset	Planned Projects		Additional Work Necessary to Overcome Deficit	
							Average Yearly Miles of Treatment	Mile-Years	Average Yearly Miles of Treatment	Mile-Years
Complete Reconstruct	1.53	25	38.33	1	3	10	1.53	38.33		
Crush & Shape, 3.5"		25		1	3	10				
3" Mill & Overlay		15		3	4	9				
2" Overlay		10		3	6	9				
1.5" Mill & Overlay		7		4	6	9			2	14
1.5" Overlay		7		4	6	9				
Chip Seal & Fog		5		4	7	8			3	15
Crack Seal		2		7	7	8			5	10
Total										
Gap Analysis: (Deficit)/Surplus								-35.55		39

Network 2 – City Local (110.82 miles)

Treatment	Average Yearly Miles of Treatment	Years of Life	Mile-Years	Minimum Trigger Reset	Maximum Trigger Reset	Reset	Planned Projects		Additional Work Necessary to Overcome Deficit	
							Average Yearly Miles of Treatment	Mile-Years	Average Yearly Miles of Treatment	Mile-Years
Complete Reconstruct	0.5	25	12.5	1	3	10	0.5	12.5		
Crush & Shape, 3.5"		25		1	3	10			0.5	12.5
3" Mill & Overlay		15		3	4	9				
2" Overlay		10		3	6	9			1	10
1.5" Mill & Overlay		7		4	6	9			1.5	10.5
1.5" Overlay		7		4	6	9				
Chip Seal & Fog		5		4	7	8			10	50
Crack Seal		2		7	7	8			2	4
Total										
Gap Analysis: (Deficit)/Surplus								-85.82		87

Modelled Trends & Gap Analysis

The Roadsoft network analysis of the City of Muskegon's planned projects for the city major and city local networks for their currently available budget does not allow the City to reach its pavement condition goals given the projects planned for the next three years. To maintain current road conditions, this deficit must be overcome with a combination of maintenance and rehabilitation/reconstruction work which would require additional funding. Table 1 (above) is an example strategy that displays the additional road work that would be necessary to overcome the deficit.

Planned Projects

The City has projects planned for the next three years. These projects are shown in red in Figure 6. The **total cost** of the projects is approximately $14,050,000. This cost includes road related items such as curb and gutter, gravel, asphalt, traffic control, contractor mobilization, as well as everything else included in the reconstruction of each project such as utilities, driveway approaches, sidewalk, ADA ramps, restoration, signing, and pavement markings. Please refer to Appendix F which shows a more detailed map and list of future projects.

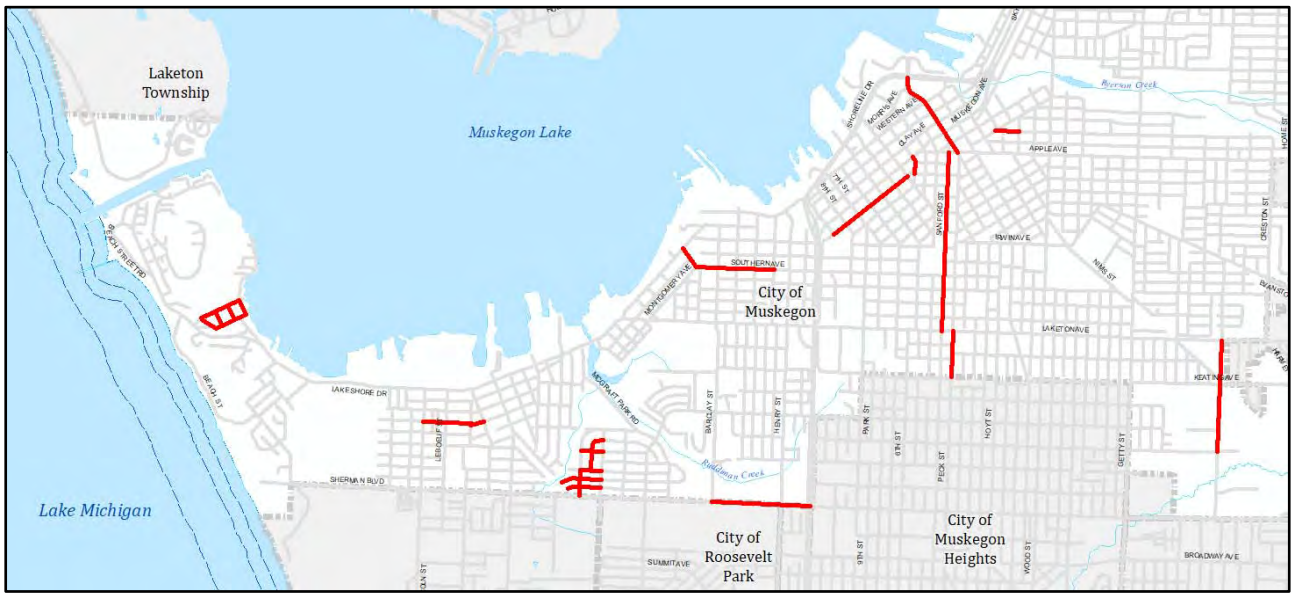

Figure 6: Map illustrating planned projects for pavement assets

2. BRIDGE ASSETS

The City is responsible for 3 bridges that provide safe service to road users across the agency network. The City seeks to implement a cost-effective program of preventive maintenance to maximize the useful service life and safety of the local bridges under its jurisdiction.

Inventory of Assets

Figure 7: Map illustrating locations of the City's bridge assets

The City has 3 total bridges in its road and bridge network; these bridges connect various points of the road network, as illustrated in Figure 7. These bridge structures can be summarized by type, size, and condition, which are detailed in Table 2. More information about each of these structures can be found in Appendix B, the City's MiBRIDGE database, or by contacting the City.

Table 2: Bridge Assets by Type: Inventory, Size, and Condition								
	Total Number of Bridges	Total Deck Area (sq ft)	Condition: Structurally Deficient, Posted, Closed			2020 Condition		
Bridge Type			Struct. Defic	Posted	Closed	Poor	Fair	Good
Concrete – Culvert	1	1,970	0	0	0	0	0	1
Steel – Multistringer	1	2,007	1	0	1	1	0	0
Steel continuous – Multistringer	1	3,202	1	0	0	1	0	0
Total SD/Posted/Closed			**2**	**0**	**1**			
Total	**3**	**7,179**				**2**	**0**	**1**
Percentage (%)			**67%**	**0**	**33**	**67**	**0**	**33**

Condition, Goals, and Trend

Bridges in Michigan are given a good, fair, or poor rating based on the National Bridge Inspection Standards (NBIS) rating scale, which was created by the Federal Highway Administration to evaluate a bridge's deficiencies and to ensure the safety of road users. The current condition of the City's bridge network is 1 (33%) is good and 2 (67%) are poor or lower with none being poor.

Bridges are designed to carry legal loads in terms of vehicles and traffic. Due to a decline in condition, a bridge may be "posted" with a restriction for what would be considered safe loads passing over the bridge. On occasion, posting a bridge may also restrict other load-capacity-related elements like speed and number of vehicles on the bridge, but this type of posting designates the bridge differently. The City has 0 structures that are posted for load restriction (Table 2). Designating a bridge as "posted" has no influence on its condition rating. A "closed" bridge is one that is closed to all traffic. Closing a bridge is contingent upon its ability to carry a set minimum live load. The City has 1 closed structure. (Table 2).

The goal of the program is the preservation and safety of the City's bridge network. Additional information and goals for the City of Muskegon's bridges are included in the Bridge Asset Management Plan in Appendix B.

Programmed/Funded Projects, Gap Analysis, and Planned Projects

The City received $250,000 from MDOT's *Local Bridge Program* towards Bridge #7700 Ottawa Street over the Muskegon River. The City has plans to remove this bridge in 2024. The City will provide a local match. The projected cost for this project is $500,000.

The City is planning to remove Bridge #7699 along Amity Avenue and replace it with an at-grade crossing. This project has not received funding however the City will apply for MDOT's *Local Bridge Program Call for Projects* and include a local match. The projected cost for this work is $600,000. The City is tentatively planning for 2026 if funding is obtained.

Bridge #7698 along Lakeshore Drive was reconstructed in 2019. Routine maintenance will be performed as necessary. Maintenance would include activies such as deck sweeping, tree/brush trimming, joint replacement, and crack sealing. Funding for maintenance will be included in the City's routine maintenance budget.

Table 3 illustrates the programmed/funded projects that will be undertaken in order to achieve the City's goal. These programmed/funded projects are juxtaposed with priority projects that remain unfunded.

Table 3: Planned Projects and Gap Analysis for City's Bridge Assets

Strategy	**2022**	**2023**	**2024**	**2025**	**2026**	**GAP**
Scheduled Maintenance						
Subtotal	$0	$1,000	$500	$500	$500	$0
Other - Demolition						
Subtotal	$0	$0	$500,000	$0	$600,000	$600,000

3. CULVERT ASSETS

The City of Muskegon exercises awareness of its culvert assets. Culvert data was collected during the EGLE Stormwater, Asset Management, and Wastewater (SAW) Grant Program between 2015-2017.

Inventory of Assets

At present, the City tracks inventory data of its culvert assets only. The City has inventoried 29 culverts, which is 100 percent of their known culverts. 23 of the 29 have been rated via a pole-mounted Zoom Camera.

Of the 23 rated culverts, the City has 22 culverts in good condition and 1 culvert in fair condition. There are no culverts considered poor or failed based on the culvert rating system that the City uses (see Appendix C *Culvert Asset Management Plan Supplement*). Ratings were performed in 2017 during the City's SAW Grant. The 6 unrated culverts were submerged and therefore not rated. Please refer to Figure 8 below which shows the locations of the City's rated culverts in red and unrated culverts in green. Located in Appendix F are more detailed maps which show culverts owned by the City of Muskegon.

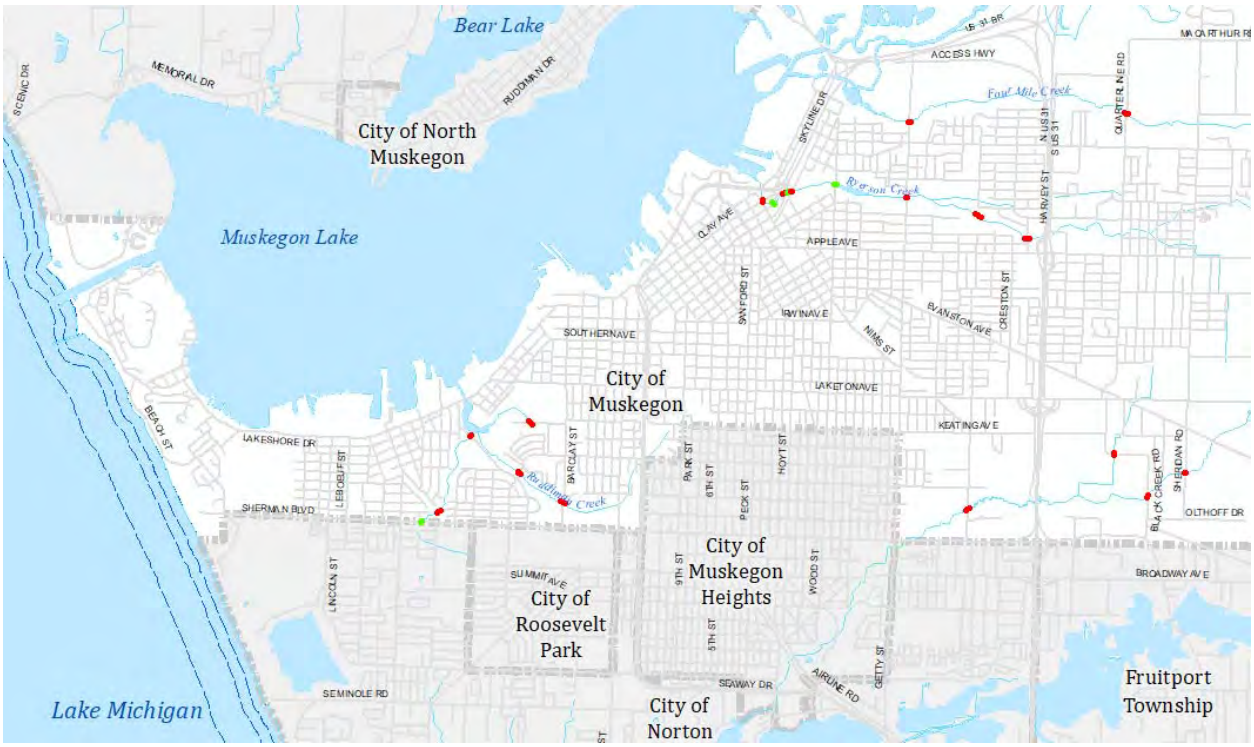

Figure 8: Map showing locations of City of Muskegon owned culverts

More detail about these culvert assets can be found in the City's Roadsoft database or by contacting the City.

Goals

The goal of the City's asset management program is the preservation of its culvert network. The City is responsible for preserving 29 inventoried culverts as well as any un-inventoried culverts that underlie its entire road network.

The second goal is to rate the condition of the remaining 6 culverts within the next 5 years. The City plans to work towards having the condition of all culverts rated and inspected on a routine basis. The inspection of the larger culverts that are under the length considered 'bridges', 15' to 20', plan to be added to the list of inspections completed by a qualified bridge inspector on a 5 year cycle. This will provide a condition inspection that includes maintenance recommendations.

The City's goal is to mitigate future storm disasters by removing multiple culverts that are placed closely together when replacement occurs. Water is more likely to enter the backfill between closely spaced culverts causing erosion. Over time, the loss of material may cause potential washout of culverts and collapsing of the road above. When the condition of an existing double or triple culvert is rated poor and has reached a point of necessary replacement, engineering review of the crossing will occur to replace with a single adequately sized culvert.

Planned Projects

The City's policy is to replace or repair culvert assets concurrent with projects affecting road segments carried by the particular culverts. The City also includes culvert assets in scheduled maintenance projects affecting road segments carried by the particular culverts.

4. SIGNAL ASSETS

The City of Muskegon exercises awareness of its traffic sign and signal assets. The City regularly reviews signals for warrants and removes or modifies signals when appropriate.

Inventory of Assets

At present, the City tracks location, signal head configuration, pole configuration, notation of pedestrian signals, flashing beacons, and whether cameras or loop detection systems are in place for each traffic signal. The City has inventoried 100% of the 25 traffic signal locations that the City owns. Please refer to Figure 9 below which shows locations of the inventoried traffic signals.

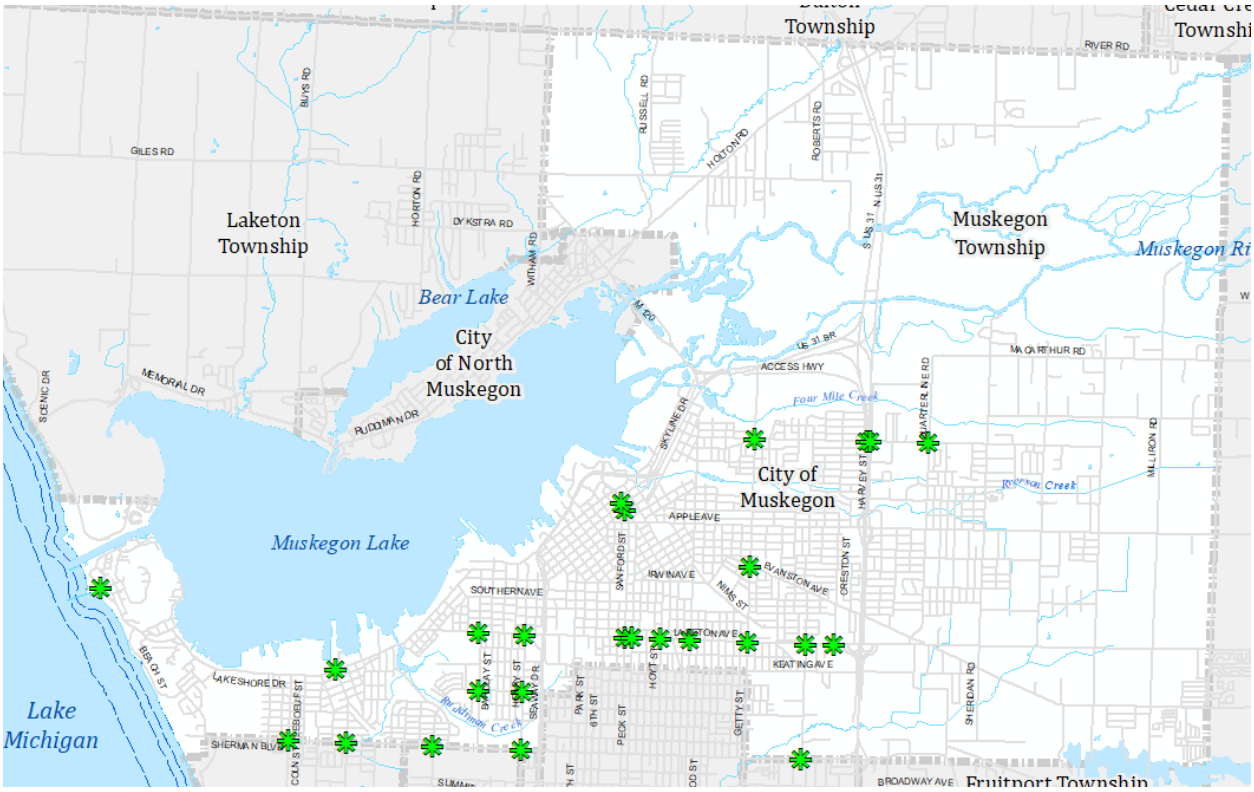

Figure 9: Map showing locations of City of Muskegon owned signals

More detail about these traffic signal assets can be found in Appendix D or by contacting the City.

Goals

The goal of the City's asset management program is the preservation and continual operation of its traffic signals and flashing beacons. The City is responsible for preserving 25 inventoried traffic signals and flashing beacons as well as providing upgrades deemed necessary based on traffic or geometric needs. Another goal of the City's is to systematically and proactively review upgrades in technology to financially prepare for large signal replacement projects.

Planned Projects

The City's policy is to evaluate traffic signal assets based on condition assessment for replacement or repair during any reconstruction, rehabilitation, preventive maintenance, or scheduled maintenance activities on the roadway affected by the particular signal. The City contracts with Muskegon County Signal Maintenance Group to annually inspect and maintain each signal. They conduct replacements or repairs for traffic signal assets reported as non-functional or as performing with reduced function. The City adheres to regular maintenance and servicing policies outlined in the *Michigan Manual of Uniform Traffic Control Devices*.

The City also plans to remove two signals along Terrace Street with a road diet project within the next three years.

5. FINANCIAL RESOURCES

Public entities must balance the quality and extent of services they can provide with the tax resources provided by citizens and businesses, all while maximizing how efficiently funds are used. Therefore, the City will overview its general expenditures and financial resources currently devoted to transportation infrastructure maintenance. This financial information is not intended to be a full financial disclosure or a formal report. Full details of the City's financial status can be found by request submitted to our agency contact (listed in this plan).

Anticipated Revenues & Expenses

The City of Muskegon receives funding from the following sources:

- **State funds** – The City's principal source of transportation funding is received from the Michigan Transportation Fund (MTF). This fund is supported by vehicle registration fees and the state's per-gallon gas tax. Allocations from the MTF are distributed to state and local governmental units based on a legislated formula, which includes factors such as population, miles of certified roads, and vehicle registration fees for vehicles registered in the agency's jurisdiction. The City also receives revenue from the Michigan Department of Transportation to maintain (e.g. plow, patch, mow) the state trunklines within its jurisdictional boundary. Revenue from these maintenance contracts are received on a time and materials basis as resources are expended to maintain the State's roads. While these contracts do not allow for capital gain (profit) and only bring in revenue to cover the cost of the work, they do provide a benefit to the City by allowing an economy of scale that enables us to provide better service at a lower cost for the City's roads while allowing the same for the State of Michigan. Examples of state grants also include local bridge grants, economic development funds, and metro funds.

- **Federal and state grants for individual projects** – These are typically competitive funding applications that are targeted at a specific project type to accomplish a specific purpose. These may include safety enhancement projects, economic development projects, or other targeted funding. Examples of federal funds include Surface Transportation Program (STP) funds, C and D funds, bridge funds, MDOT payments to private contractors, and negotiated contracts.
- **Local government entities or private developer contributions to construction projects for specific improvements** – This category includes funding received to mitigate the impact of commercial developments as a condition of construction of a specific development project, and can also include funding from a special assessment district levied by another governmental unit. Examples of contributions from local units include city, village, and township contributions to the county; special assessments; county appropriations; bond and note proceeds; contributions from counties to cities and villages; city general fund transfers; city municipal street funds; capital improvement funds; and tax millages (see below).
- **Local tax millages** – Many local agencies in Michigan use local tax millages to supplement their road-funding budget. These taxes can provide for additional construction and maintenance for new or existing roads that are also funded using MTF or MDOT funds. The City does not have local tax millages in its road-funding budget.
- **Interest** – Interest from invested funds.
- **Permit fees** – Generally, permit fees cover the cost of a permit application review.
- **Other** – Other revenues can be gained through salvage sales, property rentals, land and building sales, sundry refunds, equipment disposition or installation, private sources, and financing.
- **Charges for services** – Funds from partner agencies who contract with the City to construct or maintain its roads, or roads under joint or neighboring jurisdictions, including state trunkline maintenance and non-maintenance services and preservation.

The City is required to report transportation fund expenditures to the State of Michigan using a prescribed format with predefined expenditure categories. The definitions of these categories according to Public Act 51 of 1951 may differ from common pavement management nomenclature and practice. For the purposes of reporting under PA 51, the expenditure categories are:

- **Construction/Capacity Improvement Funds** – According to PA 51 of 1951, this financial classification of projects includes, "new construction of highways, roads, streets, or bridges, a project that increases the capacity of a highway facility to accommodate that part of traffic having neither an origin nor destination within the local area, widening of a lane width or more, or adding turn lanes of more than 1/2 mile in length."[1]
- **Preservation and Structural Improvement Funds** – Preservation and structural improvements are "activit[ies] undertaken to preserve the integrity of the existing roadway system."[2]

[1] Public Act 51 of 1951, 247.660c Definitions
[2] Public Act 51 of 1951, 247.660c Definitions

Preservation includes items such as a reconstruction of an existing road or bridge, or adding structure to an existing road.

- **Routine and Preventive Maintenance Funds** – Routine maintenance activities are "actions performed on a regular or controllable basis or in response to uncontrollable events upon a highway, road, street, or bridge".[3] Preventive maintenance activities are "planned strategy[ies] of cost-effective treatments to an existing roadway system and its appurtenances that preserve assets by retarding deterioration and maintaining functional condition without significantly increasing structural capacity".[4]
- **Winter Maintenance Funds** – Expenditures for snow and ice control.
- **Trunkline Maintenance Funds** – Expenditures spent under the City's maintenance agreement with MDOT for maintenance it performs on MDOT trunkline routes.
- **Administrative Funds** – There are specific items that can and cannot be included in administrative expenditures as specified in PA 51 of 1951. The law also states that the amount of MTF revenues that are spent on administrative expenditures is limited to 10 percent of the annual MTF funds that are received.
- **Other Funds** – Expenditures for equipment, capital outlay, debt principal payment, interest expense, contributions to adjacent governmental units, principal, interest and bank fees, and miscellaneous for cities and villages.

The Table (below) details the 2020 revenues and expenditures for the City.

Table 4: Annual Fiscal-Year Revenues & Expenditures per Fiscal Year

REVENUES			EXPENDITURES		
Item	**Estimated $**	**Percent of Total**	**Item**	**Estimated $**	**Percent of Total**
State funds	$5,280,251	77.2%	Construction & capacity improvement (CCI)	$0	0%
Federal funds	$1,049,653	15.3%	Preservation & structural improvement (PSI)	$6,558,002	85.7%
Contributions for local units	$250,000	3.7%	Routine maintenance	$180,160	2.4%
Interest, rents, and other	$91,647	1.3%	Winter maintenance	$318,134	4.2%
Charges for services	169,968	2.5%	Trunkline maintenance	$169,968	2.2%
			Administrative	$197,750	2.6%
			Other	$231,873	3%
TOTAL	$6,841,519	100%	TOTAL	$7,655,887	100%

Verify the information in this table. You can find your agency's information in the TAMC dashboard at https://www.mcgi.state.mi.us/mitrp/tamcDashboards.

[3] Public Act 51 of 1951, 247.660c Definitions
[4] Public Act 51 of 1951, 247.660c Definitions

6. RISK OF FAILURE ANALYSIS

Transportation infrastructure is designed to be resilient. The system of interconnecting roads and bridges maintained by the City provides road users with multiple alternate options in the event of an unplanned disruption of one part of the system. There are, however, key links in the transportation system that may cause significant inconvenience to users if they are unexpectedly closed to traffic. These routes are given higher priority when planning future fixes. Shown in Appendix F is a map of the City of Muskegon key transportation links in our network, including the ones who meet the following types of situations:

- **Geographic divides:** Areas where a geographic feature (river, lake, hilly terrain, or limited access road) limits crossing points of the feature. This includes the Lakeshore Drive bridge over Ruddiman Creek.
- **Emergency alternate routes for high-volume roads and bridges:** Roads and bridges that are routinely used as alternate routes for high-volume assets are included in an emergency response plan. This includes roads such as Sherman Boulevard, Laketon Avenue, Getty Street, and Peck Street.
- **Limited access areas:** Roads and bridges that serve remote or limited access areas that result in long detours if closed. This includes Beach Street, Keating Avenue, and Lakeshore Drive.
- **Main access to key commercial districts:** Areas with a large concentration of businesses or where large-size business will be significantly impacted if a road is unavailable. This includes Keating Avenue, Latimer Drive, Black Creek Road, Olthoff Street, and Sheridan Road.

7. COORDINATION WITH OTHER ENTITIES

An asset management plan provides a significant value for infrastructure owners because it serves as a platform to engage other infrastructure owners using the same shared right of way space. The City of Muskegon communicates with both public and private infrastructure owners to coordinate work in the following ways:

The City of Muskegon maintains drinking water, sanitary, and storm sewer assets in addition to transportation assets. The City follows an asset management process for all of its assets by coordinating the upgrade, maintenance, and operation of all major assets.

Planned projects for sub-surface infrastructure that the City owns are listed in the following asset management plans: drinking water asset management plan, wastewater collection system asset management plan, and storm sewer system asset management plan. These three sub-surface utility plans are coordinated with the transportation infrastructure plans to maximize value and minimize service disruptions and cost to the public.

The City Utility Department and the Streets Department meet yearly to develop the rolling 6-year CIP. City staff discuss planned projects that would disrupt transportation services or cause damage to pavements. Projects which may cause damage to pavements in good or fair condition are discussed and mitigation measures are proposed to minimize the impact to pavements. Mitigation measures could include rescheduling and coordinating projects to maximize value and minimize disruptions and cost to the public.

The City takes advantage of coordinated infrastructure work to reduce cost and maximize value using the following policies:

- Roads which are in poor condition that have a subsurface infrastructure project planned which will destroy more than half the lane width will be rehabilitated or reconstructed full width using transportation funds to repair the balance of the road width.
- Subsurface infrastructure projects which will cause damage to pavements in good condition will be delayed as long as possible, or methods that do not require pavement cuts will be considered.
- Subsurface utility projects will be coordinated to allow all under pavement assets to be upgraded in the same project regardless of ownership.
- Projects on roads which share a border with an adjacent community will have an agreement created during the planning process which defines the formal split for cost sharing. These communities include Roosevelt Park, Norton Shores, Muskegon Heights, as well as the Muskegon County Road Commission.

8. PROOF OF ACCEPTANCE

PUBLIC ACT 325

CERTIFICATION OF TRANSPORTATION ASSET MANAGEMENT PLAN

PROOF OF ACCEPTANCE

PUBLIC ACT 325

CERTIFICATION OF TRANSPORTATION ASSET MANAGEMENT PLAN

Certification Year: 2022

Local Road-owning Agency Name: City of Muskegon

Beginning October 2022 and on a three-year cycle thereafter, certification must be made for compliance to Public Act 325. A local road-owning agency with 100 certified miles or more must certify that it has developed an asset management plan for the road and bridge assets. Signing this form certifies that the hitherto referred agency meets with minimum requirements as outlined by Public Act 325 and agency-defined goals and objectives.

This form must be signed by the mayor of the local road-owning agency and the chief financial officer of the local road-owning agency.

Signature Ken Johnson

Printed Name: Ken Johnson, Mayor

Date: October 25, 2022

Signature

Printed Name: Ken Grant, Finance Director

Date: October 26, 2022

Due every three years based on agency submission schedule.

Submittal Date: _____, 2022.

See attached resolution.

CITY OF MUSKEGON
RESOLUTION
Certification of 2022 Compliance Asset Management Plan

2022-89(C)

WHEREAS, Beginning October, 2022 and on a three-year cycle thereafter, certification must be made for compliance of Public Act 325; and

WHEREAS, A local road-owning agency with 100 certified miles or more must certify that it has developed an asset management plan for the road, bridge, culvert and traffic signal assets.

NOW THEREFORE BE IT BE RESOLVED; the City of Muskegon hereby certifies the 2022 Compliance Asset Management Plan and authorizes the Mayor and Finance Director to sign the Proof of Acceptance form.

Yeas: Ramsey, Gorman, Emory, St. Clair, Johnson, and Hood

Nays: None

Abstain: None

Absent: German

I certify that the above Resolution was adopted by the City Commission of the City of Muskegon on October 11, 2022.

BY: Ann Meisch, City Clerk

Ann Meisch 10/25/2022

Signature Date

APPENDIX A. PAVEMENT ASSET MANAGEMENT PLAN

An attached Pavement Asset Management Plan follows.

City of Muskegon
2022 Pavement
Asset Management Plan

A plan describing the City of Muskegon's roadway assets and conditions

Prepared by:

Prein&Newhof

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PAVEMENT ASSET MANAGEMENT PLAN SUMMARY

As conduits for the commerce and connections to vital services, roads are among the most important assets in any the community along with other assets like bridges, culverts, traffic signs, traffic signals, and utilities that support and affect roads. The City of Muskegon's roads, other transportation assets, and support systems are also some of the most valuable and extensive public assets, all of which are paid for with taxes collected from citizens and businesses. The cost of building and maintaining roads, their importance to society, and the investment made by taxpayers all place a high level of responsibility on local agencies to plan, build, and maintain the road network in an efficient and effective manner.

An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of the City's obligations towards meeting these requirements. However, this plan and its supporting documents are intended to be much more than a fulfillment of required reporting. This asset management plan helps to demonstrate the City's responsible use of public funds by providing elected and appointed officials as well as the general public with the inventory and condition information of the City's road assets, and gives taxpayers the information they need to make informed decisions about investing in the City's essential transportation infrastructure.

This plan overviews the City's road assets and condition, and explains how the City works to maintain and improve the overall condition of those assets. These explanations can help answer the following questions:

- What kinds of road assets the City has in its jurisdiction and the different options for maintaining these assets.
- What tools and processes the City uses to track and manage road assets and funds.
- What condition road assets are in the City compared to statewide averages.
- Why some road assets are in better condition than others and the path to maintaining and improving road asset conditions through proper planning and maintenance.
- How transportation assets are funded and where those funds come from.
- How funds are used and the costs incurred during the City's road assets' normal life cycle.
- What condition the City expects the network to be if road assets continue to be funded at the current funding levels.
- How changes in funding levels can affect the overall condition of all of the City's road assets.

The City owns and manages 184.70 centerline miles of roads. This road network can be divided into the City major network, the City local network, the unpaved road network, and the National Highway System (NHS) network based on the different factors these roads have that influence asset management decisions. A summary of the City of Muskegon's historical and current network conditions, projected trends, and goals can be found in this document.

INTRODUCTION

Asset management is defined by Public Act 325 of 2018 as "an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals". In other words, asset management is a process that uses data to manage and track assets, like roads and bridges, in a cost-effective manner using a combination of engineering and business principles. This process is endorsed by leaders in municipal planning and transportation infrastructure, including the Michigan Municipal League, County Road Association of Michigan, the Michigan Department of Transportation (MDOT), and the Federal Highway Administration (FHWA). The City of Muskegon is supported in its use of asset management principles and processes by the Michigan Transportation Asset Management Council (TAMC), formed by the State of Michigan.

Asset management, in the context of this plan, ensures that public funds are spent as effectively as possible to maximize the condition of the road network. Asset management also provides a transparent decision-making process that allows the public to understand the technical and financial challenges of managing road infrastructure with a limited budget.

The City of Muskegon has adopted an "asset management" business process to begin to address the challenges presented by having limited financial, staffing, and other resources while needing to meet road users' expectations. The City is responsible for maintaining and operating over 184.70 centerline miles of roads.

This 2022 plan identifies the City's transportation assets and their condition as well as the strategy that the City of Muskegon uses to maintain and upgrade particular assets given the City's condition goals, priorities of network's road users, and resources. An updated plan is to be released approximately every three years both to comply with Public Act 325 and to reflect changes in road conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to Dan VanderHeide at 1350 E. Keating Avenue, Muskegon, MI 49442, dan.vanderheide@shorelinecity.com, or at (231) 724-4100.

Key terms used in this plan are defined in the City's comprehensive transportation asset management plan (also known as the "Compliance Plan") used for the compliance with PA 325 or 2018.

Knowing the basic features of the asset classes themselves is a crucial starting point to understanding the rationale behind an asset management approach. The following primer provides an introduction to pavements.

Pavement Primer

Roads come in two basic forms—paved and unpaved. Paved roads have hard surfaces. These hard surfaces can be constructed from asphalt, concrete, composite (asphalt and concrete), sealcoat, and brick and block materials. On the other hand, unpaved roads have no hard surfaces. Examples of these surfaces are gravel and unimproved earth.

The decision to pave with a particular material as well as the decision to leave a road unpaved allows road-owning agencies to tailor a road to a particular purpose, environment, and budget. Thus, selecting a pavement type or leaving a road unpaved depends upon purpose, materials available, and budget. Each choice represents a trade-off between budget and costs for construction and maintenance.

Maintenance enables the road to fulfill its particular purpose. To achieve the maximum service for a pavement or an unpaved road, continual monitoring of a road's pavement condition is essential for choosing the right time to apply the right fix in the right place.

Here is a brief overview of the different types of pavements, how condition is assessed, and treatment options that can lengthen a road's service life.

Surfacing

Pavement type is influenced by several different factors, such as cost of construction, cost of maintenance, frequency of maintenance, and type of maintenance. These factors can have benefits affecting asset life and road user experience.

Paved Surfacing

Typical benefits and tradeoffs for hard surface types include:

- **Concrete pavement:** Concrete pavement, which is sometimes called a rigid pavement, is durable and lasts a long time when properly constructed and maintained. Concrete pavement can have longer service periods between maintenance activities, which can help reduce maintenance-related traffic disruptions. However, concrete pavements have a high initial cost and can be challenging to rehabilitate and maintain at the end of their service life. A typical concrete pavement design life will provide service for 30 years before major rehabilitation is necessary.
- **Hot-mix asphalt pavement (HMA):** HMA pavement, sometimes known as asphalt or flexible pavement, is currently less expensive to construct than concrete pavement (this is, in some part, due to the closer link between HMA material costs and oil prices that HMA pavements have in comparison with other pavement types). However, they require frequent maintenance activities to

maximize their service life. A typical HMA pavement design life will provide service for 18 years before major rehabilitation is necessary. The vast majority of local-agency-owned pavements are HMA pavements.

- **Composite pavements:** Composite pavement is a combination of concrete and asphalt layers. Typically, composite pavements are old concrete pavements exhibiting ride-related issues that were overlaid by several inches of HMA in order to gain more service life from the pavement before it would need reconstruction. Converting a concrete pavement to a composite pavement is typically used as a "holding pattern" treatment to maintain the road in usable condition until reconstruction funds become available.

- **Sealcoat pavement:** Sealcoat pavement is a gravel road that has been sealed with a thin asphalt binder coating that has stone chips spread on top (not to be confused with a chip seal treatment over HMA pavement). This type of a pavement relies on the gravel layer to provide structure to support traffic, and the asphalt binder coating and stone chips shed water and eliminate the need for maintenance grading. Nonetheless, sealcoat pavement does require additional maintenance steps that asphalt and gravel do not require and does not last as long as HMA pavement, but it provides a low-cost alternative for lightly-trafficked areas and competes with asphalt for ride quality when properly constructed and maintained. Sealcoat pavement can provide service for ten or more years before the surface layer deteriorates and needs to be replaced.

Unpaved Surfacing

Typical benefits and tradeoffs for non-hard surfacing include:

- **Gravel:** Gravel is a low-cost, easy-to-maintain road surface made from layers of soil and aggregate (gravel). However, there are several potential drawbacks such as dust, mud, and ride smoothness when maintenance is delayed or traffic volume exceeds design expectations. Gravel roads require frequent low-cost maintenance activities. Gravel can be very cost effective for lower-volume, lower-speed roads. In the right conditions, a properly constructed and maintained gravel road can provide a service life comparable to an HMA pavement and can be significantly less expensive than the other pavement types.

Pavement Condition

Besides traffic congestion, pavement condition is what road users typically notice most about the quality of the roads that they regularly use—the better the pavement condition, the more satisfied users are with the service provided by the roadwork performed by road-owning agencies. Pavement condition is also a major factor in determining the most cost-effective treatment—that is, routine maintenance, capital preventive maintenance, or structural improvement—for a given section of pavement. As pavements age, they transition between "windows" of opportunity when a specific type of treatment can be applied to gain an increase in quality and extension of service life. Routine maintenance is day-to-day, regularly-scheduled, low-cost activity applied to "good" roads to prevent water or debris intrusion. Capital preventive maintenance (CPM) is a planned set of cost-effective treatments for "fair" roads that corrects pavement defects, slows further deterioration, and maintains the functional condition without increasing

structural capacity. The City of Muskegon uses pavement condition and age to anticipate when a specific section of pavement will be a potential candidate for preventive maintenance. More detail on this topic is included in the *Pavement Treatment* section of this primer.

Pavement condition data is also important because it allows road owners to evaluate the benefits of preventive maintenance projects. This data helps road owners to identify the most cost-effective use of road construction and maintenance dollars. Further, historic pavement condition data can enable road owners to predict future road conditions based on budget constraints and to determine if a road network's condition will improve, stay the same, or degrade at the current or planned investment level. This analysis can help determine how much additional funding is necessary to meet a network's condition improvement goals.

Paved Road Condition Rating System

The City of Muskegon is committed to monitoring the condition of its road network and using pavement condition data to drive cost-effective decision-making and preservation of valuable road assets. The City uses the Pavement Surface Evaluation and Rating (PASER) system to assess its paved roads. PASER was developed by the University of Wisconsin Transportation Information Center to provide a simple, efficient, and consistent method for evaluating road condition through visual inspection. The widely-used PASER system has specific criteria for assessing asphalt, concrete, sealcoat, and brick and block pavements. Information regarding the PASER system and PASER manuals may be found on the TAMC website at: http://www.michigan.gov/tamc/0,7308,7-356-82158_82627---,00.html.

The TAMC has adopted the PASER system for measuring statewide pavement conditions in Michigan for asphalt, concrete, the composite, sealcoat, and brick-and-block paved roads. Broad use of the PASER system means that data collected at the City is consistent with data collected statewide. PASER data is collected using trained inspectors in a slow-moving vehicle using GPS-enabled data collection software provided to road-owning agencies at no cost to them. The method does not require extensive training or specialized equipment, and data can be collected rapidly, which minimizes the expense for collecting and maintaining this data.

The PASER system rates surface condition using a 1-10 scale where 10 is a brand new road with no defects that can be treated with routine maintenance, 5 is a road with distresses but is structurally sound that can be treated with preventive maintenance, and 1 is a road with extensive surface and structural distresses that is in need of total reconstruction.

Roads with lower PASER scores generally require costlier treatments to restore their quality than roads with higher PASER scores. The cost effectiveness of treatments generally decreases as the PASER number decreases. In other words, as a road deteriorates, it costs more dollars per mile to fix it, and the dollars spent are less efficient in increasing the road's service life. Nationwide experience and asset management principles tell us that a road that has deteriorated to a PASER 4 or less will cost more to improve and the dollars spent are less efficient. Understanding this cost principle helps to draw meaning from the current PASER condition assessment.

The TAMC has developed statewide definitions of road condition by creating three simplified condition categories—"good", "fair", and "poor"—that represent bin ranges of PASER scores having similar contexts with regard to maintenance and/or reconstruction. The definitions of these rating conditions are:

- "Good" roads, according to the TAMC, have PASER scores of 8, 9, or 10. Roads in this category have very few, if any, defects and only require minimal maintenance; they may be kept in this category longer using CPM. These roads may include those that have been recently seal coated or newly constructed. Figure 1 illustrates an example of a road in this category.
- "Fair" roads, according to the TAMC, have PASER scores of 5, 6, or 7. Roads in this category still show good structural support, but their surface is starting to deteriorate. Figure 1 illustrates two road examples in this category. CPM can be cost effective for maintaining the road's "fair" condition or even raising it to "good" condition before the structural integrity of the pavement has been severely impacted. CPM treatments can be likened to shingles on a roof of a house: while the shingles add no structural value, they protect the house from structural damage by maintaining the protective function of a roof covering.
- "Poor" roads, according to the TAMC, have PASER scores of 1, 2, 3, or 4. These roads exhibit evidence that the underlying structure is failing, such as alligator cracking and rutting. These roads must be rehabilitated with treatments like a heavy overlay, crush and shape, or total reconstruction. Figure 1 illustrates a road in this category.

Figure 1: *Top image, right*– PASER 8 road that is considered "good" by the TAMC exhibit only minor defects. *Second image, right*– PASER 5 road that is considered "fair" by the TAMC. Exhibiting structural soundness but could benefit from CPM. *Third image, right*– PASER 6 road that is considered "fair" by the TAMC. *Bottom image, right*– PASER 2 road that is considered "poor" by the TAMC exhibiting significant structural distress.

The TAMC's good, fair, and poor categories are based solely on the definitions, above. Therefore, caution should be exercised when comparing other condition assessments with these categories because other

condition assessments may have “good”, “fair”, or “poor” designations similar to the TAMC condition categories but may not share the same definition. Often, other condition assessment systems define the “good”, “fair”, and “poor” categories differently, thus rendering the data of little use for cross-system the comparison. The TAMC’s definitions provide a statewide standard for all of Michigan’s road-owning agencies to use for the comparison purposes.

PASER data is collected 100 percent every two years on all federal-aid-eligible roads in Michigan. The TAMC dictates and funds the required training and the format for this collection, and it shares the data regionally and statewide. In addition, the City collects its paved non-federal-aid-eligible network using its own staff and resources. Past practice has been irregular, but plans are in place to collect every third year.

Unpaved Road Condition Rating System (IBR System™)

The condition of unpaved roads rapidly change which makes it difficult to obtain a consistent surface condition rating over the course of a season or even weeks. The City of Muskegon’s highway supervisor visually assesses their gravel roadways at various times of the year and schedules required maintenance and work as needed.

If the City ever decided to rate their unpaved roads, they would rate them with the Inventory-based Rating System™ receive an IBR number ranging from 1 to 10, with a 9 or 10 (less than one year old) having good surface width, good or fair drainage, and good structural adequacy and a 1 having poor surface width, poor drainage, and poor structural adequacy. IBR numbers can be grouped in a similar fashion as the TAMC definitions into good (8-10), fair (5-7), and poor (1-4) categories.

Pavement Treatments

Selection of repair treatments for roads aims to balance costs, benefits, and road life expectancy. All pavements are damaged by water, traffic weight, freeze/thaw cycles, and sunlight. Each of the following treatments and strategies—reconstruction, structural improvements, capital preventive maintenance, and others used by the City —counters at least one of these pavement-damaging forces.

Reconstruction

Pavement reconstruction treats failing or failed pavements by completely removing the old pavement and base and constructing an entirely new road (Figure 2). Every pavement has to eventually be reconstructed

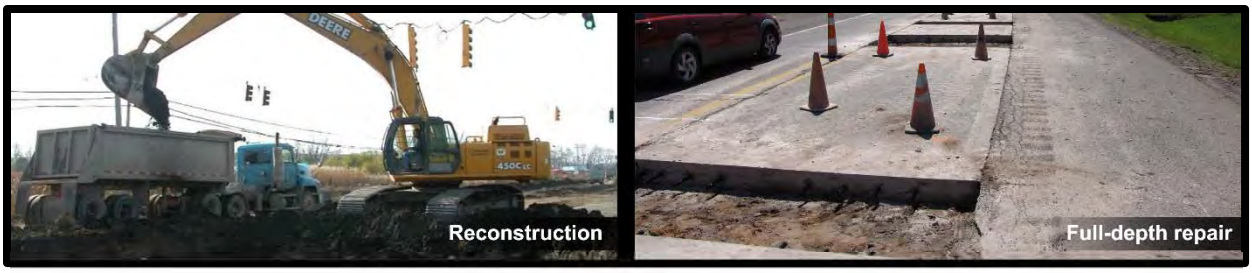


Figure 2: Examples of reconstruction treatments—(left) reconstructing a road and (right) road prepared for full-depth repair.

and it is usually done as a last resort after more cost-effective treatments have been applied, or if the road requires significant changes to road geometry, base, or buried utilities. Compared to the other treatments, which are all improvements of the existing road, reconstruction is the most extensive rehabilitation of the roadway and therefore, also the most expensive per mile and most disruptive to regular traffic patterns. Reconstructed pavement will subsequently require one or more of the previous maintenance treatments to maximize service life and performance. A reconstructed road lasts approximately 25 years and costs $380,000 per lane mile. The following descriptions outline the main reconstruction treatments used by the City.

Full-depth Concrete Repair

A full-depth concrete repair removes sections of damaged concrete pavement and replaces it with new concrete of the same dimensions (Figure 2). It is usually performed on isolated deteriorated joint locations or entire slabs that are much further deteriorated than adjacent slabs. The purpose is to restore the riding surface, delay water infiltration, restore load transfer from one slab to the next, and eliminate the need to perform costly temporary patching. This repair lasts approximately twelve years and typically costs $125,000 per mile.

Ditching (for Unpaved Roads)

Water needs to drain away from any roadway to delay softening of the pavement structure, and proper drainage is critical for unpaved roads where there is no hard surface on top to stop water infiltration into the road surface and base. To improve drainage, new ditches are dug or old ones are cleaned out. Unpaved roads typically need to be re-ditched every 10 years at a cost of $10,000 per mile.

Gravel Overlay (for Unpaved Roads)

Unpaved roads will exhibit gravel loss over time due to traffic, wind, and rain. Gravel on an unpaved road provides a wear surface and contributes to the structure of the entire road. Unpaved roads typically need to be overlaid with four inches of new gravel every 10 years at a cost of $25,000 per mile.

Structural Improvement

Roads requiring structural improvements exhibit alligator cracking and rutting and rated poor in the TAMC scale. Road rutting is evidence that the underlying structure is beginning to fail and it must be either rehabilitated with a structural treatment. Examples of structural improvement treatments include HMA overlay with or without milling, and crush and shape (Figure 3). The following descriptions outline the main structural improvement treatments used by the City of Muskegon.

Figure 3: Examples of structural improvement treatments—(from left) HMA overlay on an unmilled pavement, milling asphalt pavement, and pulverization of a road during a crush-and-shape project.

Hot-mix Asphalt (HMA) Overlay with/without Milling

An HMA overlay is a layer of new asphalt (liquid asphalt and stones) placed on an existing pavement (Figure 3). Depending on the overlay thickness, this treatment can add significant structural strength. This treatment also creates a new wearing surface for traffic and seals the pavement from water, debris, and sunlight damage. An HMA overlay lasts approximately five to ten years and costs $125,000 to $175,000 per lane mile. The top layer of severely damaged pavement can be removed by cold milling, a technique that helps prevent structural problems from being quickly reflected up through the new surface. Milling is also done to keep roads matching the height of gutterpan that is not being raised or reinstalled in the project. Milling adds $12,000 per lane mile to the HMA overlay cost.

Crush and Shape

During a crush and shape treatment, the existing pavement and base are pulverized and then the road surface is reshaped to correct imperfections in the road's profile (Figure 3). An additional layer of gravel is often added and then paved with a new wearing surface such as an HMA overlay or chip seal. Additional gravel and an HMA overlay give an increase in the pavements structural capacity. This treatment is usually performed on roads with severe structural distress; adding gravel and a wearing surface makes it more prohibitive for urban roads if the curb and gutter is not raised up. Crush and shape treatments last approximately 15 years and cost $225,000 per lane mile.

Capital Preventive Maintenance

Capital preventive maintenance (CPM) addresses pavement problems of fair-rated roads before the structural integrity of the pavement has been severely impacted. CPM is a planned set of cost-effective treatments applied to an existing roadway that slows further deterioration and that maintains or improves the functional condition of the system without significantly increasing the structural capacity. Examples of such treatments include crack seal, fog seal, chip seal, slurry seal, and microsurface (Figure 4). The purpose of the following CPM treatments is to protect the pavement structure, slow the rate of deterioration, and/or correct pavement surface deficiencies. The following descriptions outline the optional CPM treatments used by the City.

Figure 4: Examples of capital preventive maintenance treatments—(from left) crack seal, fog seal, chip seal, and slurry seal/microsurface.

Crack Seal

Water that infiltrates the pavement surface softens the pavement structure and allows traffic loads to cause more damage to the pavement than in normal dry conditions. Crack sealing helps prevent water

infiltration by sealing cracks in the pavement with asphalt sealant (Figure 4). The City seals pavement cracks early in the life of the pavement to keep it functioning as strong as it can and for as long as it can. Crack sealing lasts approximately two years and costs $2,000 per lane mile. Even though crack sealing does not last very long the compared to other treatments, it isn't very expensive for the value it provides. This makes crack sealing a very cost-effective treatment when the City looks at what crack filling costs per year of the treatment's life.

Fog Seal

Fog sealing sprays a liquid asphalt coating onto the entire pavement surface to fill hairline cracks and prevent damage from sunlight (Figure 4). Fog seals are best for good to very good pavements and last approximately two years at a cost of $1,000 per lane mile.

Chip Seal

A chip seal, also known as a sealcoat, is a two-part treatment that starts with liquid asphalt sprayed onto the old pavement surface followed by a single layer of small stone chips spread onto the wet liquid asphalt layer (Figure 4). The liquid asphalt seals the pavement from water and debris and holds the stone chips in place, providing a new wearing surface for traffic that can correct friction problems and helping to prevent further surface deterioration. Chip seals are best applied to pavements that are not exhibiting problems with strength, and their purpose is to help preserve that strength. These treatments last approximately five years and cost $15,000 per lane mile.

Slurry Seal/Microsurface

A slurry seal or microsurface's purpose is to protect existing pavement from being damaged by water and sunlight. The primary ingredients are liquid asphalt (slurry seal) or modified liquid asphalt (microsurface), small stones, water and Portland cement applied in a very thin (less than a half an inch) layer (Figure 4). The main difference between a slurry seal and a microsurface is the modified liquid asphalt used in microsurfacing provides different curing and durability properties, which allows microsurfacing to be used for filling pavement ruts. Since the application is very thin, these treatments do not add any strength to the pavement and only serves to protect the pavement's existing strength by sealing the pavement from sunlight and water damage. These treatments work best when applied before cracks are too wide and too numerous. A slurry seal treatment lasts approximately four years and costs $20,000 per lane mile, while a microsurface treatment tends to last for seven years and costs $25,000 per lane mile.

Partial-Depth Concrete Repair

A partial-depth concrete repair involves removing spalled (i.e., fragmented) or delaminated (i.e., separated into layers) areas of concrete pavement, usually near joints and cracks and replacing with new concrete (Figure 5). This is done to provide a new wearing surface in isolated areas, to slow down water infiltration, and to help delay further freeze/thaw damage. This repair lasts approximately five years and typically costs $20,000 per mile.

Maintenance Grading (for Unpaved Roads)

Maintenance grading involves regrading an unpaved road to remove isolated potholes, washboarding, and ruts then restoring the compacted crust layer (Figure 5). Crust on an unpaved road is a very tightly compacted surface that sheds water with ease but takes time to be created, so destroying a crusted surface with maintenance grading requires a plan to restore the crust. Maintenance grading often needs to be performed three to five times per year and each grading costs $300 per mile.

Dust Control (for Unpaved Roads)

Dust control typically involves spraying chloride, brine, or other chemicals on a gravel surface to reduce dust loss, aggregate loss, and maintenance (Figure 5). This is a relatively short-term fix that helps create a crusted surface. Chlorides work by attracting moisture from the air and existing gravel. This fix is not effective if the surface is too dry or heavy rain is imminent, so timing is very important. Dust control is performed two to four times per year and each application costs $700 per mile.

Figure 5: Examples of capital preventive maintenance treatments, cont'd—(from left) concrete road prepared for partial-depth repair, gravel road undergoing maintenance grading, and gravel road receiving dust control application (dust control photo courtesy of Weld County, Colorado, weldgov.the City).

Innovative Treatments

Innovative treatments are those newer, unique, non-standard treatments that provide ways of treating pavements using established engineering principles in new and cost-effective ways. Occasionally additional funding is available in exchange for implementing a non-standard treatment and documenting deterioration for research purposes. The City is open to innovative pavement treatments when applied to a road with the right level of deterioration and traffic volumes, if it saves taxpayer dollars.

The Sherman Street project is an example of an innovative treatment. Experimental sections of concrete pavement will incorporate the use of crumb rubber in the concrete mix. An EGLE grant contributed extra funding to the project to fund 1 lane of the 4 lane section. The pavement sections will be evaluated by university researchers until 2042.

Maintenance

Maintenance is the most cost-effective strategy for managing road infrastructure and prevents good and fair roads from reaching the poor category, which require costly rehabilitation and reconstruction treatments to create a year of service life. It is most effective to spend money on routine maintenance and CPM treatments, first; then, when all maintenance project candidates are treated, reconstruction and rehabilitation can be performed as money is available. This strategy is called a "mix-of-fixes" approach to managing pavements.

1. PAVEMENT ASSETS

Building a mile of new road can cost over $1 million due to the large volume of materials and equipment that are necessary. The high cost of constructing road assets underlines the critical nature of properly managing and maintaining the investments made in this vital infrastructure. The specific needs of every mile of road within an agency's overall road network is a complex assessment, especially when considering rapidly changing conditions and the varying requisites of road users; understanding each road-mile's needs is an essential duty of the road-owning agency.

In Michigan, many different governmental units (or agencies) own and maintain roads, so it can be difficult for the public to understand who is responsible for items such as planning and funding construction projects, [patching] repairs, traffic control, safety, and winter maintenance for any given road. MDOT is responsible for state trunkline roads, which are typically named with "M", "I", or "US" designations regardless of their geographic location in Michigan. Cities and villages are typically responsible for all public roads within their geographic boundary with the exception of the previously mentioned state trunkline roads managed by MDOT. County Road Commissions (or departments) are typically responsible for all public roads within the county's geographic boundary, with the exception of those managed by cities, villages, and MDOT.

In cases where non-trunkline roads fall along jurisdictional borders, local and intergovernmental agreements dictate ownership and maintenance responsibility. Quite frequently, roads owned by one agency may be maintained by another agency because of geographic features that make it more cost effective for a neighboring agency to maintain the road instead of the actual road owner. Other times, road-owning agencies may mutually agree to coordinate maintenance activities in order to create economies of scale and take advantage of those efficiencies.

The City of Muskegon is responsible for a total of 184.70 centerline of public roads, as shown in Figure 6.

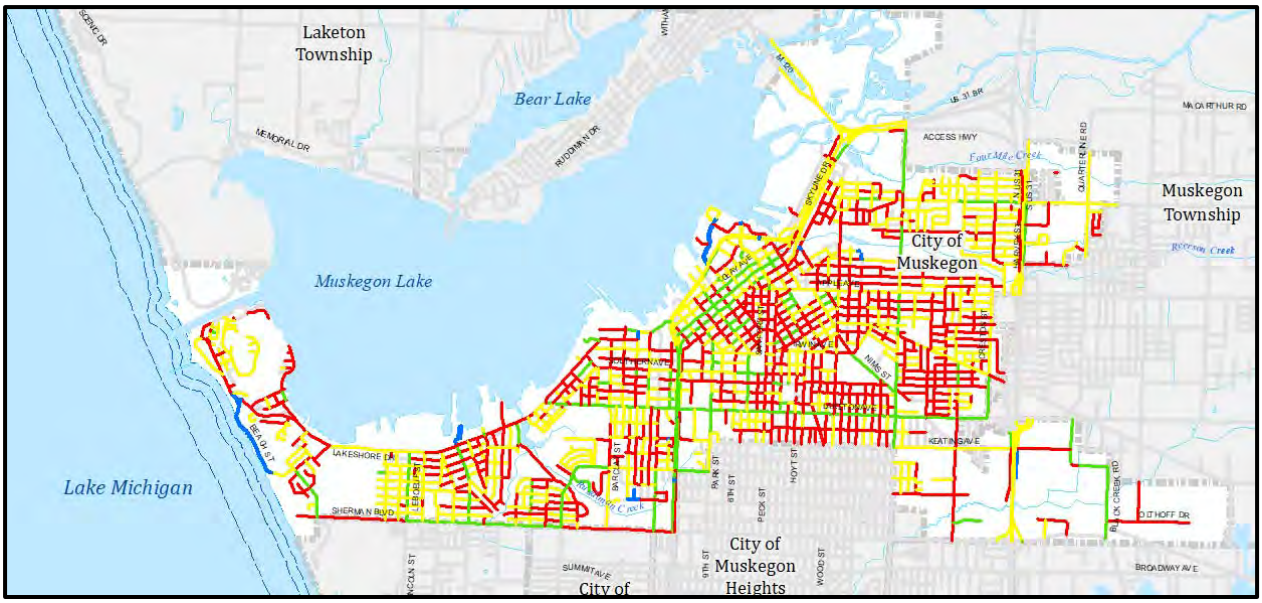


Figure 6: Map showing location of the City's paved roads (i.e., those managed by the City) and their current condition for paved roads with green for good (i.e., PASER 10, 9, 8), yellow for fair (i.e., PASER 7, 6, 5), and red for poor (i.e., PASER 4, 3, 2, 1), as well as the location of the City's unrated roads in blue

Inventory

Michigan Public Act 51 of 1951 (PA 51), which defines how funds from the Michigan Transportation Fund (MTF) are distributed to and spent by road-owning agencies, classifies roads owned by the City of Muskegon as either city major or city local roads.

The City of Muskegon is responsible for 184.70 centerline miles of public roads. An inventory of these miles divides them into different network classes based on road purpose/use and funding priorities as identified at the state level: city major road network, which is prioritized for state-level funding, and city local road network.

Of the City's 184.70 miles of road, 73.88 miles are classified as city major and 110.82 miles are classified as city local. Approximately 82% of all Primary roads are classified as federal aid eligible, which allows them to receive federal funding for their maintenance and construction. Only 1% of Local roads are considered federal aid eligible, which means state and local funds must be used to manage the majority of these roads.

Figure 6 identifies these paved roads in green, yellow, and red with the colors being determined based on the road segment's condition and shows unrated roads in blue.

Figure 7 illustrates the percentage of roads owned by the City that are classified as city major and city local roads.

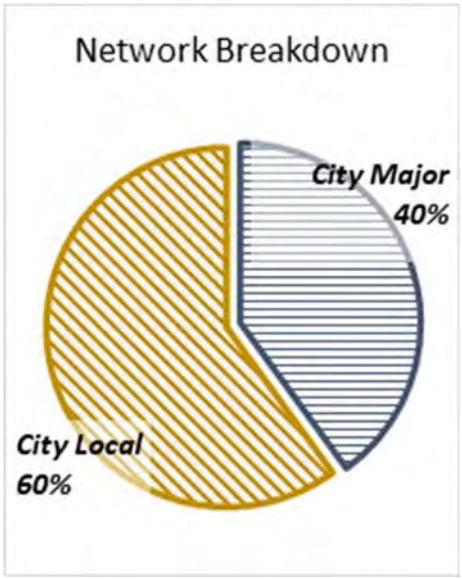


Figure 7: Percentage of city major and city local roads for the City.

The City manages 11.205 miles of roads that are part of the National Highway System (NHS)—in other words, those roads that are critical to the nation's economy, defense, and mobility—and monitors and maintains their condition. The NHS is subject to special rules and regulations and has its own performance metrics dictated by the FHWA. While most NHS roads in Michigan are managed by MDOT, The City manages a percentage of those roads located in its jurisdiction, as shown in Figure 8.

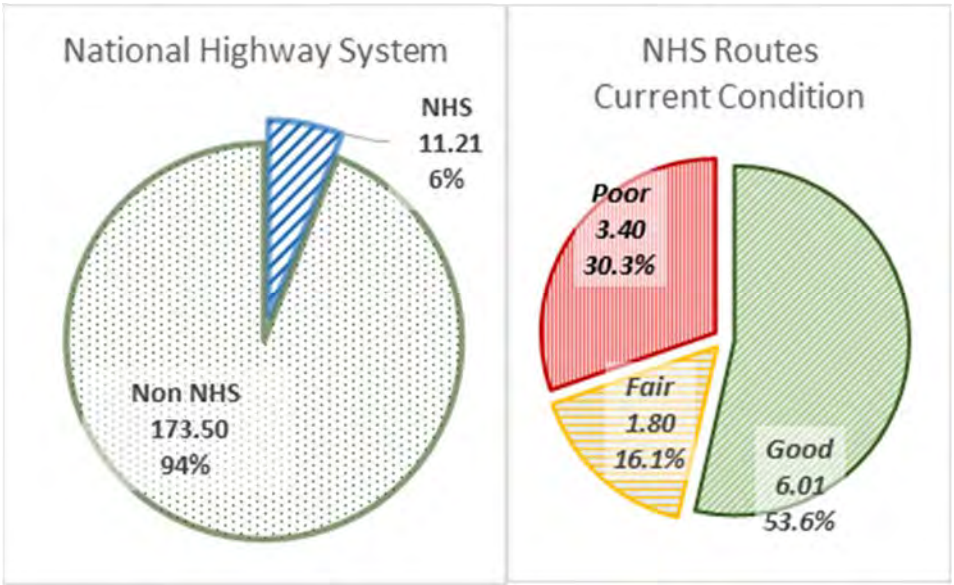


Figure 8: Miles of roads managed by the City that are part of the National Highway System and condition.

In addition, the City has 7.175 miles of unpaved roads.

Types

The City has multiple types of pavements in its jurisdiction, including asphalt and concrete; it also has unpaved roads (i.e., gravel and earth). Factors influencing pavement type include cost of construction, cost of maintenance, frequency of maintenance, type of maintenance, asset life, and road user experience. More information on pavement types is available in the Introduction's Pavement Primer.

Figure 9 illustrates the percentage of various pavement types that the City has in its network.

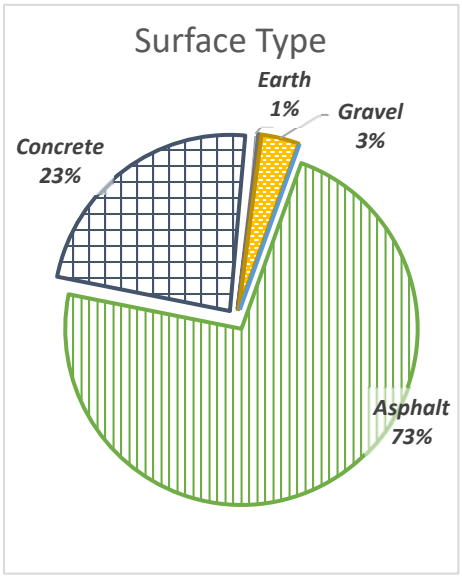


Figure 9: Pavement type by percentage maintained by the City of Muskegon

Locations

Locations and sizes of each asset can be found in the City's Roadsoft database. For more detail, please refer to the agency contact listed in the *Introduction* of this pavement asset management plan.

Condition

The road characteristic that road users most readily notice is pavement condition and ride quality. Pavement condition is a major factor in determining the most cost-effective treatment—that is, routine maintenance, capital preventive maintenance, or structural improvement—for a given section of pavement. The City uses pavement condition and age to anticipate when a specific section of pavement will be a potential candidate for preventive maintenance. Pavement condition data enables the City to evaluate the benefits of preventive maintenance projects and to identify the most cost-effective use of road construction and maintenance dollars. Historic pavement condition data can be used to predict future road conditions based on budget constraints and to determine if a road network's condition will improve, stay the same, or degrade at the current or planned investment level. This analysis helps to determine how

much additional funding is necessary to meet a network's condition improvement goals. More detail on this topic is included in the Introduction's *Pavement Primer*.

Paved Roads

The City of Muskegon is committed to monitoring the condition of its road network and using pavement condition data to drive cost-effective decision-making and preservation of valuable road assets. The City uses the Pavement Surface Evaluation and Rating (PASER) system, which has been adopted by the TAMC for measuring statewide pavement conditions, to assess its paved roads. The PASER system provides a simple, efficient, and consistent method for evaluating road condition through visual inspection. More information regarding the PASER system can be found in the Introduction's Pavement Primer.

PASER data is collected 100 percent every two years on all federal-aid-eligible roads in Michigan. The TAMC dictates and funds the required training and the format for this collection, and it shares the data regionally and statewide. In addition, the City collects its paved non-federal-aid-eligible network using its own staff and resources. Past data collection of the non-federal aid roads has been irregular, but plans are in place to collect every third year.

The City's 2019 paved city major road network has 26 percent of roads in the TAMC good condition category, 32 percent in fair, and 42 percent in poor (Figure 10A). The paved city local road network has 2 percent in good, 46 percent in fair, and 52 percent in poor (Figure 10B).

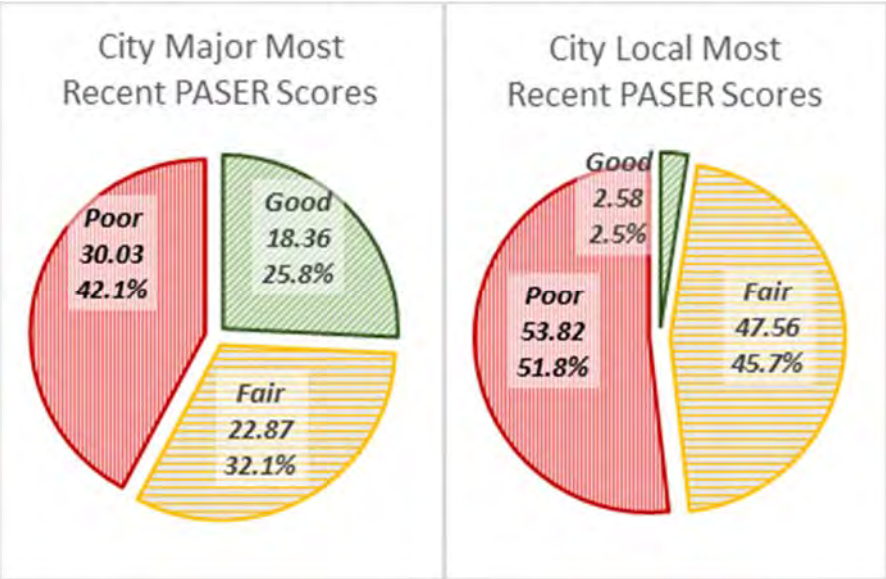


Figure 10: (A) Left: The City paved city major road network conditions by percentage of good, fair, or poor, and (B) Right: paved city local road network conditions by percentage of good, fair, or poor

In the comparison, the statewide paved city major road network has 30 percent of roads in the TAMC good condition category, 30 percent in fair, and 40 percent in poor (Figure 11A). The statewide paved city local road network has 30 percent in good, 30 percent in fair, and 40 percent in poor (Figure 11B). Comparing Figure 10A and Figure 11A shows that the City's paved major road network is in better shape

than similarly-classified roads in the rest of the state, while Figure 10B and Figure 11B show that the City's paved city local road network is in worse shape than similarly-classified roads in the rest of the state. Other road condition graphs can be viewed on the TAMC pavement condition dashboard at: http://www.mcgi.state.mi.us/mitrp/Data/PaserDashboard.aspx.

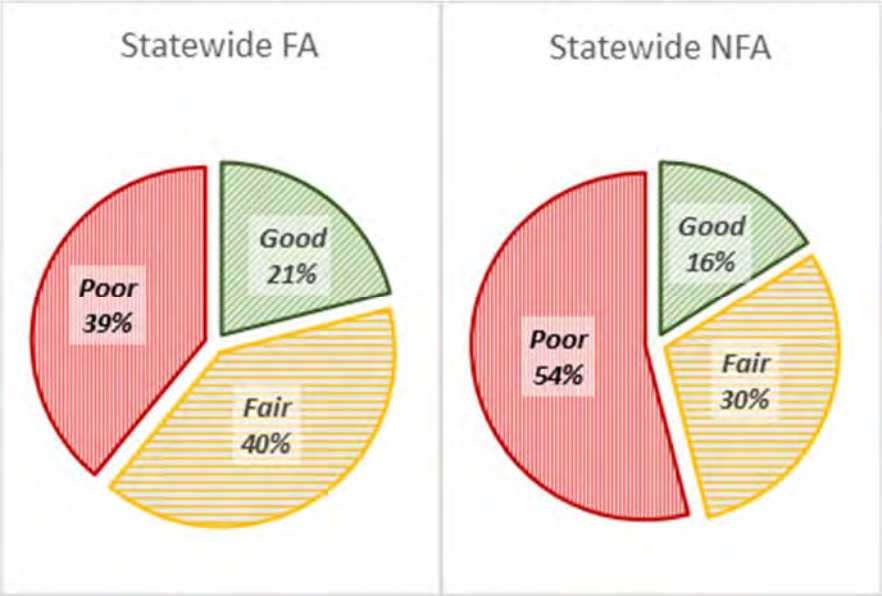


Figure 11: (A) Left: Statewide paved city major road network conditions by percentage of good, fair, or poor, and (B) Right: paved city local road network conditions by percentage of good, fair, or poor

Figure 12 and Figure 13 show the number of miles for the City's roads with PASER scores expressed in TAMC definition categories for the paved city major road network (Figure 12) and the paved city local road network (Figure 13). The City considers road miles on the transition line between good and fair (PASER 8) and the transition line between fair and poor (PASER 5) as representing parts of the road network where there is a risk of losing the opportunity to apply less expensive treatments that gain significant improvements in service life.

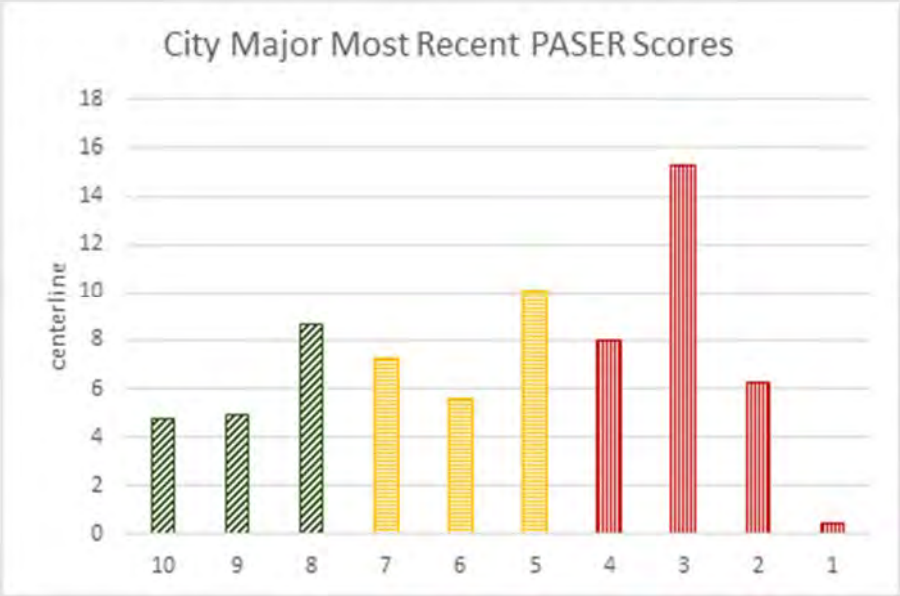


Figure 12: The City paved city major road network conditions. Bar graph colors correspond to good/fair/poor TAMC designations.

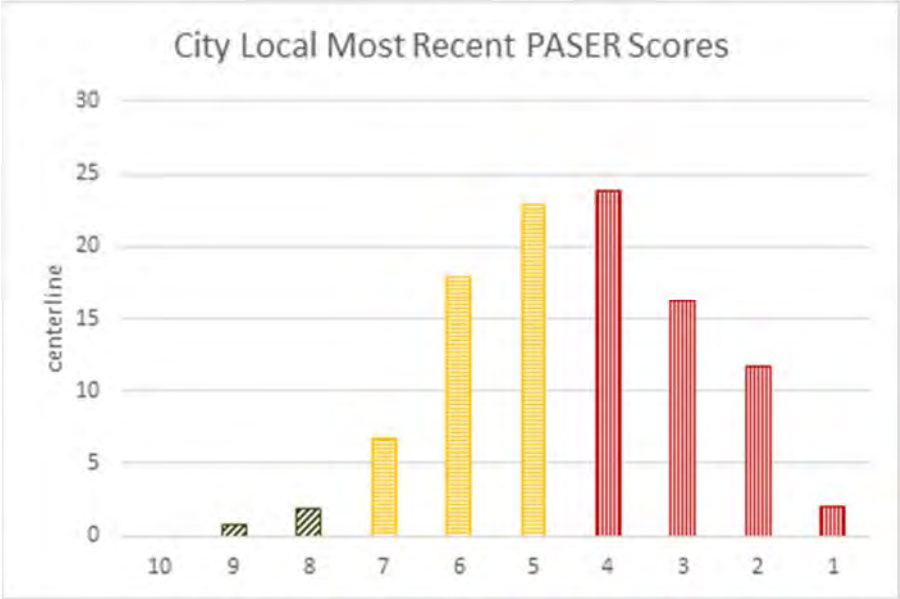


Figure 13: The City paved city local network condition by PASER rating. Bar graph colors correspond to good/fair/poor TAMC designations.

Figure 14 provides a map illustrating the geographic location of paved roads and their respective PASER condition. An online version of the most recent PASER data is located at https://www.mcgi.state.mi.us/tamcMap/.

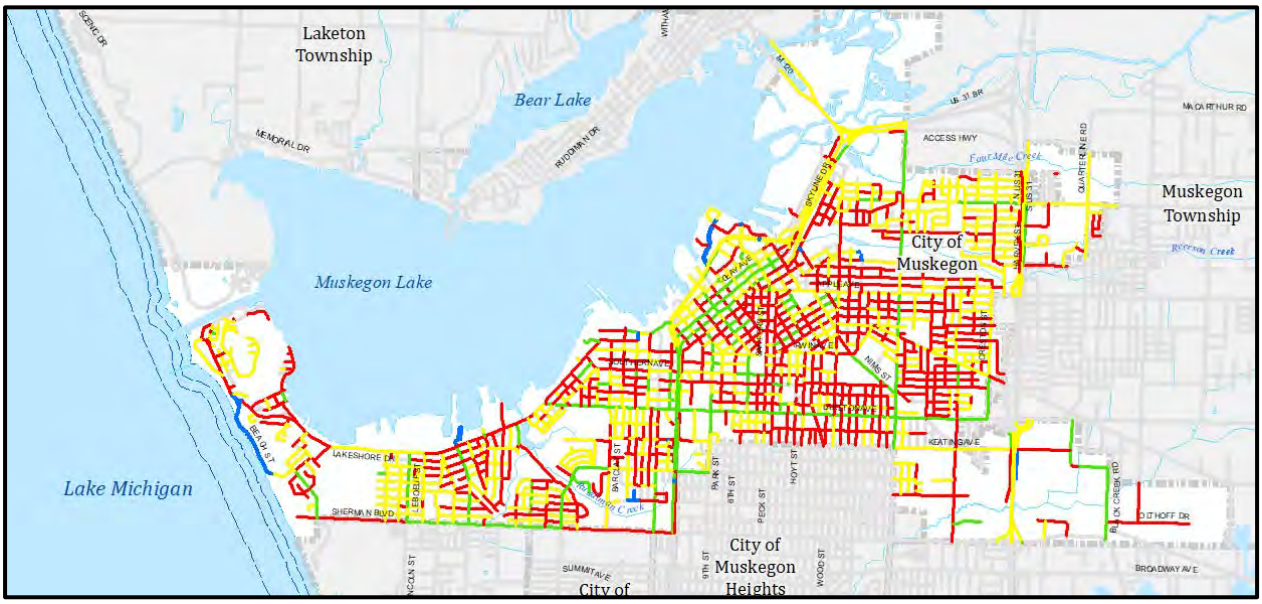


Figure 14: Map of the current paved road condition in good (PASER 10, 9, 8) shown in green, fair (PASER 7, 6, 5) shown in yellow, and poor (PASER 4, 3, 2, 1) shown in red. Only Roads owned by the City are shown.

Historically, the overall quality of the City's paved city major roads has been improving at a noticeable rate as can be observed in Figure 15.

Comparing the City's paved city major road condition trends illustrated in Figure 15 with overall statewide condition trends for similarly-classified roads, which are illustrated in Figure 16, the City is showing improvement in PASER scores whereas the statewide condition shows a very consistent trend. Figures 15-18 indicate poor roads in red, fair roads in yellow, and good roads in green.

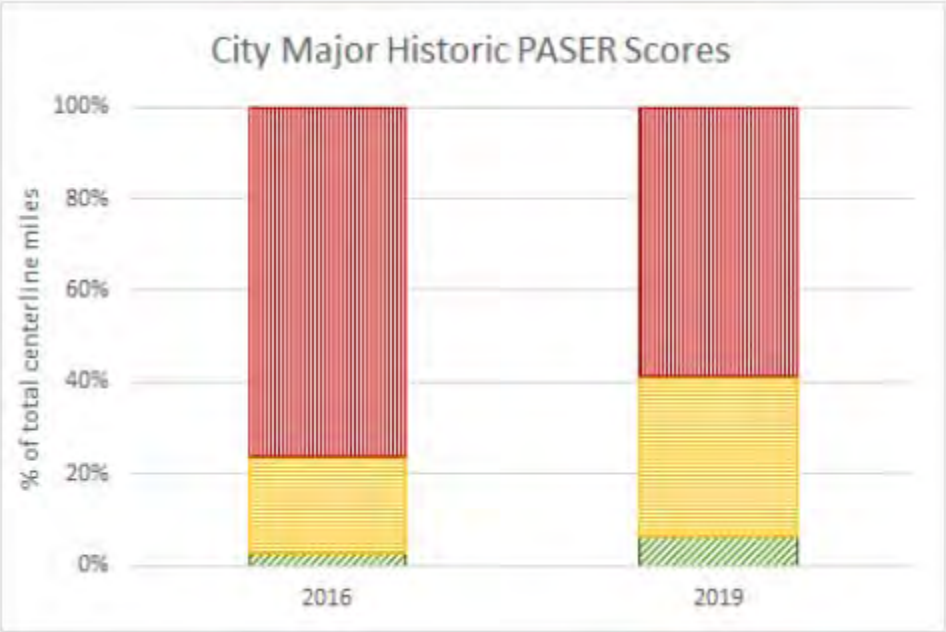


Figure 15: Historical City of Muskegon paved city major road network condition trend

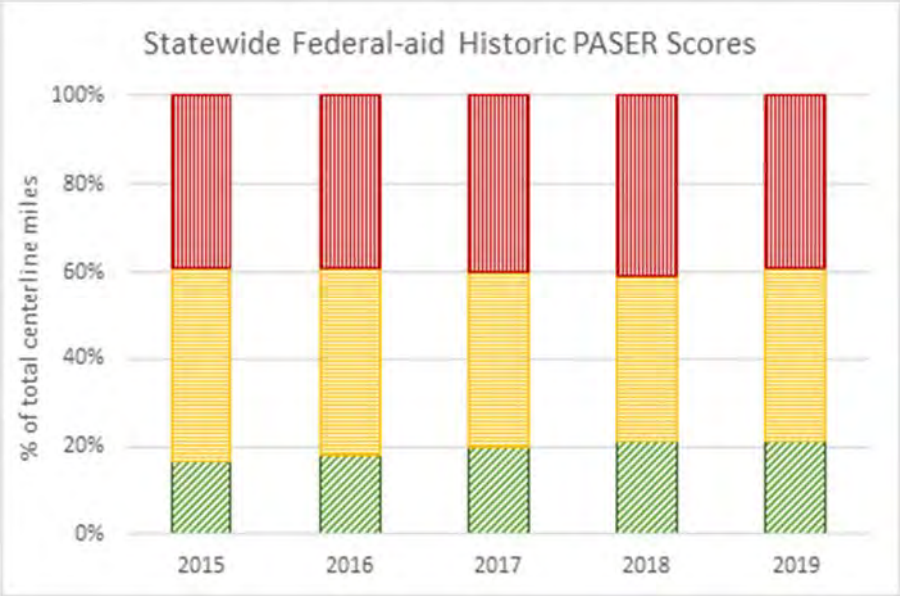


Figure 16: Historical statewide federal-aid road network condition trend

Historically, the overall quality of the City's paved city local roads have been much worse than the paved city major road network due to the lack of a source of state and federal funding. The local roads must be supported locally. Figure 17 illustrates the condition of the paved city local road network while Figure 18 illustrates the non-Federal-Aid conditions statewide. With the lack of local data for the City of Muskegon, it is hard to make any further comparison. Year to year variations in the paved city minor network are usually due to the fact that only a portion of the network is collected each year, both locally

and statewide. This variation likely occurs as a result of reporting bias since a representative sample of roads is not collected each year.

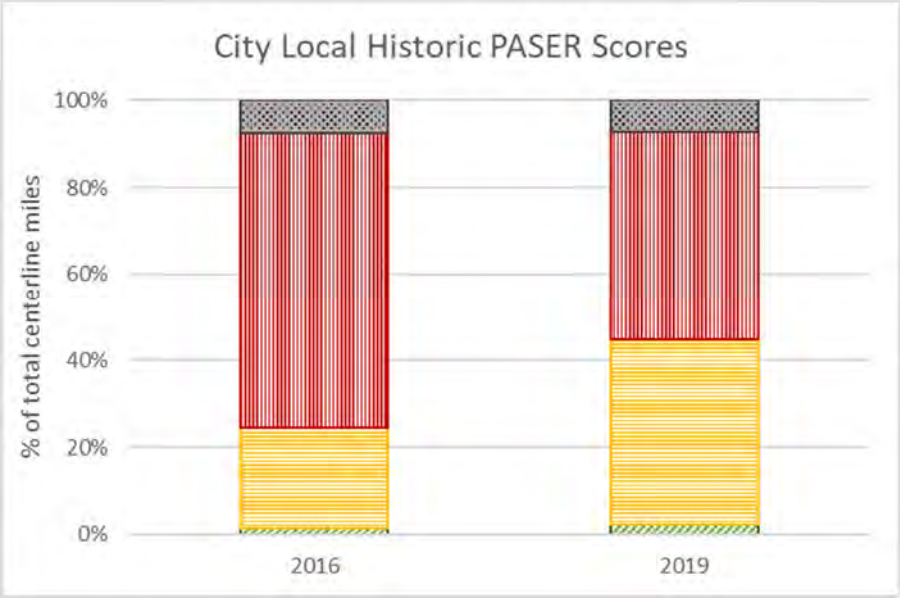


Figure 17: Historical paved city local road network condition trend

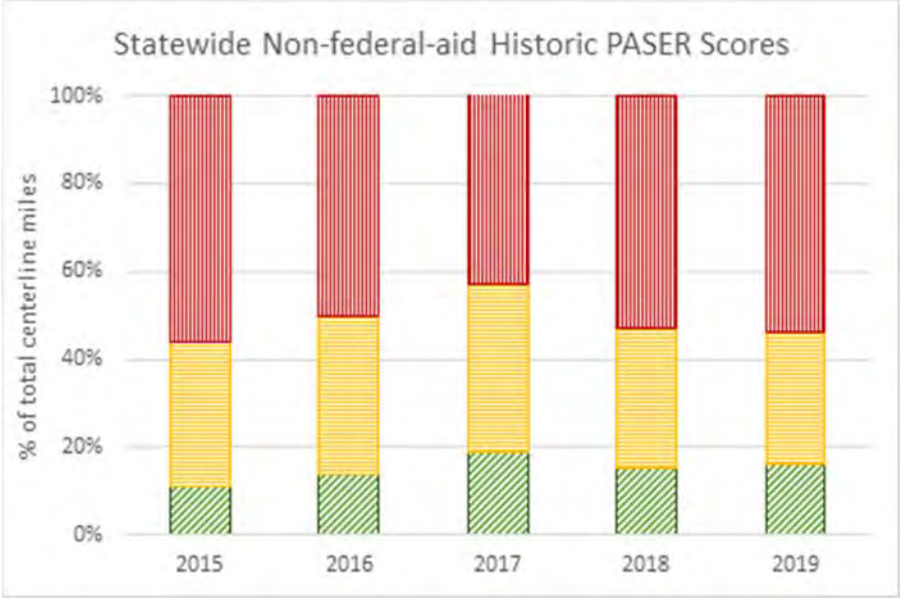


Figure 18: Historical statewide paved non-federal-aid road network condition trend

Unpaved Roads

The City of Muskegon has 7.175 miles of unpaved roads and are located on the map in Figure 19. The condition of unpaved roads rapidly change which makes it difficult to obtain a consistent surface condition rating over the course of a season or even weeks. The City of Muskegon's highway supervisor visually assesses their gravel roadways at various times of the year and schedules required maintenance and work as needed.

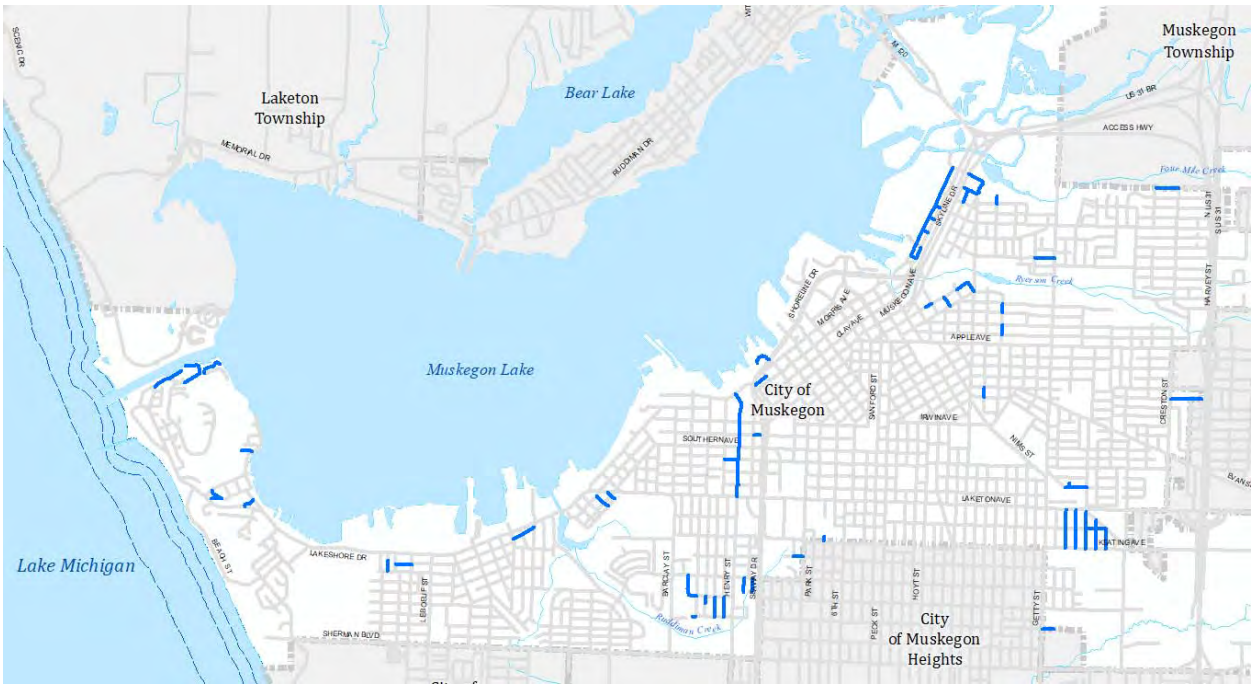


Figure 19: Map of the unpaved roads. Unpaved roads owned by the City are shown in blue.

Goals

Goals help set expectations to how pavement conditions will change in the future. Pavement condition changes are influenced by water infiltration, soil conditions, sunlight exposure, traffic loading, and repair work performed. The City is not able to control any of these factors fully due to seasonal weather changes, traffic pattern changes, and its limited budget. In spite of the uncontrollable variables, it is still important to set realistic network condition goals that efficiently use budget resources to build and maintain roads meeting taxpayer expectations. An assessment of the progress toward these goals is provided in the *1. Pavement Assets*: *Gap Analysis* section of this plan.

Goals for Paved City Major Roads

The overall goal for The City's paved city major road network is to maintain or improve road conditions network-wide at 2022 levels. The baseline condition for this goal is illustrated in Figure 20.

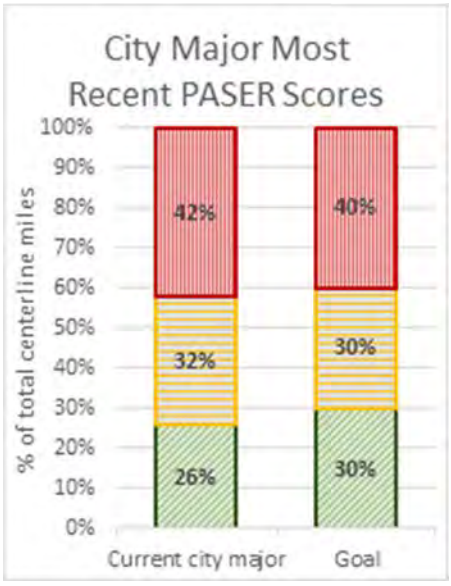


Figure 20: The City's 2019 city major road network condition by percentage of good/fair/poor

The City's network-level pavement condition strategy for paved city major roads is:

1. Maintain or improve current condition of city major roads.
2. Maintain the percentage of paved city major roads in the good and fair category (PASER 10 - 5) and not increase the percentage in the poor category (PASER 4 - 1).
3. Introduce Preventive Maintenance fixes into our CIP through the annual road program.
4. Perform Roadway Report after PASER ratings are collected giving a snapshot of current systemwide road health and conditions. This will be used to aid in the determination of future road work.

Goals for Paved City Local Roads

The overall goal for the City's paved city local road network is to maintain or improve road conditions network-wide at 2022 levels. The baseline condition for this goal is illustrated in Figure 21.

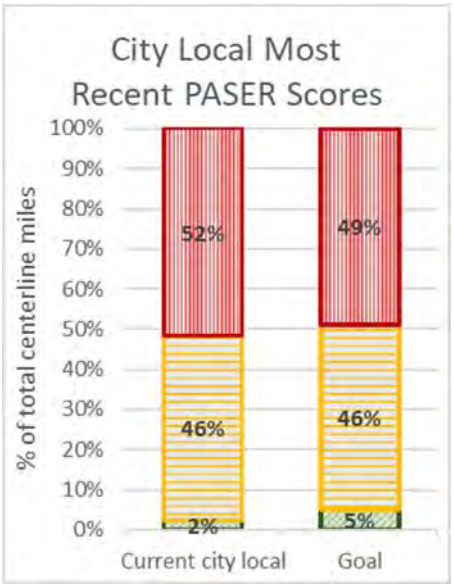


Figure 21: The City's 2019 paved city local road network condition by percentage of good/fair/poor

The City's network-level pavement condition strategy for paved city local roads is:

1. Prevent the percentage of City's good and fair (PASER 10 - 5) paved city local roads from becoming poor (PASER 4 - 1).
2. Introduce Preventive Maintenance fixes into our CIP through the annual road program.
3. Increase funding for city local road program.
4. Move 3% percent of paved city local roads out of the poor category within 3 years.
5. Perform Roadway Report after PASER ratings are collected giving a snapshot of current systemwide road health and conditions. This will be used to aid in the determination of future road work.

Goals for Unpaved Roads

The City's year-round unpaved roads will be maintained at their current structural adequacy assessments and current drainage adequacy assessments for roads where these two IBR elements are assessed as good or fair. Unpaved roads that have either or both of these two categories assessed as poor will be strategically upgraded as funding is available to address. Our first priority will be drainage issues and secondly structural issues. Surface widths will be addressed on an as-needed basis to provide service or to

address safety issues. Seasonal roads will be addressed to provide passability and safety but do not have a goal associated with them.

An additional goal of the City is to pave problematic gravel roads to address maintenance issues which are costly to continue fixing; such as washouts, controlling washed out gravel from entering and clogging storm drains, and dust control.

Modelled Trends

Roads age and deteriorate just like any other asset. All pavements are damaged by water, traffic weight, freeze/thaw cycles, sunlight, and traffic weight. To offset natural deterioration and normal wear-and-tear on the road, must complete treatment projects that either protect and/or add life to its pavements. The year-end condition of the whole network depends upon changes or preservation of individual road section condition that preservation treatments have affected.

The City uses many types of repair treatments for its roads, each selected to balance costs, benefits, and road life expectancy. When agency trends are modelled, any gap between goals and accomplishable work becomes evident. Financial resources influence how much work can be accomplished across the network within agency budget and what treatments and strategies can be afforded; a full discussion of The City's financial resources can be found in the *5. Financial Resources* section.

Treatments and strategies that counter pavement-damaging forces include reconstruction, structural improvement, capital preventive maintenance, innovative treatments, and maintenance. For a complete discussion on the pavement treatment tools, refer to the *1. Introduction*'s *Pavement Primer*.

Correlating with each PASER score are specific types of treatments best performed either to protect the pavement (CPM) or to add strength back into the pavement (structural improvement) (Table 1). MDOT provides guidance regarding when a specific pavement may be a candidate for a particular treatment. These identified PASER scores "trigger" the timing of projects appropriately to direct the right pavement fix at the right time, thereby providing the best chance for a successful project. The information provided in Table 1 is a guide for identifying potential projects; however, this table should not be the sole criteria for pavement treatment selection. Other information such as future development, traffic volume, utility projects, and budget play a role in project selection. This table should not be a substitute for engineering judgement.

Table 1: Service Life Extension (in Years) for Pavement Types Gained by Fix Type[1]

Fix Type	Life Extension (in years)*			PASER
	Flexible	Composite	Rigid	
HMA crack treatment	1-3	1-3	N/A	6-7
Overband crack filling	1-2	1-2	N/A	6-7
One course non-structural HMA overlay	5-7	4-7	N/A	4-5****
Mill and one course non-structural HMA overlay	5-7	4-7	N/A	3-5
Single course chip seal	3-6	N/A	N/A	5-7†
Double chip seal	4-7	3-6	N/A	5-7†
Single course microsurface	3-5	**	N/A	5-6
Multiple course microsurface	4-6	**	N/A	4-6****
Ultra-thin HMA overlay	3-6	3-6	N/A	4-6****
Paver placed surface seal	4-6	**	N/A	5-7
Full-depth concrete repair	N/A	N/A	3-10	4-5***
Concrete joint resealing	N/A	N/A	1-3	5-8
Concrete spall repair	N/A	N/A	1-3	5-7
Concrete crack sealing	N/A	N/A	1-3	4-7
Diamond grinding	N/A	N/A	3-5	4-6
Dowel bar retrofit	N/A	N/A	2-3	3-5***
Longitudinal HMA wedge/scratch coat with surface treatment	3-7	N/A	N/A	3-5****
Flexible patching	**	**	N/A	N/A
Mastic joint repair	1-3	1-3	N/A	4-7
Cape seal	4-7	4-7	N/A	4-7
Flexible interlayer “A”	4-7	4-7	N/A	4-7
Flexible interlayer “B” (SAMI)	4-7	4-7	N/A	3-7
Flexible interlayer “C”	4-7	4-7	N/A	3-7
Fiber reinforced flexible membrane	4-7	4-7	N/A	3-7
Fog seal	**	**	N/A	7-10
GSB 88	**	**	N/A	7-10
Mastic surface treatment	**	**	N/A	7-10
Scrub seal	**	**	N/A	4-8

* The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

** Data is not available to quantify the life extension.

*** The concrete slabs must be in fair to good condition.

**** Can be used on a pavement with a PASER equal to 3 when the sole reason for rating is rutting or severe raveling of the surface asphalt layer.

† For PASER 4 or less providing structural soundness exists and that additional pre-treatment will be required for example, wedging, bar seals, spot double chip seals, injection spray patching or other pre-treatments.

[1] Part of Appendix D-1 from *MDOT Local Agency Programs Guidelines for Geometrics on Local Agency Projects* 2017 Edition Approved Preventive Maintenance Treatments

Roadsoft Pavement Condition Forecast to Forecast Future Trends

The City of Muskegon uses Roadsoft, an asset management software suite, to manage road- and bridge-related infrastructure. Roadsoft is developed by Michigan Technological University and is available for Michigan local agencies at no cost to them. Roadsoft uses pavement condition data to drive network-level deterioration models that forecast future road conditions based on planned construction and maintenance work. A screenshot of Roadsoft's pavement condition model and the associated output is shown in Figure 22.

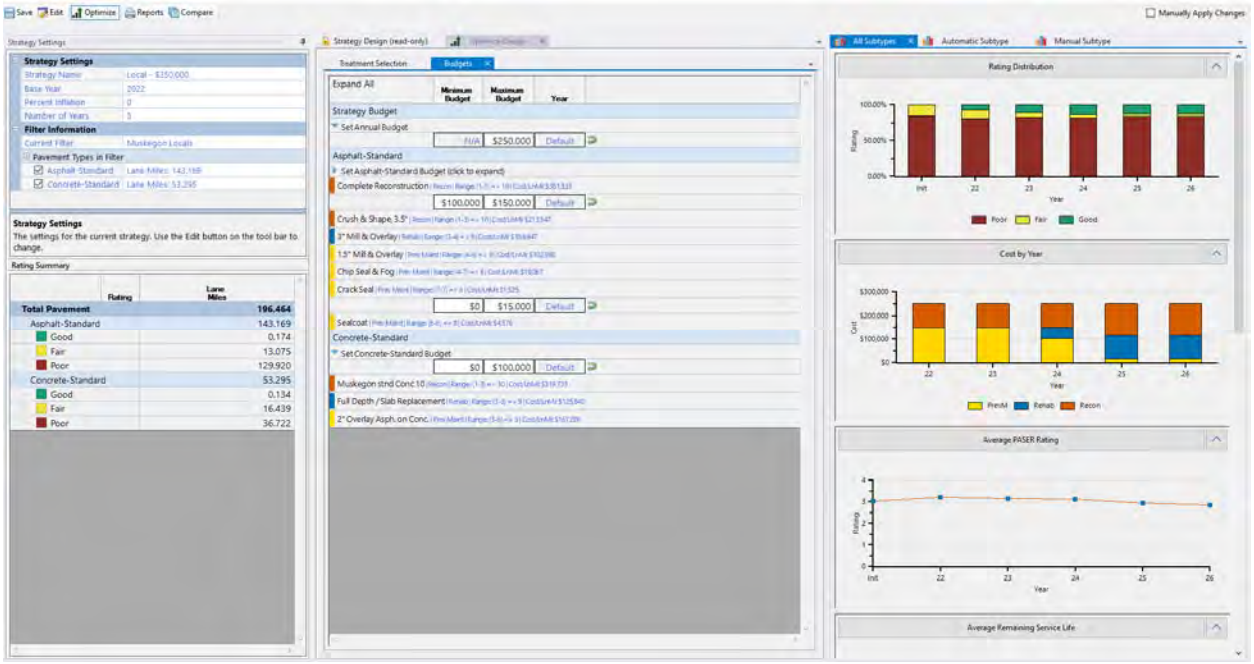


Figure 22: Pavement condition forecast model in the software program Roadsoft.

Paved City Major Roads

Table 2 illustrates the network-level model inputs for Roadsoft on the paved city major road network. Other pavement types in this network were neglected due to their small numbers relative to HMA pavements. The treatments outlined in Table 2 are the average treatment volume of planned projects scheduled to be completed in 2023-2026. It should be noted that Roadsoft only analyzes the traveling lane portion of a project; the road/pavement costs. Incidental related costs are oftentimes 50% more in a roadway reconstruction or rehabilitation project. These additional items include necessary elements such as municipal utilities, drainage, traffic control, sidewalk improvements, guardrail, pavement markings, signing, and restoration. Although the City's annual road budget is $6.2 Million, only a portion of that funding is applied to the actual roadway which is modeled in Roadsoft. See Appendix F of the Compliance Asset Management Plan for details on planned projects. Full model inputs and outputs are included in Appendix P-2.

Table 2: Roadsoft Modelled Trends and Planned Projects: Roadsoft Annual Work Program for the Paved City Major Road Network Forecast

Treatment Name	Years of Life	Average Yearly Miles of Treatment	Trigger Life
Complete Reconstruction	25	1.5	1-3
Crush & Shape	25		1-3
3” Mill & Overlay	15		3-4
2” Overlay	10		3-6
1.5” Mill & Overlay	7		4-6
Chip Seal & Fog	5		4-7
Sealcoat	5		6-6
Crackseal	2		7-7

Results from the Roadsoft network condition model for the City major roads are shown in Figure 23. The Roadsoft network analysis of the City’s planned projects from its currently-available budget of $6.2 Million does allow the City to reach and exceed its pavement condition goals given the projects planned for the next three years. For modeling purposes, $4 Million of the budget was assumed to be applied to the physical roadway.

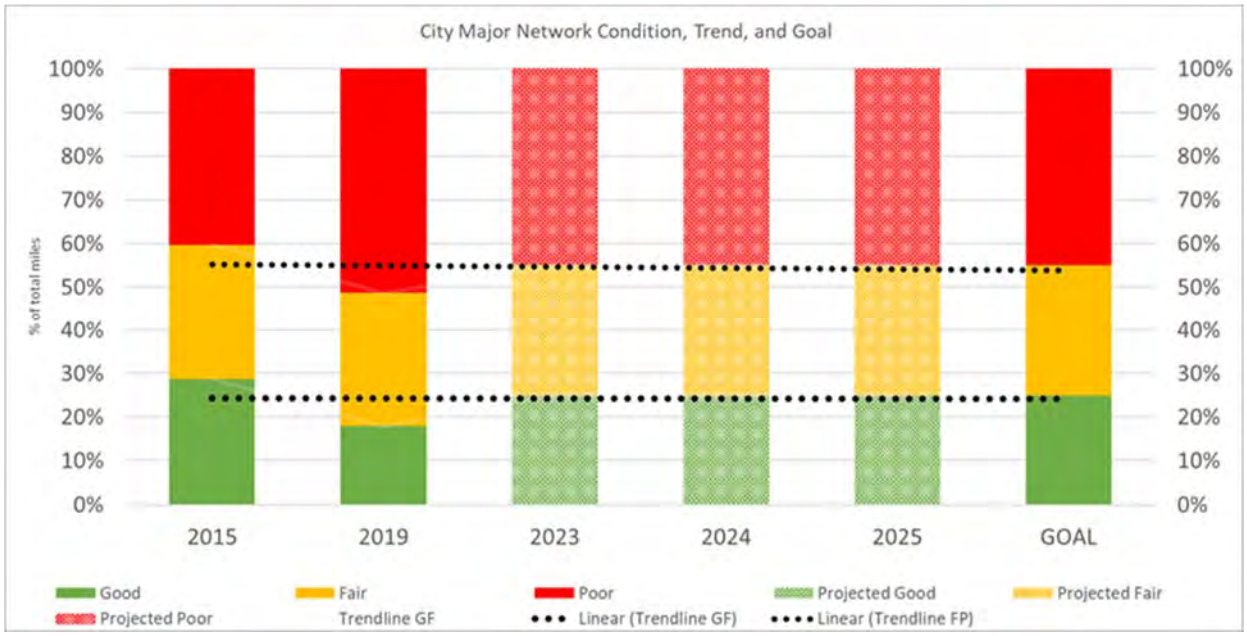


Figure 23: Forecast good/fair/poor changes to the city network condition from planned projects on the City major road network.

Paved City Local Road

A screenshot of Roadsoft's pavement condition model and the associated output is shown in Figure 24.

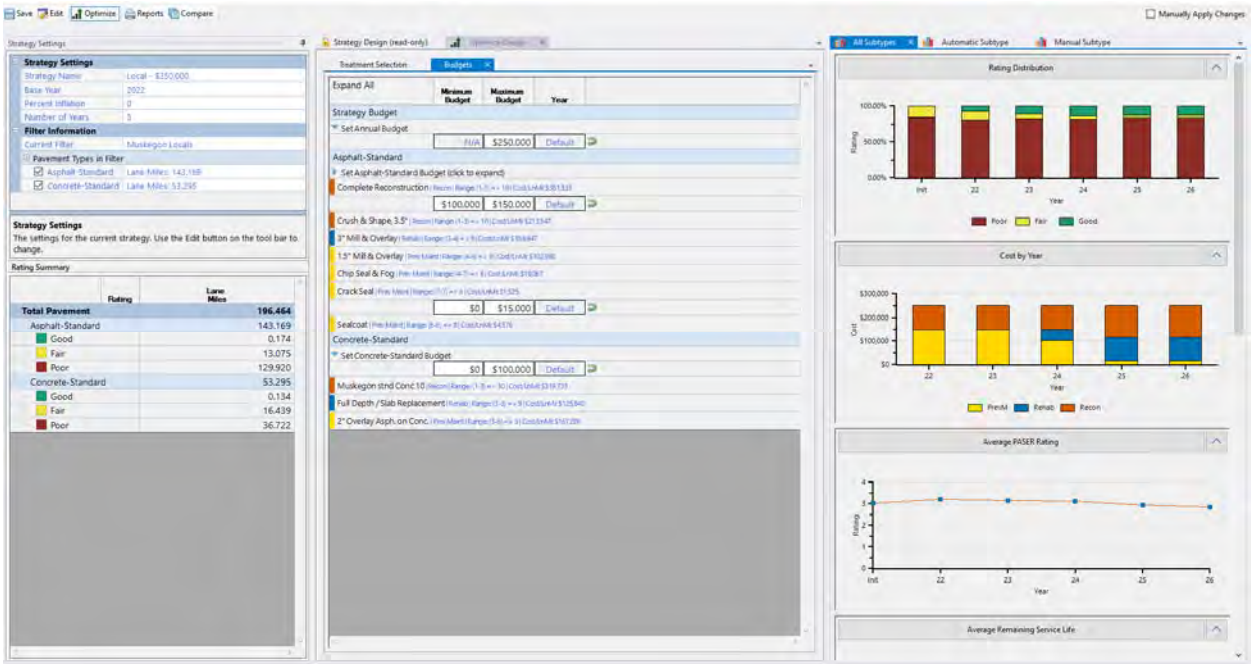


Figure 24: Pavement condition forecast model in the software program Roadsoft.

Table 3 illustrates the network-level model inputs for Roadsoft on the paved city local road network. The City of Muskegon has a significant amount of local concrete pavements which needs to be addressed along with the larger percentage of asphalt pavements. The treatments outlined in Table 3 are the average treatment volume of planned projects scheduled to be completed in 2023-2026 with a budget of $250,000. See Appendix F of the Compliance Asset Management Plan for details on planned projects. Full model inputs and outputs are included in Appendix P-2.

Table 3: Roadsoft Modelled Trends and Planned Projects: Roadsoft Annual Work Program for the Paved City Local Road Network Forecast

Treatment Name	Years of Life	Average Yearly Miles of Treatment	Trigger Life
Complete Reconstruction	25	0.25	1-3
Crush & Shape	25		1-3
3" Mill & Overlay	15		3-4
2" Overlay	10		3-6
1.5" Mill & Overlay	7		4-6
Chip Seal & Fog	5		4-7
Sealcoat	5		6-6
Crackseal	2		7-7

Results from the Roadsoft network condition model for the paved city local roads are shown in Figure 25. The Roadsoft network analysis of the City's planned projects from its currently available budget of $250,000. This budget does not allow the City to reach its pavement condition goal given the projects planned for the next three years.

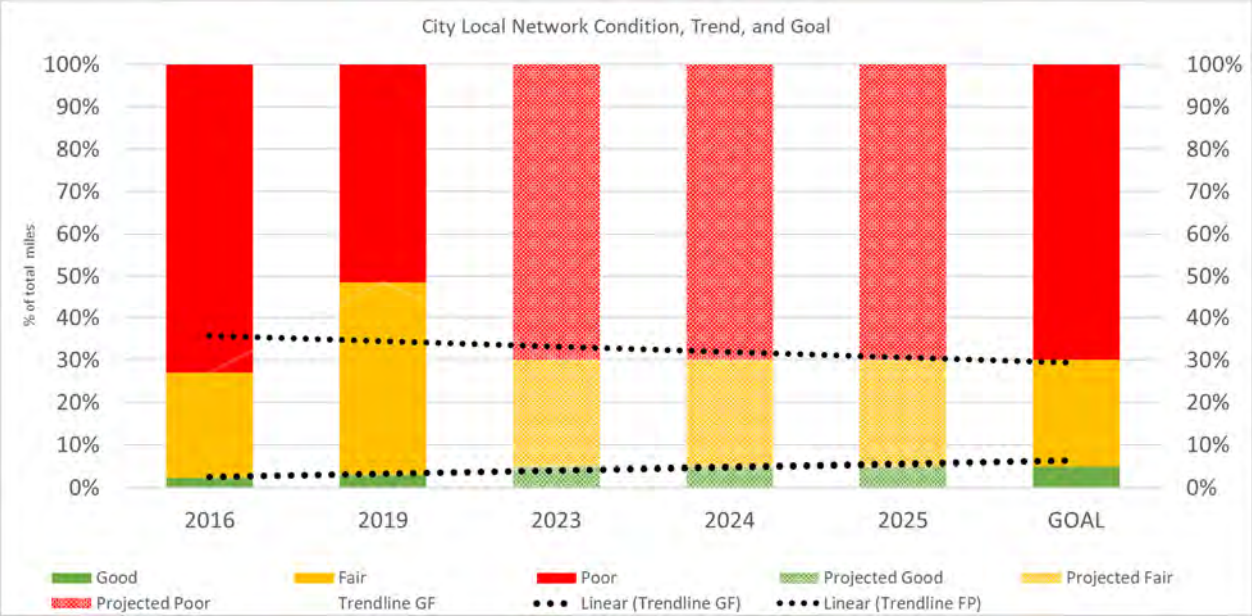


Figure 25: Forecast good/fair/poor changes to the city network condition from planned projects on the paved city local road network. Shown above are projections based only on data collected.

Planned Projects

The City of Muskegon plans construction and maintenance projects several years in advance. A multi-year planning threshold is required due to the time necessary to plan, design, and finance construction and maintenance projects on the paved city major road network. This includes planning and programming requirements from state and federal agencies that must be met prior to starting a project and can include studies on environmental and archeological impacts, review of construction and design documents and plans, documentation of rights-of-way ownership, planning and permitting for storm water discharges, and other regulatory and administrative requirements.

Per PA 499 of 2002 (later amended by PA 199 of 2007), road projects for the upcoming three years are required to be reported annually to the TAMC. Planned projects represent the best estimate of future activity; however, changes in design, funding, and permitting may require the City to alter initial plans. Project planning information is used to predict the future condition of the road networks that the City

maintains. The *1. Pavement Assets*: *Modelled Trends* section of this plan provides a detailed analysis of the impact of the proposed projects on their respective road networks.

Planned Projects

The City has projects planned for the next three years. These projects are shown in red in Figure 26. The total cost of the projects is approximately $14,050,000. Please refer to See Appendix F of the Compliance Asset Management Plan for details on planned projects.

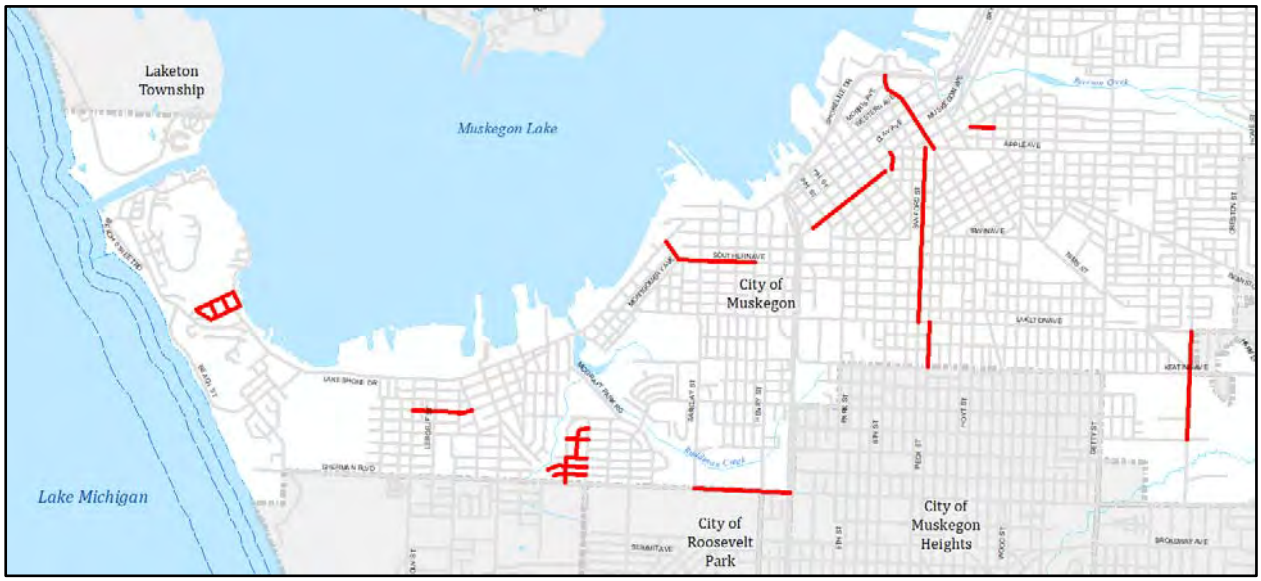


Figure 26. Map of 2023 – 2026 Construction Projects

Gap Analysis

The current funding levels that the City of Muskegon receives are not sufficient to meet the goals for the paved city major road network, the paved city local road network, and the unpaved road network. The *1. Pavement Assets*: *Goals* section of this plan provides further detail about the goals and the *1. Pavement Assets*: *Modelled Trends* section provides further detail on the shortfall given the current budget. However, the City believes that the overall condition of this network can be maintained or improved with additional funding for construction and maintenance. Possible solutions are to reduce the amount of funding put towards the major network and increase the spending on the local network, passing a millage for the local road system, or consider reverting select paved local roads back to gravel. Alternate strategies will need to be developed to overcome the current shortfall and meet the goals on the paved city major road network, the paved city local road network, and the unpaved road network.

2. FINANCIAL RESOURCES

Public entities must balance the quality and extent of services they can provide with the tax resources provided by citizens and businesses, all while maximizing how efficiently funds are used. Therefore, the City will overview its general expenditures and financial resources currently devoted to transportation infrastructure maintenance. This financial information is not intended to be a full financial disclosure or a formal report. Full details of the City's financial status can be found by request submitted to our agency contact (listed in this plan).

Anticipated Revenues & Expenses

The City of Muskegon receives funding from the following sources:

- **State funds** – The City's principal source of transportation funding is received from the Michigan Transportation Fund (MTF). This fund is supported by vehicle registration fees and the state's per-gallon gas tax. Allocations from the MTF are distributed to state and local governmental units based on a legislated formula, which includes factors such as population, miles of certified roads, and vehicle registration fees for vehicles registered in the agency's jurisdiction. The City also receives revenue from the Michigan Department of Transportation to maintain (e.g. plow, patch, mow) the state trunklines within its jurisdictional boundary. Revenue from these maintenance contracts are received on a time and materials basis as resources are expended to maintain the State's roads. While these contracts do not allow for capital gain (profit) and only bring in revenue to cover the cost of the work, they do provide a benefit to the City by allowing an economy of scale that enables us to provide better service at a lower cost for the City's roads while allowing the same for the State of Michigan. Examples of state grants also include local bridge grants, economic development funds, and metro funds.

- **Federal and state grants for individual projects** – These are typically competitive funding applications that are targeted at a specific project type to accomplish a specific purpose. These may include safety enhancement projects, economic development projects, or other targeted funding. Examples of federal funds include Surface Transportation Program (STP) funds, C and D funds, bridge funds, MDOT payments to private contractors, and negotiated contracts.
- **Local government entities or private developer contributions to construction projects for specific improvements** – This category includes funding received to mitigate the impact of commercial developments as a condition of construction of a specific development project, and can also include funding from a special assessment district levied by another governmental unit. Examples of contributions from local units include city, village, and township contributions to the county; special assessments; county appropriations; bond and note proceeds; contributions from counties to cities and villages; city general fund transfers; city municipal street funds; capital improvement funds; and tax millages (see below).
- **Local tax millages** – Many local agencies in Michigan use local tax millages to supplement their road-funding budget. These taxes can provide for additional construction and maintenance for new or existing roads that are also funded using MTF or MDOT funds. The City does not have local tax millages in its road-funding budget.
- **Interest** – Interest from invested funds.
- **Permit fees** – Generally, permit fees cover the cost of a permit application review.
- **Other** – Other revenues can be gained through salvage sales, property rentals, land and building sales, sundry refunds, equipment disposition or installation, private sources, and financing.
- **Charges for services** – Funds from partner agencies who contract with the City to construct or maintain its roads, or roads under joint or neighboring jurisdictions, including state trunkline maintenance and non-maintenance services and preservation.

The City is required to report transportation fund expenditures to the State of Michigan using a prescribed format with predefined expenditure categories. The definitions of these categories according to Public Act 51 of 1951 may differ from common pavement management nomenclature and practice. For the purposes of reporting under PA 51, the expenditure categories are:

- **Construction/Capacity Improvement Funds** – According to PA 51 of 1951, this financial classification of projects includes, "new construction of highways, roads, streets, or bridges, a project that increases the capacity of a highway facility to accommodate that part of traffic having neither an origin nor destination within the local area, widening of a lane width or more, or adding turn lanes of more than 1/2 mile in length."[1]
- **Preservation and Structural Improvement Funds** – Preservation and structural improvements are "activit[ies] undertaken to preserve the integrity of the existing roadway system."[2]

[1] Public Act 51 of 1951, 247.660c Definitions
[2] Public Act 51 of 1951, 247.660c Definitions

Preservation includes items such as a reconstruction of an existing road or bridge, or adding structure to an existing road.

- **Routine and Preventive Maintenance Funds** – Routine maintenance activities are "actions performed on a regular or controllable basis or in response to uncontrollable events upon a highway, road, street, or bridge".[3] Preventive maintenance activities are "planned strategy[ies] of cost-effective treatments to an existing roadway system and its appurtenances that preserve assets by retarding deterioration and maintaining functional condition without significantly increasing structural capacity".[4]
- **Winter Maintenance Funds** – Expenditures for snow and ice control.
- **Trunkline Maintenance Funds** – Expenditures spent under the City's maintenance agreement with MDOT for maintenance it performs on MDOT trunkline routes.
- **Administrative Funds** – There are specific items that can and cannot be included in administrative expenditures as specified in PA 51 of 1951. The law also states that the amount of MTF revenues that are spent on administrative expenditures is limited to 10 percent of the annual MTF funds that are received.
- **Other Funds** – Expenditures for equipment, capital outlay, debt principal payment, interest expense, contributions to adjacent governmental units, principal, interest and bank fees, and miscellaneous for cities and villages.

The Table (below) details the 2020 revenues and expenditures for the City.

Table 4: Annual Fiscal-Year Revenues & Expenditures per Fiscal Year

REVENUES			EXPENDITURES		
Item	**Estimated $**	**Percent of Total**	**Item**	**Estimated $**	**Percent of Total**
State funds	$5,280,251	77.2%	Construction & capacity improvement (CCI)	$0	0%
Federal funds	$1,049,653	15.3%	Preservation & structural improvement (PSI)	$6,558,002	85.7%
Contributions for local units	$250,000	3.7%	Routine maintenance	$180,160	2.4%
Interest, rents, and other	$91,647	1.3%	Winter maintenance	$318,134	4.2%
Charges for services	169,968	2.5%	Trunkline maintenance	$169,968	2.2%
			Administrative	$197,750	2.6%
			Other	$231,873	3%
TOTAL	$6,841,519	100%	TOTAL	$7,655,887	100%

Verify the information in this table. You can find your agency's information in the TAMC dashboard at https://www.mcgi.state.mi.us/mitrp/tamcDashboards.

[3] Public Act 51 of 1951, 247.660c Definitions
[4] Public Act 51 of 1951, 247.660c Definitions

The City of Muskegon currently has a total budget for pavement asset management of $6,500,000. Historically $6,200,000 is spent on city major-network projects consisting of, but not limited to, reconstruction, overlay, culvert replacement, and preventive maintenance. $250,000 is spent on city local-network projects historically. Spending on projects depends on revenue from Michigan Transportation Fund (MTF).

3. RISK OF FAILURE ANALYSIS

Transportation infrastructure is designed to be resilient. The system of interconnecting roads and bridges maintained by the City provides road users with multiple alternate options in the event of an unplanned disruption of one part of the system. There are, however, key links in the transportation system that may cause significant inconvenience to users if they are unexpectedly closed to traffic. See Appendix F of the Compliance Asset Management Plan for a map of the City of Muskegon's key transportation links in our network, including the ones who meet the following types of situations:

- **Geographic divides:** Areas where a geographic feature (river, lake, hilly terrain, or limited access road) limits crossing points of the feature. This includes the Lakeshore Drive bridge over Ruddiman Creek.
- **Emergency alternate routes for high-volume roads and bridges:** Roads and bridges that are routinely used as alternate routes for high-volume assets are included in an emergency response plan. This includes roads such as Sherman Boulevard, Laketon Avenue, Getty Street, and Peck Street.
- **Limited access areas:** Roads and bridges that serve remote or limited access areas that result in long detours if closed. This includes Beach Street, Keating Avenue, and Lakeshore Drive.
- **Main access to key commercial districts:** Areas with a large concentration of businesses or where large-size business will be significantly impacted if a road is unavailable. This includes Keating Avenue, Latimer Drive, Black Creek Road, Olthoff Street, and Sheridan Road.

4. COORDINATION WITH OTHER ENTITIES

An asset management plan provides a significant value for infrastructure owners because it serves as a platform to engage other infrastructure owners using the same shared right of way space. The City of Muskegon communicates with both public and private infrastructure owners to coordinate work in the following ways:

The City of Muskegon maintains drinking water, sanitary, and storm sewer assets in addition to transportation assets. The City follows an asset management process for all of its assets by coordinating the upgrade, maintenance, and operation of all major assets.

Planned projects for sub-surface infrastructure that the City owns are listed in the following asset management plans: drinking water asset management plan, wastewater collection system asset management plan, and storm sewer system asset management plan. These three sub-surface utility plans are coordinated with the transportation infrastructure plans to maximize value and minimize service disruptions and cost to the public.

The City Utility Department and the Streets Department meet yearly to develop the rolling 6-year CIP. City staff discuss planned projects that would disrupt transportation services or cause damage to pavements. Projects which may cause damage to pavements in good or fair condition are discussed and mitigation measures are proposed to minimize the impact to pavements. Mitigation measures could include rescheduling and coordinating projects to maximize value and minimize disruptions and cost to the public.

The City takes advantage of coordinated infrastructure work to reduce cost and maximize value using the following policies:

- Roads which are in poor condition that have a subsurface infrastructure project planned which will destroy more than half the lane width will be rehabilitated or reconstructed full width using transportation funds to repair the balance of the road width.
- Subsurface infrastructure projects which will cause damage to pavements in good condition will be delayed as long as possible, or methods that do not require pavement cuts will be considered.
- Subsurface utility projects will be coordinated to allow all under pavement assets to be upgraded in the same project regardless of ownership.
- Projects on roads which share a border with an adjacent community will have an agreement created during the planning process which defines the formal split for cost sharing. These communities include Roosevelt Park, Norton Shores, Muskegon Heights, as well as the Muskegon County Road Commission.

APPENDIX P-1

A Quick Check of Your Highway Network Health

By Larry Galehouse, Director, National Center for Pavement Preservation
and

Jim Sorenson, Team Leader, FHWA Office of Asset Management

Historically, many highway agency managers and administrators have tended to view their highway systems as simply a collection of projects. By viewing the network in this manner, there is a certain comfort derived from the ability to match pavement actions with their physical/functional needs. However, by only focusing on projects, opportunities for strategically managing entire road networks and asset needs are overlooked. While the "bottom up" approach is analytically possible, managing networks this way can be a daunting prospect. Instead, road agency administrators have tackled the network problem from the "top down" by allocating budgets and resources based on historical estimates of need. Implicit in this approach, is a belief that the allocated resources will be wisely used and prove adequate to achieve desirable network service levels.

Using a quick checkup tool, road agency managers and administrators can assess the needs of their network and other highway assets and determine the adequacy of their resource allocation effort. A quick checkup is readily available and can be usefully applied with minimum calculations.

It is essential to know whether present and planned program actions (reconstruction, rehabilitation, and preservation) will produce a net improvement in the condition of the network. However, before the effects of any planned actions on the highway network can be analyzed, some basic concepts should be considered.

Assume every lane-mile segment of road in the network was rated by the number of years remaining until the end of life (terminal condition). Remember that terminal condition does not mean a failed road. Rather, it is the level of deterioration that management has set as a minimum operating condition for that road or network. Consider the rated result of the current network condition as shown in Figure 1.

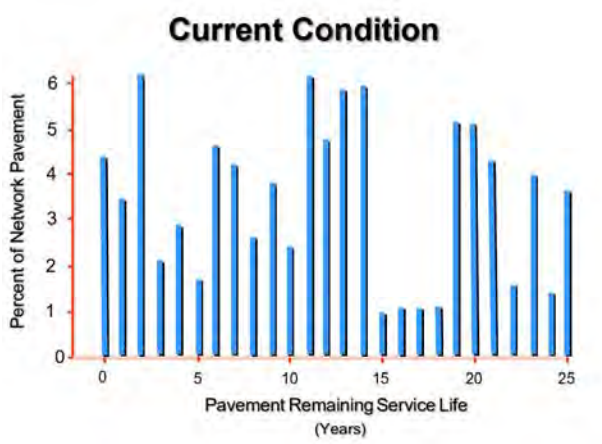


Figure 1 – Current Condition

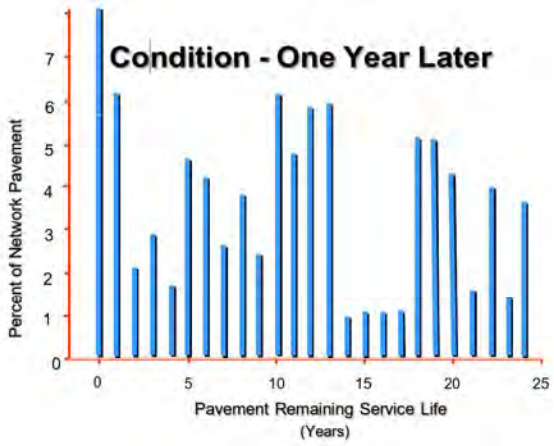


Figure 2 – Condition 1-Year Later

If no improvements are made for one year, then the number of years remaining until the end of life will decrease by one year for each road segment, except for those stacked at zero. The zero- stack will increase significantly because it maintains its previous balance and also becomes the recipient of those roads having previously been stacked with one year remaining. Thus, the entire network will age one year to the condition shown in Figure 2, with the net lane-miles in the zero stack raised from 4% to 8% of the network.

Some highway agencies still subscribe to the old practice of assigning their highest priorities to the reconstruction or rehabilitation of the worst roads. This practice of "worst first", i.e., continually addressing only those roads in the zero-stack, is a proven death spiral strategy because reconstruction and rehabilitation are the most expensive ways to maintain or restore serviceability. Rarely does sufficient funding exist to sustain such a strategy.

The measurable loss of pavement life can be thought of as the network's total lane-miles multiplied by 1 year, i.e., lane-mile-years. Consider the following quantitative illustration. Suppose your agency's highway network consisted of 4,356 lane-miles. Figure 3 shows that without intervention, it will lose 4,356 lane-mile-years per year.

Agency Highway Network = 4,356 lane miles

Each year the network will lose

4,356 lane-mile-years

Figure 3 – Network Lane Miles

To offset this amount of deterioration over the entire network, the agency would need to annually perform a quantity of work equal to the total number of lane-mile-years lost just to maintain the status quo. Performing work which produces fewer than 4,356 lane-mile-years would lessen the natural decline of the overall network, but still fall short of maintaining the

status quo. However, if the agency produces more than 4,356 lane-mile-years, it will improve the network.

In the following example, an agency can easily identify the effect of an annual program consisting of reconstruction, rehabilitation, and preservation projects on its network. This assessment involves knowing the only two components for reconstruction and rehabilitation projects: lane-miles and design life of each project fix. Figure 4 displays the agency's programmed activities for reconstruction and Figure 5 displays it for rehabilitation.

Reconstruction Evaluation

Projects this Year = 2

Project	Design Life	Lane Miles	Lane Mile Years	Lane Mile Cost	Total Cost
No. 1	25 yrs	22	550	$463,425	$10,195,350
No. 2	30 yrs	18	540	$556,110	$10,009,980
	Total	=	**1,090**		$20,205,330

Figure 4 - Reconstruction

Rehabilitation Evaluation

Projects this Year = 3

Project	Design Life	Lane Miles	Lane Mile Years	Lane Mile Cost	Total Cost
No. 10	18 yrs	22	396	$263,268	$5,791,896
No. 11	15 yrs	28	420	$219,390	$6,142,920
No. 12	12 yrs	32	384	$115,848	$3,707,136
	Total	=	**1,200**		$15,641,952

Figure 5 – Rehabilitation

When evaluating pavement preservation treatments in this analysis, it is appropriate to think in terms of "extended life" rather than design life. The term design life, as used in the reconstruction and rehabilitation tables, relates better to the new pavement's structural adequacy to handle repetitive loadings and environmental factors. This is not the goal of pavement preservation. Each type of treatment/repair has unique benefits that should be targeted to the specific mode of pavement deterioration. This means that life extension depends on factors such as type and severity of distress, traffic volume, environment, etc. Figure 6 exhibits the agency's programmed activities for preservation.

Preservation Evaluation

Project	Life Extension	Lane Miles	Lane Mile Years	Lane Mile Cost	Total Cost
No. 101	2 yrs	12	24	$2,562	$30,744
No. 102	3 yrs	22	66	$7,743	$170,346
No. 103	5 yrs	26	130	$13,980	$363,480
No. 104	7 yrs	16	112	$29,750	$476,000
No. 105	10 yrs	8	80	$54,410	$435,280
Total		=	**412**		$1,475,850

Figure 6 – Preservation

To satisfy the needs of its highway network, the agency must accomplish 4,356 lane-mile-years of work per year. The agency's program will derive 1,090 lane-mile-years from reconstruction, 1,200 lane-mile-years from rehabilitation, and 412 lane-mile-years from pavement preservation, for a total of 2,702 lane-mile-years. Thus, these programmed activities fall short of the minimum required to maintain the status quo, and hence would contribute to a net loss in network pavement condition of 1,653 lane-mile-years. The agency's programmed tally is shown in Figure 7.

Network Trend

Programmed Activity	Lane-Mile-Years	Total Cost
Reconstruction	1,090	$20,205,330
Rehabilitation	1,200	$15,641,952
Preservation	412	$1,475,850
Total	**2,702**	**$37,323,132**
Network Needs (Loss)	(-) 4,356	
Deficit =	**- 1,654**	

Figure 7 – Programmed Tally

This exercise can be performed for any pavement network to benchmark its current trend. Using this approach, it is possible to see how various long-term strategies could be devised and evaluated against a policy objective related to total-network condition.

Once the pavement network is benchmarked, an opportunity exists to correct any shortcomings in the programmed tally. A decision must first be made whether to improve the

network condition or just to maintain the status quo. This is a management decision and system goal.

Continuing with the previous example, a strategy will be proposed to prevent further network deterioration until additional funding is secured.

The first step is to modify the reconstruction and rehabilitation (R&R) programs. An agonizing decision must be made about which projects to defer, eliminate, or phase differently with multi- year activity. In Figure 8, reductions are made in the R&R programs to recover funds for less costly treatments in the pavement preservation program. The result of this decision recovered slightly over $6 million.

Program Modification

Programmed Activity	Lane-Mile-Years	Cost Savings
Reconstruction ***31 lane miles*** ~~(40 lane-miles)~~	***820*** ~~(1,090)~~	**$5,004,990**
Rehabilitation ***77 lane miles*** ~~(82 lane-miles)~~	***1,125*** ~~(1,200)~~	**$1,096,950**
Pavement Preservation (84 lane-miles)	(412)	**0**
Total =	***2,357*** **(2,702)**	**$6,101,940**

Figure 8 – Revised R & R Programs

Modifying the reconstruction and rehabilitation programs has reduced the number of lane-mile- years added to the network from 2,702 to 2,357 lane-mile-years. However, using less costly treatments elsewhere in the network to address roads in better condition will increase the number of lane-mile-years added to the network. A palette of pavement preservation treatments, or mix of fixes, is available to address the network needs at a much lower cost than traditional methods.

Preservation treatments are only suitable if the right treatment is used on the right road at the right time. In Figure 9, the added treatments used include concrete joint resealing, thin hot-mix asphalt (HMA) overlay (≤ 1.5”), microsurfacing, chip seal, and crack seal. By knowing the cost per lane-mile and the treatment life-extension, it is possible to create a new strategy (costing $36,781,144) that satisfies the network need. In this example, the agency saved in excess of $500,000 from traditional methods (costing $37,323,132), while erasing the 1,653 lane-mile-year deficit produced by the initial program tally. Network Strategy

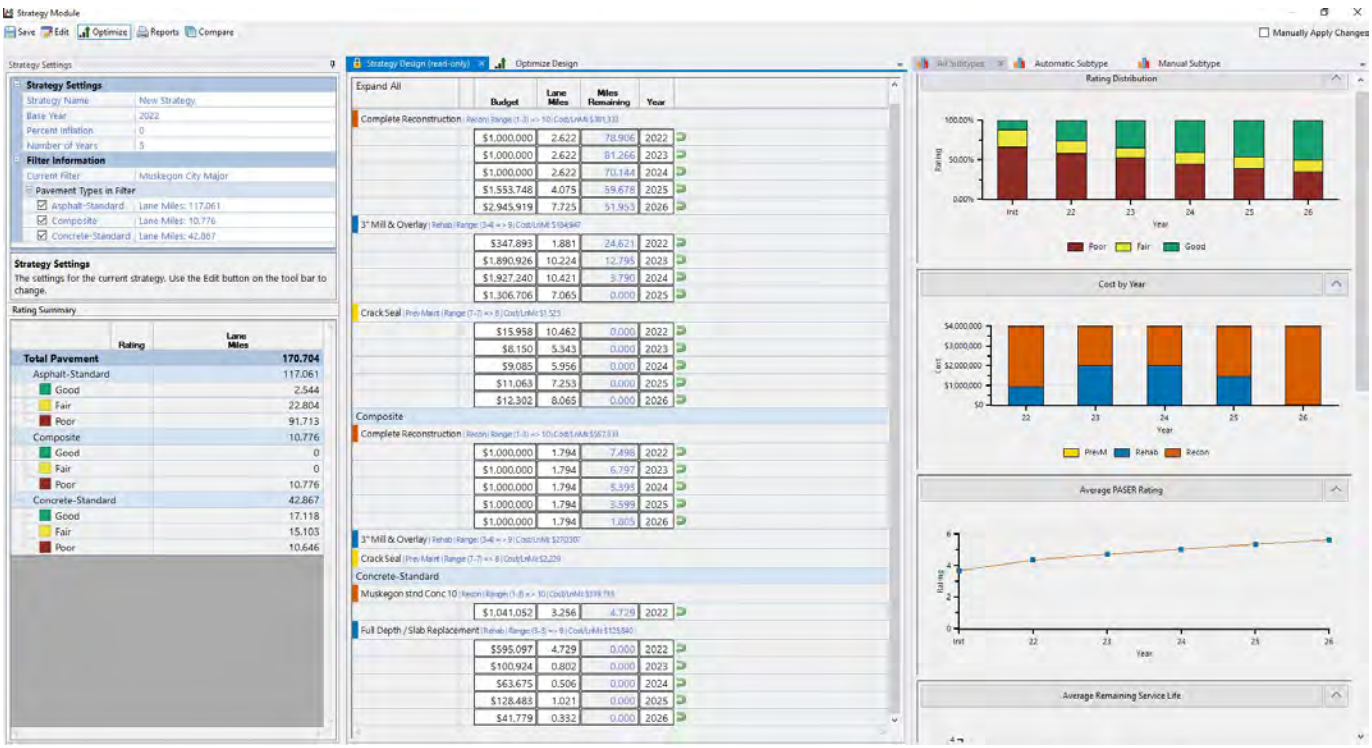
Programmed Activity		Lane Mile Years	Total Cost
Reconstruction	(31 lane-miles)	820	$15,200,340
Rehabilitation	(77 lane-miles)	1,125	$14,545,002
Pavement Preservation	(84 lane-miles)	412	$1,475,850
Concrete Resealing	(4 years x 31 lane-miles)	124	$979,600
Thin HMA Overlay	(10 years x 16 lane-miles)	160	$870,560
Microsurfacing	(7 years x 44 lane-miles)	308	$1,309,000
Chip Seal	(5 years x 79 lane-miles)	395	$1,104,420
Crack Seal	(2 years x 506 lane-miles)	1,012	$1,296,372
	Total =	4,356	$36,781,144

Figure 9 – New Program Tally

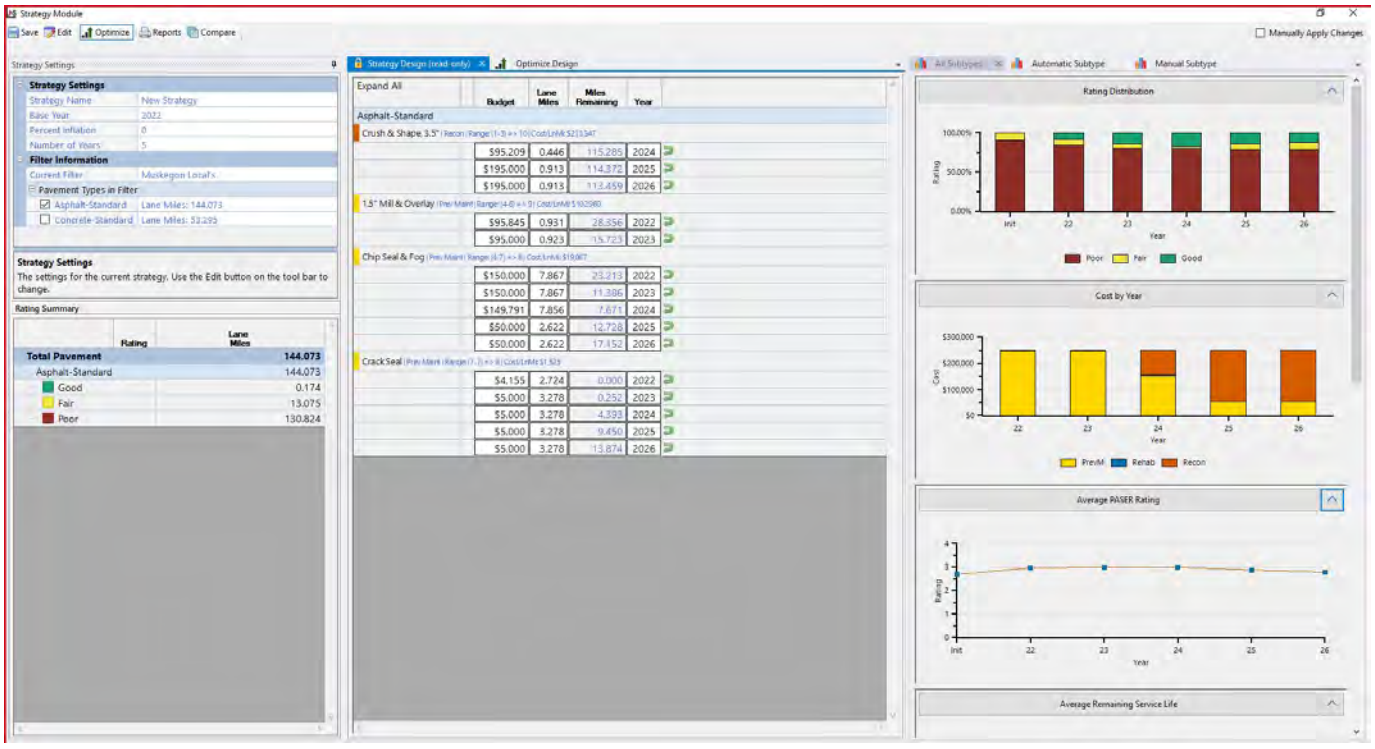
In a real-world situation, the highway agency would program its budget to achieve the greatest impact on its network condition. Funds allocated for reconstruction and rehabilitation projects must be viewed as investments in the infrastructure. Conversely, funds directed for preservation projects must be regarded as protecting and preserving past infrastructure investments.

Integrating reconstruction, rehabilitation, and preservation in the proper proportions will substantially improve network conditions for the taxpayer while safeguarding the highway investment.

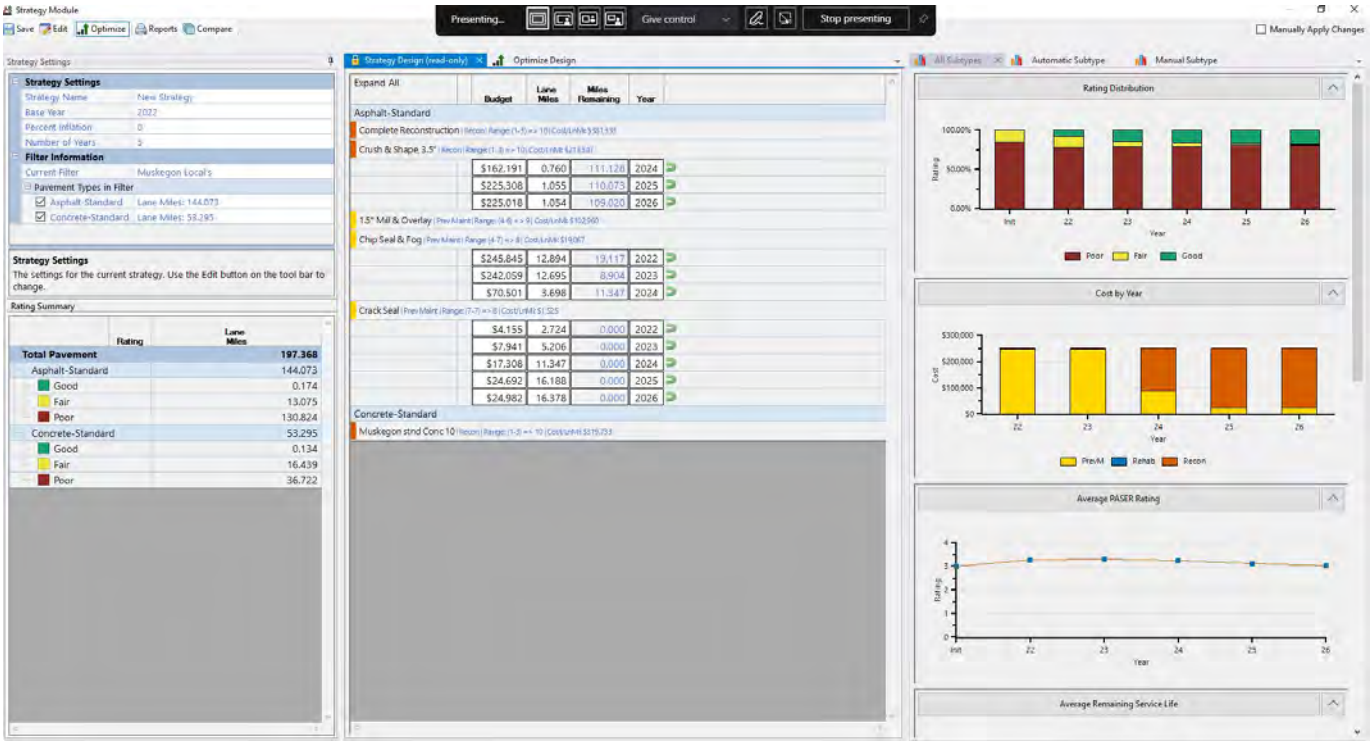
APPENDIX P-2: ROADSOFT MODEL INPUTS & OUTPUTS



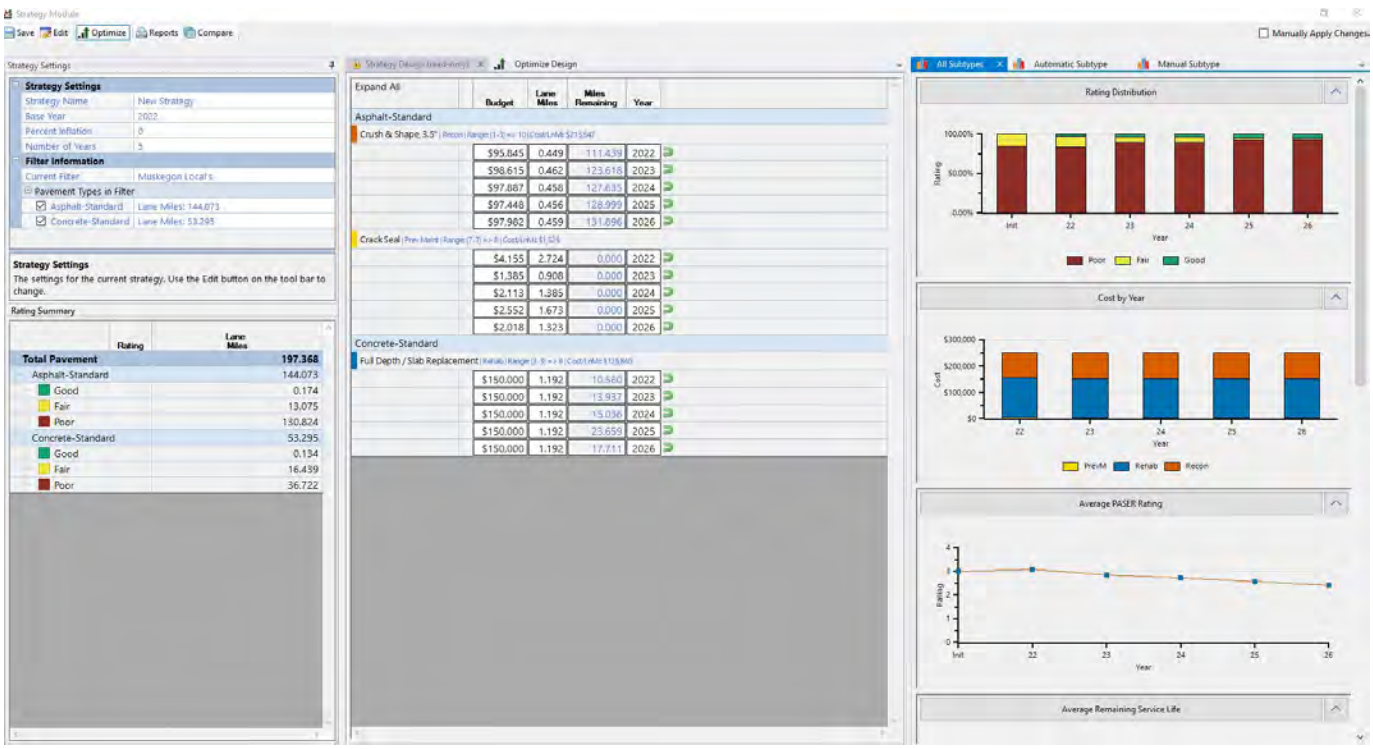
Major Roads $4M



Local Asphalts - $250,000
with Mill and Overlay Fix Option



Local Asphalts - $250,000
without Mill and Overlay Fix Option



Local - $250,000
Concrete and Asphalt Fix Options

APPENDIX B. BRIDGE ASSET MANAGEMENT PLAN

An attached Bridge Asset Management Plan follows.

City of Muskegon
2022 Bridge
Asset Management Plan

West Michigan's Shoreline City
www.shorelinecity.com

A plan describing the City of Muskegon's Bridge Assets and Conditions

Prepared by:

Prein&Newhof

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BRIDGE ASSET MANAGEMENT PLAN SUMMARY

As conduits for commerce and connections to vital services, bridges are among the most important assets in any community that support and affect the road network. The City of Muskegon's bridges, other road-related assets, and support systems are some of the most valuable and extensive public assets, all of which are paid for with taxes collected from citizens and businesses. The cost of building and maintaining bridges, their importance to society, and the investment made by taxpayers all place a high level of responsibility on local agencies to plan, build, and maintain the road and bridge network in an efficient and effective manner.

An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of the City's obligations towards meeting these requirements. This asset management plan also helps demonstrate the City's responsible use of public funds by providing elected and appointed officials as well as the general public with inventory and condition information of the City's bridge assets, and gives taxpayers the information they need to make informed decisions about investing in essential transportation infrastructure

This plan overviews the condition of the City of Muskegon's 3 bridges and explains how the City will work to maintain and improve the overall condition of those assets. These explanations can help answer:

- What kinds of bridge assets the City has in its jurisdiction and the different options for maintaining these assets.
- What tools and processes the City uses to track and manage bridge assets and funds.
- What condition the City's bridge assets are in compared to statewide averages.
- Why some bridge assets are in better condition than others and the path to maintaining and improving bridge asset conditions through proper planning and maintenance.
- How agency bridge assets are funded and where those funds come from.
- How funds are used and the costs incurred during the City's bridge assets' normal life cycle.
- What condition the City can expect of its bridge assets if those assets continue to be funded at the current funding levels.
- How changes in funding levels can affect the overall condition of all of the City's bridge assets.

INTRODUCTION

Asset management is defined by Public Act 325 of 2018 as "an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals". In other words, asset management is a process that uses data to manage and track assets, like roads and bridges, in a cost-effective manner using a combination of engineering and business principles. This process is endorsed by leaders in municipal planning and transportation infrastructure, including the Michigan Municipal League, County Road Association of Michigan, the Michigan Department of Transportation (MDOT), and the Federal Highway Administration (FHWA). The City of Muskegon is supported in its use of asset management principles and processes by the Michigan Transportation Asset Management Council (TAMC), formed by the State of Michigan.

Asset management, in the context of this plan, ensures that public funds are spent as effectively as possible to maximize the condition of the necessary bridges in City of Muskegon's road network. Asset management also provides a transparent decision-making process that allows the public to understand the technical and financial challenges of managing infrastructure with a limited budget.

The City of Muskegon has adopted an "asset management" business process to overcome the challenges presented by having limited financial, staffing, and other resources while needing to meet safety standards and bridge users' expectations. The City is currently responsible for 3 bridges. Two bridges are open to traffic and being maintained for public use. The third bridge is closed to the public and has been planned for removal with appropriate site restoration in 2024.

This 2022 plan outlines how the City determines its strategy to maintain and upgrade bridge asset condition given agency goals, priorities of its bridge users, and resources provided. An updated plan is to be released approximately every three years to reflect changes in bridge conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to Dan VanderHeide at 1350 E. Keating Avenue, Muskegon, MI 49442, dan.vanderheide@shorelinecity.com, or at (231) 724-4100.

Key terms used in this plan are defined in the City's comprehensive transportation asset management plan (also known as the "compliance plan") used for compliance with PA 325 or 2018.

Knowing the basic features of an asset class is a crucial starting point to understanding the rationale behind an asset management approach. The following primer provides an introduction to bridges.

Bridge Primer

Bridge Types

Bridges are structures that span 20 feet or more. These bridges can extend across one or multiple spans.

If culverts are placed side by side to form a span of 20 feet or more (for example, three 6-foot culverts with one-foot between each culvert), then this culvert system would be defined as a bridge. (Note: The Compliance Plan Appendix C contains a primer on culverts not defined as bridges.)

Figure 1: Girder bridge

Bridge types are classified based on two features: design and material.

The most common bridge design is the **girder system** (Figure 1). With this design, the bridge deck transfers vehicle loads to girders (or beams) that, in turn, transfer the load to the piers or abutments (see Figure 6).

Figure 2: Slab bridge

A similar design that lacks girders (or beams) is a **slab bridge** (Figure 2, and see Figure 6). A slab bridge transfers the vehicle load directly to the abutments and, if necessary, piers.

Truss bridges were once quite common and consist of a support structure that is created when structural members are connected at joints to form interconnected triangles (Figure 4). Structural members may consist of steel tubes or angles connected at joints with gusset plates.

Figure 3: Truss bridge

Another common bridge design in Michigan is the three-sided pre-cast box or arch bridge (Figure 4).

Michigan is also home to several unique bridge designs.

Adding another layer of complexity to bridge typing is the primary construction materials used (Figure 5). Bridges are generally constructed from concrete, steel, pre-stressed concrete, or timber. Some historical bridges or bridge components in Michigan may be constructed from stone or masonry.

Figure 4: Three-sided box bridge

Figure 5: Examples of common bridge construction materials used in Michigan

Bridge Condition

Michigan inspectors rate bridge condition on a 0-9 scale known as the National Bridge Inventory (NBI) rating scale (see Table for a summary of the NBI Rating scale). Elements of the bridge's superstructure, deck, and substructure receive a 9 if they are in excellent condition down to a 0 if they are in failed condition. A complete guide for Michigan bridge condition rating according to the NBI can be found in the MDOT Bridge Field Services' *Bridge Safety Inspection NBI Rating Guidelines* (https://www.michigan.gov/documents/mdot/BIR_Ratings_Guide_Combined_2017-10-30_606610_7.pdf).

Table 1: Summary of the NBI Rating Scale

NBI Rating	General Condition
9-7	Like new/good
6-5	Fair
4-3	Poor/serious
2-0	Critical/failed

Bridge Treatments

Replacement

Replacement work is typically performed when a bridge is in poor condition (NBI rating of 4 or less) and will improve the bridge to good condition (NBI rating of 7 or more). The Local Bridge Program, a part of MDOT's Local Agency Program, defines bridge replacement as full replacement, which removes the entire bridge (superstructure, deck, and substructure) before re-building a bridge at the same location (Figure 6). The decision to perform a total replacement over rehabilitation (see below) should be made based on a life-cycle cost analysis. Generally, replacement is selected if rehabilitation costs more than two-thirds of the cost of replacement. Replacement is generally the most expensive of the treatment options.

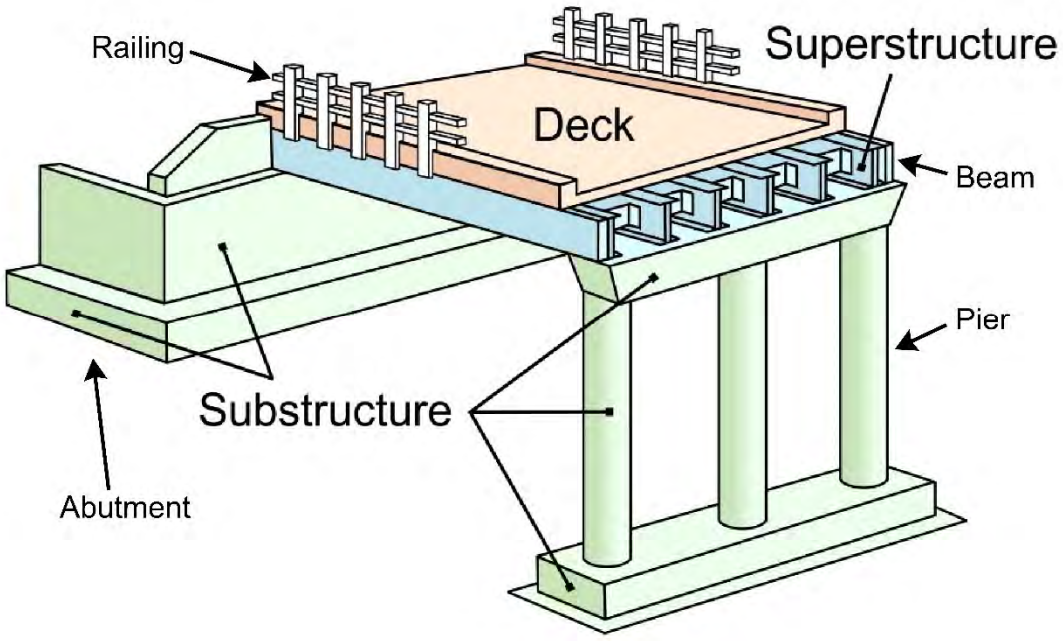


Figure 6: Diagram of basic elements of a bridge

Rehabilitation

Rehabilitation involves repairs that improve the existing condition and extend the service life of the structure and the riding surface. Most often, rehabilitation options are associated with bridges that have degraded beyond what can be fixed with preventive maintenance. Rehabilitation is typically performed on poor-rated elements (NBI rating of 4 or less) to improve them to fair or good condition (NBI rating of 5 or more). Rehabilitation can include superstructure replacement (removal and replacement of beams and deck) or deck replacement. While typically more expensive than general maintenance, rehabilitation treatments may be more cost-effective than replacing the entire structure.

- **Railing retrofit/replacement:** A railing retrofit or replacement either reinforces the existing railing or replaces it entirely (Figure 6). This rehabilitation is driven by a need for safety improvements on poor-rated railings or barriers (NBI rating less than 5).
- **Beam repair:** Beam repair corrects damage that has reduced beam strength (Figure 6). In the case of steel beams, it is performed if there is 25 percent or more of section loss in an area of the beam that affects load-carrying capacity. In the case of concrete beams, this is performed if there is 50 percent or more spalling (i.e., loss of material) at the ends of beams.
- **Substructure concrete patching and repair:** Patching and repairing the substructure is essential to keep a bridge in service. These rehabilitation efforts are performed when the abutments or piers are fair or poor (NBI rating of 5 or 4), or if spalling and delamination affect less than 30 percent of the bridge surface.

Preventive Maintenance

The Federal Highway Administration's (FHWA) *Bridge Preservation Guide* (2018) defines preventive maintenance as "a strategy of extending service life by applying cost-effective treatments to bridge elements…[that] retard future deterioration and avoid large expenses in bridge rehabilitation or replacements."

Preventive maintenance work is typically done on bridges rated fair (NBI rating of 5 or 6) in order to slow the rate of deterioration and keep them from falling into poor condition.

- **Concrete deck overlay:** A concrete deck overlay involves removing and replacing the driving surface. Typically, this is done when the deck surface is poor (NBI rating is less than 5) and the underneath portion of the deck is at least fair (NBI rating greater than 4). A shallow or deep concrete overlay may be performed depending on the condition of the bottom of the deck. The MDOT *Bridge Deck Preservation* matrices provide more detail on concrete deck overlays (see https://www.michigan.gov/mdot/0,4616,7-151-9625_24768_24773---,00.html).

- **Deck repairs:** Deck repairs include three common techniques: HMA overlay with or without waterproof membranes, concrete patching, deck sealing, crack sealing, and joint repair/replacement. An HMA overlay with an underlying waterproof membrane can be placed on bridge decks with a surface rating of fair or lower (NBI of 5 or less) and with deficiencies that cover between 15 and 30 percent of the deck surface and deck bottom. An HMA overlay without a waterproof membrane should be used on a bridge deck with a deck surface and deck bottom rating of serious condition or lower (NBI rating of 3 or less) and with deficiencies that cover greater than 30 percent of the deck surface and bottom; this is considered a temporary holdover to improve ride quality when a bridge deck is scheduled to undergo major rehabilitation within five years. All HMA overlays need to be accompanied by an updated load rating. Patching of the concrete on a bridge deck is done in response to an inspector's work recommendation or when the deck surface is in good, satisfactory, or fair condition (NBI rating of 7, 6, or 5) with minor delamination and spalling. To preserve a good bridge deck in good condition, a deck sealer can be used.
  Deck sealing should only be done when the bridge deck has surface rating of fair or better (NBI of 5 or more). Concrete sealers should only be used when the top and bottom surfaces of the deck are free from major deficiencies, cracks, and spalling. An epoxy overlay may be used when between 2 and 5 percent of the deck surface has delaminations and spalls, but these deficiencies must be repaired prior to the overlay. An epoxy overlay may also be used to repair an existing epoxy overlay. Concrete crack sealing is an option to maintain concrete in otherwise good condition that has visible cracks with the potential of reaching the steel reinforcement. Crack sealing may be performed on concrete with a surface rating of good, satisfactory, or fair (NBIS rating of 7, 6, or 5) with minor surface spalling and delamination; it may also be performed in response to a work recommendation by an inspector who has determined that the frequency and size of the cracks require sealing.

- **Steel bearing repair/replacement:** Rather than sitting directly on the piers, a bridge superstructure is separated from the piers by bearings. Bearings allow for a certain degree of movement due to temperature changes or other forces. Repairing or replacing the bearings is considered preventive

maintenance. Girders and a deck in at least fair condition (NBI of 5 or higher) and bearings in poor condition (NBI rating of 4 or less) identifies candidates for this maintenance activity.

- **Painting:** Re-painting a bridge structure can either be done in totality or in part. Total re-painting is done in response to an inspector's work recommendation or when the paint condition is in serious condition (NBI rating of 3 or less). Partial re-painting can either consist of zone re-painting, which is a preventive maintenance technique, or spot re-painting, which is scheduled maintenance (see below). Zone re-painting is done when less than 15 percent of the paint in a smaller area, or zone, has failed while the rest of the bridge is in good or fair condition. It is also done if the paint condition is fair or poor (NBI rating of 5 or 4).
- **Channel improvements:** Occasionally, it is necessary to make improvements to the waterway that flows underneath the bridge. Such channel improvements are driven by an inspector's work recommendation based on a hydraulic analysis or to remove vegetation, debris, or sediment from the channel and banks (Figure 6).
- **Scour countermeasures:** An inspector's work recommendations or a hydraulic analysis may require scour countermeasures (see the *Risk Management* section of this plan for more information on scour). This is done when a structure is categorized as scour critical and is not scheduled for replacement or when NBI comments in abutment and pier ratings indicate the presence of scour holes.
- **Approach repaving:** A bridge's approach is the transition area between the roadway leading up to and away from the bridge and the bridge deck. Repaving the approach areas is performed in response to an inspector's work recommendation, when the pavement surface is in poor condition (NBI rating of 4 or less), or when the bridge deck is replaced or rehabilitated (e.g., concrete overlay).
- **Guardrail repair/replacement:** A guardrail is a safety feature on many roads and bridges that prevents or minimizes the effects of lane departure incidents. Keeping bridge guardrails in good condition is important. Repair or replacement of bridge guardrail should be done when a guardrail is missing or damaged, or when it needs a safety improvement.

Scheduled Maintenance

Scheduled maintenance activities are those activities or treatments that are regularly scheduled and intend to maintain serviceability while reducing the rate of deterioration.

- **Superstructure washing:** Washing the superstructure, or the main structure supporting the bridge, typically occurs in response to an inspector's work recommendation or when salt-contaminated dirt and debris collected on the superstructure is causing corrosion or deterioration by trapping moisture.
- **Drainage system cleanout/repair:** Keeping a bridge's drainage system clean and in good working order allows the bridge to shed water effectively. An inspector's work recommendation may

indicate drainage system cleanout/repair. Signs that a drainage system needs cleaning or repair include clogs and broken, deteriorated, or damaged drainage elements.

- **Spot painting:** Spot painting is a form of partial bridge painting. This scheduled maintenance technique involves painting a small portion of a bridge. Generally, this is done in response to an inspector's work recommendation and is used for zinc-based paint systems only.
- **Slope repair/reinforcement:** The terrain on either side of the bridge that slopes down toward the channel is called the slope. At times, it is necessary to repair the slope. Situations that call for slope repair include when the slope is degraded, when the slope has significant areas of distress or failure, when the slope has settled, or if the slope is in fair or poor condition (NBI rating of 5 or less). Other times, it is necessary to reinforce the slope. Reinforcement can be added by installing Riprap, which is a side-slope covering made of stones. Riprap protects the stability of side slopes of channel banks when erosion threatens the surface.
- **Vegetation control and debris removal:** Keeping the area around a bridge structure free of vegetation and debris safeguards the bridge structure from these potentially damaging forces. Removing or restricting vegetation around bridges prevents damage to the structure. Vegetation control is done in response to an inspector's work recommendation or when vegetation traps moisture on structural elements or is growing from joints or cracks. Debris in the water channel or in the bridge can also cause damage to the structure. Removing this debris is typically done in response to an inspector's work recommendation or when vegetation, debris, or sediment accumulates on the structure or channel.
- **Miscellaneous repairs:** These are uncategorized repairs in response to an inspector's work recommendation.

1. BRIDGE ASSETS

The City seeks to implement an asset management program for its bridge structures. This program balances the decision to perform reconstruction, rehabilitation, preventive maintenance, scheduled maintenance, or new construction, with the City's bridge funding in order to maximize the useful service life and to ensure the safety of the local bridges under its jurisdiction. In other words, the City's bridge asset management program aims to preserve the condition of its local bridge network within the means of its financial resources.

Nonetheless, the City recognizes that limited funds are available for improving the bridge network. Since preservation strategies like preventive maintenance are generally a more effective use of these funds than costly alternative management strategies like major rehabilitation or replacement, the City is addressing those bridges that pose usability and/or safety concerns.

The three-fold goal of the City's asset management program is the preservation and safety of its bridge network, increase of its bridge assets' useful service life by extending of the time that bridges remain in good and fair condition, and reduction of future maintenance costs. To quantify this goal, the City specifically aims to remove the two structurally deficient bridges within the next 5 years and to maintain their remaining structure in good condition.

Thus, the City's asset management plan objectives are:

- To establish the current condition of the city's bridges.
- To develop a "mix of fixes" that will:
    - Program scheduled maintenance actions to impede deterioration of bridges in good condition.
    - Implement removal of degraded bridges rather than restore functionality.

- To identify available funding sources, such as:
    - Dedicated city resources.
    - City funding through Michigan's Local Bridge Program.
    - Opportunities to obtain other funding.
- To prioritize the programmed actions within available funding limitations.
- To preserve bridges currently rated fair (5) or higher in their current condition in order to extend their useful service life.

Inventory

The City is responsible for 3 local bridges. Table 2 summarizes the City's bridge assets by type, sizes by bridge type, and condition by bridge type. The bridge inventory data was obtained from MDOT MiBRIDGE and other sources. See Appendix B-1.

Types

Of the City's 3 structures, 1 is a concrete bridge and 2 are steel bridges.

Locations and Sizes

Figure 7 illustrates the locations of bridge assets owned by the City. Details about the locations and sizes of each individual asset can be found in the City's MiBRIDGE database. For more information, please refer to the agency contact listed in the *Introduction* of this bridge asset management plan.

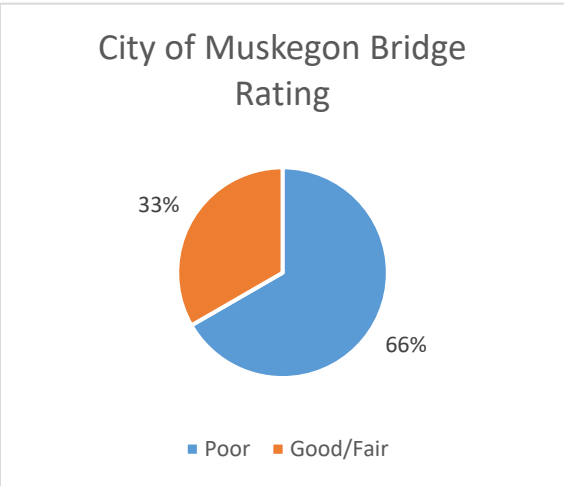
Figure 7: Map illustrating locations of the City's of bridge assets

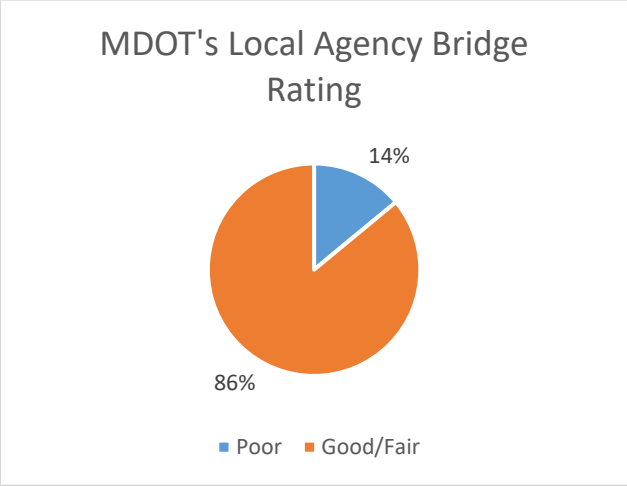
Condition

The City evaluates its bridges according to the National Bridge Inspection Standards rating scale, with a rating of 9 to 7 being like new to good condition, a rating of 6 and 5 being fair condition, and a rating of 4 or lower being poor or serious/critical condition. The current condition of the City's bridge network is 1 (33%) is good and 2 (67%) are poor or lower. See Appendix B-2.

Another layer of classification of the City's bridge inventory classifies 2 bridges as structurally deficient with 1 being closed. No bridges are posted. Structurally deficient bridges are those with a deck, superstructure, substructure, and/or culvert rated as "poor" according to the NBI rating scale, with a load-carrying capacity significantly below design standards, or with a waterway that regularly overtops the bridge during floods. Closed bridges are those that are closed to all traffic; closing a bridge is contingent upon its ability to carry a set minimum live load. Posted bridges are those that have declined in condition to a point where a restriction is necessary for what would be considered a safe vehicular or traffic load passing over the bridge; designating a bridge as "posted" has no influence on its condition rating.

Table 2: Bridge Assets by Type: Inventory, Size, and Condition								
Bridge Type	Total Number of Bridges	Total Deck Area (sq ft)	Condition: Structurally Deficient, Posted, Closed			2020 Condition		
			Struct. Defic	Posted	Closed	Poor	Fair	Good
Concrete – Culvert	1	1,970	0	0	0	0	0	1
Steel – Multistringer	1	2,007	1	0	1	1	0	0
Steel continuous – Multistringer	1	3,202	1	0	0	1	0	0
Total SD/Posted/Closed			**2**	**0**	**1**			
Total	**3**	**7,179**				**2**	**0**	**1**
Percentage (%)			**67%**	**0**	**33**	**67**	**0**	**33**





Statewide, MDOT's statistics for local agency bridges show that 14% are poor and 86% are good/fair, indicating that the City currently has a greater percentage of poor bridges compared to the statewide average for local agencies. Correspondingly, the City has 33% of its bridges in fair/good condition versus the statewide average of 86% for local agency bridges. Statewide, 97% of local agency bridge deck area classifies as structurally deficient compared to 67% of the City's bridge deck area.

Goals

The goal of the City's asset management program is the preservation and safety of its bridge network; it also aims to extend the period of time that bridges remain in good and fair condition, thereby increasing their useful service life and reducing future maintenance costs.

The City has the goal of removing 2 bridges from their system. The City decided to remove these structures after looking at connectivity, condition, cost to replace, and available funding. Specifically, this goal translates into long-range goals of having 100% of its bridges rated fair/good and having 0% classify as structurally deficient within the next five years.

Metrics will be used to assess the effectiveness of this asset management program. The City will monitor and report the annual change in its bridge ratings.

Prioritization, Programmed/Funded Projects, and Planned Projects

Prioritization

The City's asset management program aims to address the structures of critical concern by targeting elements rated as being in poor condition and to improve and maintain the overall condition of the bridge network to good or fair condition through a "mix of fixes" strategy. Therefore, the City prioritizes bridges for projects by evaluating five factors and weighting them as follows: condition –20%, load capacity –20%, traffic volume –20%, Emergency service response/safety –20%, and detour –20%. There are several components within each factor that are used to arrive at its score. Each project under consideration is scored, and its total score is then compared with other proposed project to establish a priority order.

The City reviews the current condition of each bridge based on its required frequency using the NBIS inspection data contained in the *MDOT Bridge Safety Inspection Report* and the inspector's work recommendations contained in MDOT's *Bridge Inspection Report*. The inspector's notes and repair recommendations based on condition are consolidated in spreadsheet format for the City's bridges in Appendix B-3. Inspection follow-up actions are summarized in Appendix B-4. The City then determines management and preservation needs and corresponding actions for each bridge, see Appendix B-5. The management and preservation actions are selected in accordance with criteria contained in the *Summary of Preservation Criteria* table (below) and adapted to the City's specific bridge network.

Table 3: Summary of Preservation Criteria

Preservation Action	Bridge Selection Criteria	Expected Service Life
Replacement		
Total Replacement	• NBI rating of 3 or less [1] [2] • *OR* Cost of rehabilitation exceeds cost of replacement [1] • *OR* Bridge is scour critical with no counter-measures available [1]	70 years
Rehabilitation		
Superstructure Replacement	• NBI rating of 4 or less for the superstructure [1] [2] • *OR* Cost of superstructure and deck rehabilitation exceeds cost of replacement [1]	40 years [1]
Deck Replacement Epoxy Coated Steel Black Steel	• Use guidelines in MDOT's Bridge Deck Preservation Matrix [3] [4] • NBI rating of 4 or less for the deck surface and deck bottom [1] [2] • Deck bottom has more than 25% total area with deficiencies [1] • *OR* Replacement cost of deck is competitive with rehabilitation [1]	60+ years [3] [4]
Substructure Replacement (Full or Partial)	• NBI rating of 4 or less for abutments, piers, or pier cap [1] [2] • Has open vertical cracks, signs of differential settlement, or active movement [1] • Pontis rating of 3 or 5 for more than 30 percent of the substructure [1] [5] • *OR* Bridge is scour critical with no counter-measures available	40 years [1*]
Steel Beam Repair	• More than 25% section loss in an area of the beam that affects load carrying capacity [1]	40 years [1*]

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
	• *OR* To correct impact damage that impairs beam strength [1]	
Prestressed Concrete Beam Repair	• More than 5% spalling at ends of prestressed I-beams [1] • *OR* Impact damage that impairs beam strength or exposes prestressing strands [1]	40 years [1*]
Substructure Concrete Patching and Repair	• NBI rating of 5 or 4 for abutments or piers, and surface has less than 30% area spalled and delaminated [1] [2] • *OR* Pontis rating of 3 or 4 for the column or pile extension, pier wall, and/or abutment wall and surface has between 2% and 30% area with deficiencies [1] [5] • *OR* In response to inspector's work recommendation for substructure patching [1]	
Abutment Repair/Replacement	• NBI rating of 4 or less for the abutment [1] [2] • *OR* Has open vertical cracks, signs of differential settlement, or active movement	
Railing/Barrier Replacement	• NBI rating greater than 5 for the deck [1] [2] • NBI rating less than 5 for the railing with more than 30% total area having deficiencies [1] [2] • *OR* Pontis rating is 4 for railing [1] [5] • *OR* Safety improvement is needed [1]	
Culvert Repair/Replacement	• NBI rating of 4 or less for culvert or drainage outlet structure • *OR* Has open vertical cracks, signs of deformation, movement, or differential settlement	
Preventive Maintenance		
Shallow Concrete Deck Overlay	• NBI rating is 5 or less for deck surface, and deck surface has more than 15% area with deficiencies [1] [2] • NBI rating of 4 or 5 for deck bottom, and deck bottom has between 5% and 30% area with deficiencies [1] [2] • *OR* In response to inspector's work recommendation [1]	12 years
Deep Concrete Deck Overlay	• NBI rating of 5 or less for deck surface, and deck surface has more than 15% area with deficiencies [1] [2] • NBI deck bottom rating is 5 or 6, and deck bottom has less than 10% area with deficiencies [1] [2] • *OR* In response to inspector's work recommendation [1]	25 years
HMA Overlay with Waterproofing Membrane	• NBI rating of 5 or less for deck surface, and both deck surface and bottom have between 15% and 30% area with deficiencies [1] [2] • *OR* Bridge is in poor condition and will be replaced in the near future and the most cost-effective fix is HMA overlay [1]	
HMA Overlay Cap without Membrane	• Note: All HMA caps should have membranes unless scheduled for replacement within five years. • NBI rating of 3 or less for deck surface and deck bottom, and deck surface and deck bottom have more than 30% area with deficiencies. Temporary holdover to improve ride quality for a bridge in the five-year plan for rehab/replacement. [1] [2]	3 years
Concrete Deck Patching	• NBI rating of 5, 6, or 7 for deck surface, and deck surface has between 2% and 5% area with delamination and spalling [1] [2] • *OR* In response to inspector's work recommendation [1]	5 years

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
Steel Bearing Repair/Replacement	• NBI rating of 5 or more for superstructure and deck, and NBI rating 4 or less for bearing [2]	
Deck Joint Replacement	• Always include when doing deep or shallow concrete overlays [1] • NBI rating of 4 or less for joints [1] [2] • *OR* Joint leaking heavily [1] • *OR* In response to inspector's work recommendation for replacement [1]	
Pin and Hanger Replacement	• NBI rating of 4 or less for superstructure for pins and hangers [1] [2] • Pontis rating of 1, 2, or 3 for a frozen or deformed pin and hanger [1] [5] • *OR* Presence of excessive section loss, severe pack rust, or out-of-plane distortion [1]	15 years
Zone Repainting	• NBI rating of 5 or 4 for paint condition, and paint has 3% to 15% total area failing [1] [2] • *OR* During routine maintenance on beam ends or pins and hangers [1] • *OR* less than 15% of existing paint area has failed and remainder of paint system is in good or fair condition [1]	10 years
Complete Repainting	• NBI rating of 3 or less for paint condition [1] [2] • *OR* Painted steel beams that have greater than 15% of the existing paint area failing [1]	
Partial Repainting	• See Zone or Spot Painting	
Channel Improvements	• Removal of vegetation, debris, or sediment from channel and banks to improve channel flow • *OR* in response to inspector's work recommendation	
Scour Countermeasures	• Pontis scour rating of 2 or 3 and is not scheduled for replacement [1] [5] • OR NBI comments in abutment and pier ratings indicate presence of scour holes [1] [2]	
Approach Repaving	• Approach pavement relief joints should be included in all projects that contain a significant amount of concrete roadway (in excess of 1000' adjacent to the structure). The purpose is to alleviate the effects of pavement growth that may cause distress to the structure. Signs of pavement growth include: o Abutment spalling under bearings [1] o Beam end contact [1] o Closed expansion joints and/or pin and hangers [1] o Damaged railing and deck fascia at joints [1] o Cracking in deck at reference line (45 degree angle) [1]	
Guard Rail Repair/Replacement	• Guard rail missing or damaged [2*] • *OR* Safety improvement is needed [2*]	

Scheduled Maintenance		
Superstructure Washing	• When salt contaminated dirt and debris collected on superstructure is causing corrosion or deterioration by trapping moisture [1] • *OR* Expansion or construction joints are to be replaced and the steel is not to be repainted [1] • *OR* Prior to a detailed replacement [1] • *OR* In response to inspector's work recommendation [1]	2 years
Drainage System Clean-Out/Repair	• When drainage system is clogged with debris [1] • *OR* Drainage elements are broken, deteriorated, or damaged [1] • *OR* NBI rating comments for drainage system indicate need for cleaning or repair [1] [2]	2 years
Spot Repainting	• For zinc-based paint systems only. Do not spot paint with lead-based paints. • Less than 5% of paint area has failed in isolated areas [1] • *OR* In response to inspector's work recommendation [1]	5 years
Slope Paving Repair	• NBI rating is 5 or less for slope protection [1] [2] • *OR* Slope is degraded or sloughed • *OR* Slope paving has significant areas of distress, failure, or has settled [1]	
Riprap Installation	• To protect surface when erosion threatens the stability of side slopes of channel banks	
Vegetation Control	• When vegetation traps moisture on structural elements [1] • *OR* Vegetation is growing from joints or cracks [1] • *OR* In response to inspector's work recommendation for brush cut [1]	1 year
Debris Removal	• When vegetation, debris, or sediment accumulates on the structure or in the channel • *OR* In response to inspectors work recommendation	1 year
Deck Joint Repair	• Do not repair compression joint seals, assembly joint seals, steel armor expansions joints, and block out expansion joints; these should always be replaced. [1] • NBI rating is 5 for joint [1] [2] • *OR* In response to inspector's work recommendation for repair [1]	
Concrete Sealing	• Top surface of pier or abutments are below deck joints and, when contaminated with salt, salt can collect on the surface [1] • *OR* Surface of the concrete has heavy salt exposure. Horizontal surfaces of substructure elements are directly below expansion joints [1]	
Concrete Crack Sealing	• Concrete is in good or fair condition, and cracks extend to the depth of the steel reinforcement [1] • *OR* NBI rating of 5, 6, or 7 for deck surface, and deck surface has between 2% and 5% area with deficiencies [1] [2] • *OR* Unsealed cracks exist that are narrow and/or less than 1/8" wide and spaced more than 8' apart [1] • *OR* In response to inspector's work recommendation [1]	5 years
Minor Concrete Patching	• Repair minor delaminations and spalling that cover less than 30% of the concrete substructure [1]	

	• *OR* NBI rating of 5 or 4 for abutments or piers, and comments indicate that their surface has less than 30% spalling or delamination [1] [2] • *OR* Pontis rating of 3 or 4 for the column or pile extension, pier wall and/or abutment wall, and surface has between 2% and 30% area with deficiencies [1] [5] • *OR* In response to inspector's work recommendation [1]	
HMA Surface Repair/Replacement	• HMA surface is in poor condition • *OR* In response to inspector's work recommendation	
Seal HMA Cracks/Joints	• HMA surface is in good or fair condition, and cracks extend to the surface of the underlying slab or sub course • *OR* In response to inspector's work recommendation	
Timber Repair	• NBI rating of 4 or less for substructure for timber members • *OR* To repair extensive rot, checking, or insect infestation	
Miscellaneous Repair	• Uncategorized repairs in response to inspector's work recommendation	

This table was produced by TransSystems and includes information from the following sources:

[1] MDOT, *Project Scoping Manual*, MDOT, 2019.

[2] MDOT, *MDOT NBI Rating Guidelines*, MDOT, 2017.

[3] MDOT, *Bridge Deck Preservation Matrix - Decks with Uncoated "Black" Rebar*, MDOT, 2017.

[4] MDOT, *Bridge Deck Preservation Matrix - Decks with Epoxy Coated Rebar*, 2017.

[5] MDOT, *Pontis Bridge Inspection Manual*, MDOT, 2009.

* From source with interpretation added.

In terms of management and preservation actions, the City's asset management program uses a "mix of fixes" strategy that is made up of replacement.

Replacement involves substantial changes to the existing structure, such as bridge deck replacement, superstructure replacement, or complete structure replacement, and is intended to improve critical or closed bridges to a good condition rating.

Rehabilitation is undertaken to extend the service life of existing bridges. The work will restore deficient bridges to a condition of structural or functional adequacy, and may include upgrading geometric features. Rehabilitation actions are intended to improve the poor or fair condition bridges to fair or good condition.

Preventive maintenance work will improve and extend the service life of fair bridges, and will be performed with the understanding that future rehabilitation or replacement projects will contain appropriate safety and geometric enhancements. Preventive maintenance projects are directed at limited bridge elements that are rated in fair condition with the intent of improving these elements to a good rating. Most preventive maintenance projects will be one-time actions in response to a condition state need. Routine preventive work will be performed by contracted agencies.

The City's **scheduled maintenance** program is an integral part of the preservation plan, and is intended to extend the service life of fair and good structures by preserving the bridges in their

current condition for a longer period of time. Scheduled maintenance is proactive and not necessarily condition driven. In-house maintenance crews and contractors will perform work as necessary.

Replacement, rehabilitation, and preventive maintenance projects are not generally eligible for funding under the local bridge program, however any needs for funding will be programmed in the City of Muskegon's annual budget.

To achieve its goals, the City's asset management program incorporates preservation of bridges currently rated fair (5) or higher in their current condition in order to extend their useful service life. The primary work activities used to meet this preservation objective include preventive maintenance. A bridge-by-bridge maintenance plan is presented in the Appendix B-5.

Programmed/Funded Projects

The City received $250,000 from MDOT's *Local Bridge Program* towards Bridge #7700 Ottawa Street over the Muskegon River. The City has plans to remove this bridge in 2024. The City will provide a local match. The projected cost for this project is $500,000.

Planned Projects

The City is planning to remove Bridge #7699 along Amity Avenue and replace it with an at-grade crossing. This project has not received funding however the City will apply for MDOT's *Local Bridge Program Call for Projects* and include a local match. The projected cost for this work is $600,000

2. FINANCIAL RESOURCES

Anticipated Revenues

The City has programmed projects and has been granted MDOT Local Agency funding for the purpose of removal of Bridge #7700. This funding is intended for use in 2024.

The City plans to prepare and submit an application for MDOT Local Agency funding for the purpose of removing Bridge #7699. This funding would be intended for use in funding year 2026.

Anticipated Expenses

Scheduled maintenance activities and minor repairs that are not affiliated with any applications, grants, or other funded projects will be performed by the agency's in-house maintenance forces or hired contractors and are funded through the City's annual operating budget.

3. RISK MANAGEMENT

The City recognizes that the potential risks associated with bridges generally fall into several categories:

- Personal injury and property damage resulting from a bridge collapse or partial failure.
- Loss of access to a region or individual properties resulting from bridge closures, restricted load postings, or extended outages for rehabilitation and repair activities; and
- Delays, congestion, and inconvenience due to serviceability issues, such as poor-quality riding surface, loose expansion joints, or missing expansion joints.

The City addresses these risks by implementing regular bridge inspections and a preservation strategy consisting of preventive maintenance.

> The City administers the biennial inspection of its bridges in accordance with NBIS and MDOT requirements. The inspection reports document the condition of the City's bridges and evaluates them in order to identify new defects and monitor advancing deterioration. The inspection reports in Appendix B-6 identifies items needing follow-up, special inspection actions, and recommended bridge-by-bridge maintenance activities.

The City has no scour critical bridges. Bridges that are considered "scour critical" pose a risk to the City's road and bridge network. Scour is the depletion of sediment from around the foundation elements of a bridge commonly caused by fast-moving water. According to MDOT's *Michigan Structure Inventory and Appraisal Coding Guide*, a scour critical bridge is one that has unstable abutment(s) and/or pier(s) due to observed or potential (based on an evaluation study) scour. Bridges receiving a scour rating of 3 or less are considered scour critical.

The preservation strategy identifies actions in the operations and maintenance plan that are preventive or are responsive to specific bridge conditions. The actions are prioritized to correct critical structural safety and traffic issues first, and then to address other needs based on the operational importance of each bridge and the long-term preservation of the network. The inspection results serve as a basis for modifying and updating the operations and maintenance plan annually.

APPENDIX B-1 - Inventory

Inventory Data								Inspection Items										
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Structure Type Main Span (Item 43A - Material)	Structure Type Main Span (Item 43B)	Number of Main Span (Item 45)	Total Str Length (Item 49)	Total Str Width (Item 52)	Total Str (sq ft)	Initial Inspection	In Depth Steel Inspection	Pin and Hanger Inspection	Diving Inspection	Provide Monitoring	Review Scour Criticality	Load Rating	Update SIA
Concrete – Culvert	7698	614461800016B02	LAKESHORE DRIVE	RUDDIMAN CREEK	1	19	1	29.9	65.9	1970								
Steel continuous – Multistringer	7699	614461800071R01	AMITY ST	C O RAILROAD	4	2	5	100.7	31.8	3202								
Steel – Multistringer	7700	614461800205B01	OTTAWA ST	MUSKEGON RIVER S BRANCH	3	2	1	37.3	53.8	2007								

APPENDIX B-2 – Structure Condition Ratings

Inventory Data													
Bridge Type	**Structure Number**	**Bridge ID**	**Facility Carried**	**Features Intersected**	**Primary or Secondary Route**	**Structure Type Main Span (Item 43A - Material)**	**Structure Type Main Span (Item 43B)**	**Number of Main Span (Item 45)**	**Total Str Length (Item 49)**	**Year Built (Item 27)**	**Year Reconstr (Item 106)**	**ADT**	**Year of ADT**
Concrete – Culvert	7698	614461800016B02	LAKESHORE DRIVE	RUDDIMAN CREEK	P	1	19	1	29.9	1900	1986	12520	2002
Steel continuous – Multistringer	7699	614461800071R01	AMITY ST	C O RAILROAD	P	4	2	5	100.7	1900	1969	1972	2004
Steel – Multistringer	7700	614461800205B01	OTTAWA ST	MUSKEGON RIVER S BRANCH	P	3	2	1	37.3	1929		599	2002

Inspection Findings													
Bridge Type	**Structure Number**	**Inspection Date**	**Operational Status (Item 41)**	**Deck Rating (Item 58)**	**Deck Bottom Rating**	**SuperStr Rating (Item 59)**	**Substr Rating (Item 60)**	**Channel Rating (Item 61)**	**Culvert Rating (Item 62)**	**Surface Rating (Item 58A)**	**Paint Rtg**	**Exp Joint Rating**	**Other Joints**
Concrete – Culvert	7698	8/2/2020	A	N		N	N	7	7				
Steel continuous – Multistringer	7699	8/31/2021	A	5	5	4	6	N	N	4	4	4	4
Steel – Multistringer	7700	8/31/2021	K	3	4	1	5	5	N	4		N	N

Appraisal						
Bridge Type	**Structure Number**	**Structure Evaluation**	**Structurally Deficient**	**Sufficiency Rating**	**Section Loss**	**Scour Critical (Item 113)**
Concrete – Culvert	7698	G		95.4		5
Steel continuous – Multistringer	7699	P	Struct Def	47.5		N
Steel – Multistringer	7700	P	Struct Def			U

APPENDIX B-3 – Inspector Notes and Repair Recommendations

Jurisdiction: LA City - MUSKEGON

Report created on 08/15/2022

Structure #	BRKEY	Facility Carried	Features Intersected	Region	STRNO CS	INSPECTION DATE	Inspector Name	Joint Repair	Joint Repair Notes	Detailed Inspection	Detailed Inspection Notes	Slope Repair	Slope Repair Notes
7698	614461800016B02	LAKESHORE DRIVE	RUDDIMAN CREEK	Grand		8/26/2020	Ryan Worden			Medium	Watch gap at southside sheeting, and cracks in block retaining walls. Also watch cracking in arch legs at abutment	Medium	grout cracks in retaining walls.
7699	614461800071R01	AMITY ST	C O RAILROAD	Grand		8/31/2021	Ryan Worden	High	Replace joints			High	repair failing sheet walls and seal any wall gaps allowing erosion and settlement of approach sidewalk.
7700	614461800205B01	OTTAWA ST	MUSKEGON RIVER S BRANCH	Grand		8/31/2021	Ryan Worden						

Structure #	BRKEY	Brush Cut	Brush Cut Notes	Other Crew Work	Other Crew Work Notes	Bridge Replacement	Bridge Replacement Notes	Paint	Paint Notes	Deep Overlay	Deep Overlay Notes	Superstructure Repair	Superstructure Repair Notes	Other Contract	Other Contract Work Notes
7698	614461800016B02														
7699	614461800071R01	High	Cut brush around bridge	High	Remove the bridge is likely the best option since the crossing is no longer needed.			High	Full paint is needed on beams, piers remain okay.	High	Place concrete overlay	High	Repair beam ends	High	Remove the bridge is likely the best option since the crossing is no longer needed.
7700	614461800205B01					High	Beams and deck are too far gone to repair, replacement or removal is the best option.								

APPENDIX B-4 – Summary of Inspection Fix Recommendations

City of Muskegon Bridge Inspection Report Executive Summary

General Recommendations

- Structure #7698 - 2020
  -Watch gap at southside sheeting, watch cracks in block retaining walls and watch cracking in arch legs at abutments
  -Grout the cracks in the retaining walls
- Structure #7699 - 2021
  - Cut brush around bridge
  -Repair failing sheet walls and seal any wall gaps allowing erosion and settlement of approach sidewalk
  -Replace joints
  -Place concrete overlay
  -Full paint is needed on beams, piers remain okay
  -Repair beam ends
  -Remove the bridge is likely the best option since the crossing is no longer needed
  The plan is to remove this bridge.
- Structure #7700 - 2021
  -Beams and deck are too far gone to repair, replacement or removal is the best option
  The plan is to remove this bridge.

APPENDIX B-5 – Plans for Future Action

Inventory Data											Replacement			
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Structure Type Main Span (Item 43A - Material)	Structure Type Main Span (Item 43B)	Number of Main Span (Item 45)	Total Str Length (Item 49)	Total Str Width (Item 52)	Total Str (sq ft)	Total	Super-structure	Deck	Sub-structure
Concrete – Culvert	7698	614461800016B02	LAKESHORE DRIVE	RUDDIMAN CREEK	1	19	1	29.9	65.9	1970				
Steel continuous – Multistringer	7699	614461800071R01	AMITY ST	C O RAILROAD	4	2	5	100.7	31.8	3202	N/A - bridge set for removal in 2025			
Steel – Multistringer	7700	614461800205B01	OTTAWA ST	MUSKEGON RIVER S BRANCH	3	2	1	37.3	53.8	2007	N/A - bridge set for removal in 2024			

Rehabilitation													
Bridge Type	Structure Number	Bridge ID	Deep Overlay	Shallow Overlay	HMA Overlay w/ Membrane	HMA Cap	Replace/Retrofit Railing	Steel Beam Repairs	P/S Conc Beam Repairs	Repair/Replace Culvert	Repair/Replace Retaining Wall	Geometric Upgrades	Patch Substruct Concrete
Concrete – Culvert	7698	614461800016B02									Grout cracks		
Steel continuous – Multistringer	7699	614461800071R01	N/A - bridge set for removal in 2026										
Steel – Multistringer	7700	614461800205B01	N/A - bridge set for removal in 2024										

Proposed Preventive Maintenance											
Bridge Type	Structure Number	Bridge ID	Repair/Replace Deck	Repair/Replace Steel Bearings	Complete Painting	Zone Painting	Epoxy Overlays	HMA Cap w/o Membrane	Concrete Deck Patching	Channel Improvements	Scour Counter Measures
Concrete – Culvert	7698	614461800016B02									
Steel continuous – Multistringer	7699	614461800071R01	N/A - bridge set for removal in 2026								
Steel – Multistringer	7700	614461800205B01	N/A - bridge set for removal in 2024								

Proposed Scheduled Maintenance																	
Bridge Type	Structure Number	Bridge ID	Superstruc Washing	Concrete Surface Washing	Vegetation Control	Debris Removal	Clean Drainage System	Spot Painting	Repair/Replace HMA Surface	Seal HMA Cracks/Joints	Seal Concrete Cracks/Joints	Minor Concrete Patching	Timber Repairs	Repair/Replace Guardrails	Repave Approaches	Repair Slopes	Install RipRap
Concrete – Culvert	7698	614461800016B02															
Steel continuous – Multistringer	7699	614461800071R01	N/A - bridge set for removal in 2026														
Steel – Multistringer	7700	614461800205B01	N/A - bridge set for removal in 2024														

APPENDIX B-6 – Bridge Inspection Reports

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7698 — CULVERT SAFETY INSPECTION REPORT

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

CULVERT INSPECTION — OY0T

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
Ryan Worden	Scott Civil Engineering	24	08/26/2020

GENERAL NOTES

Good. New road section over culvert.

NBI INSPECTION

	08/16	08/18	08/20	
1. Culvert Rating (SIA-62)	8	7	7	(08/20) (08/18) (08/16)
2. Channel (SIA-61)	7	7	7	Riprap has been thrown into the stream to create weir, underwater at the time of the inspection. Higher water due to high lake level. (08/20) Riprap has been thrown into the stream to create weir, underwater at the time of the inspection. (08/18) riprap thrown into stream to create weir. (08/16)
3. Scour	8	8	8	none noted (08/20) none noted (08/18) none noted (08/16)

AASHTO ELEMENTS — (English Units)

Element Number	Element Name	Total Quantity	Unit	Good CS1	Fair CS2	Poor CS3	Severe CS4
Culvert							
241	Re Conc Culvert	98	ft	80	18	0	0
				82%	18%	0%	0%
Section 8S has small section of wire reinforcement exposed along south edge of west side of arch. Cracks noted along bottom of section 1S, 2S, & 4S at west abutment. New pavement, curbs, & sidwalks placed over culvert. Guardrails were replaced with architectural barricades.							
857	Culvert Joints	15	(EA)	15	0	0	0
				100%	0%	0%	0%
Joints remain good, no leakage noted							
861	Culvert Wingwall	4	(EA)	4	0	0	0
				100%	0%	0%	0%
fine vertical cracks noted. Some spalling of concrete footing under precast walls, SW & SE quads.							
862	Culvert Footing	196	ft	196	0	0	0
				100%	0%	0%	0%
footings remain buried, fine vertical cracks in stems below the precast arch sections.							
863	Culvert Headwall	2	(EA)	2	0	0	0
				100%	0%	0%	0%
Headwalls remain good. Some cracking in block retaining walls outside of wingwalls in each quadrant areas of settlement noted. Heavy vegetation covers sections of walls. Gaps in sheeting along retaining and wingwalls. SW sheeting gaps have been monitored, 1.5" at 9th sheeting corrugation and 1.375" at 6th corrugation, remains the same as 2018. The flange of SW wale is bent at tie-back rods, which have been present over many inspection cycles.							

STR 7698 CULVERT SAFETY INSPECTION REPORT

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

MISCELLANEOUS

Guard Rail

Item	Rating
36A. Bridge Railings	1
36B. Transitions	N
36C. Approach Guardrail	1
36D. Approach Guardrail Ends	N

Other Items

Item	Rating
71. Water Adequacy	8
72. Approach Alignment	8
Special Insp. Equipment	2
Underwater Insp. Method	1

RECOMMENDATIONS & ACTION ITEMS

Recommendation Type	Priority	Description
Detailed Insp.	M	Watch gap at southside sheeting, and cracks in block retaining walls. Also watch cracking in arch legs at abutment
Slope Repair	M	grout cracks in retaining walls.

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7698 — STRUCTURE INVENTORY AND APPRAISAL

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

Bridge History, Type, Materials

27 - Year Built	1900	
106 - Year Reconstructed	1986	
202 - Year Painted		
203 - Year Overlay		
43 - Main Span Bridge Type	1	19
44 - Appr Span Bridge Type		
77 - Steel Type	0	
78 - Paint Type	0	
79 - Rail Type	1	
80 - Post Type	0	
107 - Deck Type	1	
108A - Wearing Surface	6	
108B - Membrane	2	
108C - Deck Protection	1	

Structure Dimensions

34 - Skew	0
35 - Struct Flared	0
45 - Num Main Spans	1
46 - Num Apprs Spans	0
48 - Max Span Length	26.9
49 - Structure Length	29.9
50A - Width Left Curb/SW	5.9
50B - Width Right Curb/SW	5.9
33 - Median	0
51 - Width Curb to Curb	47.9
52 - Width Out to Out	65.9
112 - NBIS Length	Y

Inspection Data

90 - Inspection Date	08/26/2020	
91 - Inspection Freq	24	
92A - Frac Crit Req/Freq	N	
93A - Frac Crit Insp Date		
92B - Und Water Req/Freq	N	
93B - Und Water Insp Date		
92C - Oth Spec Insp Req/Freq	N	
93C - Oth Spec Insp Date		
92D - Fatigue Req/Freq	N	
93D - Fatigue Insp Date		
176A - Und Water Insp Method	1	
58 - Deck Rating	N	
58A/B - Deck Surface/Bottom		
59 - Superstructure Rating	N	
59A - Paint Rating		
60 - Substructure Rating	N	
61 - Channel Rating	7	
62 - Culvert Rating	7	

Navigation Data

38 - Navigation Control	0
39 - Vertical Clearance	0
40 - Horizontal Clearance	0
111 - Pier Protection	
116 - Lift Brdg Vert Clear	0

Route Carried By Structure(ON Record)

5A - Record Type	1	
5B - Route Signing	5	
5C - Level of Service	0	
5D - Route Number	02007	
5E - Direction Suffix	0	
10L - Best 3m Unclr-Lt	0	0
10R - Best 3m Unclr-Rt	99	99
PR Number		
Control Section		
11 - Mile Point	0	
12 - Base Highway Network	0	
13 - LRS Route-Subroute	0000008639 10	
19 - Detour Length	4	
20 - Toll Facility	3	
26 - Functional Class	16	
28A - Lanes On	3	
29 - ADT	12520	
30 - Year of ADT	2002	
32 - Appr Roadway Width	44	
32A/B - Ap Pvt Type/Width	4	44
42A - Service Type On	1	
47L - Left Horizontal Clear	0.0	
47R - Right Horizontal Clear	44.0	
53 - Min Vert Clr Ov Deck	99	99
100 - STRAHNET	0	
102 - Traffic Direct	2	
109 - Truck %	0	
110 - Truck Network	0	
114 - Future ADT	15100	
115 - Year Future ADT	2022	
Freeway	0	

Structure Appraisal

36A - Bridge Railing	1
36B - Rail Transition	N
36C - Approach Rail	1
36D - Rail Termination	N
67 - Structure Evaluation	7
68 - Deck Geometry	5
69 - Underclearance	N
71 - Waterway Adequacy	8
72 - Approach Alignment	8
103 - Temporary Structure	
113 - Scour Criticality	5

Miscellaneous

37 - Historical Significance	1
98A - Border Bridge State	
98B - Border Bridge %	
101 - Parallel Structure	N
EPA ID	
Stay in Place Forms	
143 - Pin & Hanger Code	
148 - No. of Pin & Hangers	

Route Under Structure (UNDER Record)

5A - Record Type		
5B - Route Signing		
5C - Level of Service		
5D - Route Number		
5E - Direction Suffix		
10L - Best 3m Unclr-Lt		
10R - Best 3m Unclr-Rt		
PR Number		
Control Section		
11 - Mile Point		
12 - Base Highway Network		
13 - LRS Route-Subroute		
19 - Detour Length		
20 - Toll Facility		
26 - Functional Class		
28B - Lanes Under		
29 - ADT		
30 - Year of ADT		
42B - Service Type Under	5	
47L - Left Horizontal Clear		
47R - Right Horizontal Clear		
54A - Left Feature		
54B - Left Underclearance	99	99
54C - Right Feature		
54D - Right Clearance	99	99
Under Clearance Year		
55A - Reference Feature	N	
55B - Right Horiz Clearance	99.9	
56 - Left Horiz Clearance	0	
100 - STRAHNET		
102 - Traffic Direct		
109 - Truck %		
110 - Truck Network		
114 - Future ADT		
115 - Year Future ADT		
Freeway		

Proposed Improvements

75 - Type of Work		
76 - Length of Improvement		
94 - Bridge Cost		
95 - Roadway Cost		
96 - Total Cost		
97 - Year of Cost Estimate		

Load Rating and Posting

31 - Design Load	5		
41 - Open, Posted, Closed	A		
63 - Fed Oper Rtg Method	0		
64F - Fed Oper Rtg Load	1.67		
64MA - Mich Oper Rtg Method	0		
64MB - Mich Oper Rtg	77		
64MC - Mich Oper Truck	18		
65 - Inv Rtg Method	0		
66 - Inventory Load	1		
70 - Posting	5		
141 - Posted Loading			
193 - Overload Class			N

STR 7698 SAFETY INSPECTION REPORT - AASHTO ELEMENTS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

NBI INSPECTION OY0T

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
Ryan Worden	Scott Civil Engineering	24	08/26/2020

AASHTO ELEMENTS (English Units)

Element Number	Element Name	Total Quantity	Unit	Good CS1	Fair CS2	Poor CS3	Severe CS4
Culvert							
241	Re Conc Culvert	98	ft	80	18	0	0
				82%	18%	0%	0%
Section 8S has small section of wire reinforcement exposed along south edge of west side of arch. Cracks noted along bottom of section 1S, 2S, & 4S at west abutment. New pavement, curbs, & sidwalks placed over culvert. Guardrails were replaced with architectural barricades.							
857	Culvert Joints	15	(EA)	15	0	0	0
				100%	0%	0%	0%
Joints remain good, no leakage noted							
861	Culvert Wingwall	4	(EA)	4	0	0	0
				100%	0%	0%	0%
fine vertical cracks noted. Some spalling of concrete footing under precast walls, SW & SE quads.							
862	Culvert Footing	196	ft	196	0	0	0
				100%	0%	0%	0%
footings remain buried, fine vertical cracks in stems below the precast arch sections.							
863	Culvert Headwall	2	(EA)	2	0	0	0
				100%	0%	0%	0%
Headwalls remain good. Some cracking in block retaining walls outside of wingwalls in each quadrant areas of settlement noted. Heavy vegetation covers sections of walls. Gaps in sheeting along retaining and wingwalls. SW sheeting gaps have been monitored, 1.5" at 9th sheeting corrugation and 1.375" at 6th corrugation, remains the same as 2018. The flange of SW wale is bent at tie-back rods, which have been present over many inspection cycles.							

STR 7698	WORK RECOMMENDATIONS		
Facility	**Latitude / Longitude**	**MDOT Structure ID**	**Structure Condition**
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

WORK RECOMMENDATIONS OY0T

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7698	**SCOUR CRITICAL BRIDGE ACTION PLAN**		
Facility	**Latitude / Longitude**	**MDOT Structure ID**	**Structure Condition**
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

No plan available for bridge key 614461800016B02

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7698 — LOAD RATING ASSUMPTIONS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

Rating Considers Field Condition of Members: Yes **Inspection Date:** 08/14/2012

Deterioration:

Hairline cracks in bottom of arch legs of several precast sections and minor spall of section 8S with exposed rebar

Most Recent Year Construct / Reconstruct / Overlay:

History of Work Impacting Load Rating:

no recent work known

Superstructure Component: 1 Concrete **Beam fy:** ksi **Beam f'c / fb:** ksi

Composite: No **Number of Beams:** **Shop Drawings Verified:** No

Beam Size(s) & Names (each span): Precast arch culvert

Deck: **Thickness (in.):** **Fy / f'c:** / ksi **Deck Design Load > H15:** No

Wearing Surface: **Mat'l:** **Thickness (in.):** **Unit Weight (pcf.):**

	LEFT	CENTER	RIGHT
Barrier: Type / Weight (plf.):	/	/	/
Sidewalk: Width / Thick (in.):	/	/	/

Clear Roadway (ft.):

Additional Loads:

Unique Factors That Affect Capacity:

HMA, curb and gutter, and sidewalk over precast arch culvert

Analyzed By: rtw **Date:** 08/20/2012

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7698 — LOAD RATING SUMMARY

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

Compliance Issue: None
Compliance Verified: No
Analysis Program: Other
Analysis Program Version: Inspection and shop drawing review, performance
Rating Considers Field Condition of Members: Yes **Inspection Date:** 08/14/2012
Controlling component and failure mode:

concrete precast arch overloading

NEW INVENTORY CODING

NBI Item 63 - Operating Rating Method 0 Judgment in Rtg Factor
NBI Item 64F - Federal Operating Ratings 1.67

MDOT Item 64MA - Michigan Operating Method 0 Judgment in Rtg Factor
MDOT Item 64MB - Michigan Operating Rating 77.0
MDOT Item 64MC - Michigan Operating Truck 18

NBI Item 65 - Inventory Rating Method 0 Judgment in Rtg Factor
NBI Item 66 - Federal Inventory Rating 1.0

NBI Item 41 - Structure Open Posted Closed A A Open, no restriction
NBI Item 70 - Bridge Posting 5 5 - 100% or more
Posted By No Posting
MDOT Item 141 - Posted Loading

MDOT Item 193A - Michigan Overload Class
MDOT Item 193C - Overload Status N-No Restriction

Analyzed By: rtw **Date:** 08/20/2012
Checked By: rwl **Date:** 08/20/2012

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7698	**REQUEST FOR ACTION**		
Facility	**Latitude / Longitude**	**MDOT Structure ID**	**Structure Condition**
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

No inspections available for bridge key 614461800016B02

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7698	OUTSTANDING WORK		
Facility	**Latitude / Longitude**	**MDOT Structure ID**	**Structure Condition**
LAKESHORE DRIVE	43.2182 / -86.2847	614461800016B02	Good Condition(7)
Feature	**Length / Width / Spans**	**Owner**	
RUDDIMAN CREEK	29.9 / 65.9 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.1 MI N OF ADDISON AVE	1900 / 1986 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	1 Concrete / 19 Culvert	08/26/2020 / OY0T	5 Stable w/in footing

WORK RECOMMENDATIONS

OTHER

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Slope Repair				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments

grout cracks in retaining walls. (Ryan Worden 08/28/2020)

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Detailed Insp.				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments

Watch gap at southside sheeting, and cracks in block retaining walls. Also watch cracking in arch legs at abutment (Ryan Worden 08/28/2020)

STR 7699 BRIDGE SAFETY INSPECTION REPORT

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.02 E OF MYRTLE AVE	1900 / 1969 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

NBI INSPECTION EP21

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
Ryan Worden	Scott Civil Engineering	12	08/31/2021

GENERAL NOTES

Poor. Remove overgrown trees from sidewalk areas and repair settled sidewalk sections. Repair west bearings and beam ends. Spalling with HMA patching continues to increase along the center of the bridge. Lots of trash along slopes, watch for broken glass. The homeless may be living at the west end.

DECK

	08/18	08/20	08/21	
1. Surface (SIA-58A)	5	5	4	The concrete deck has transverse cracks throughout the deck, spaced every 6'-10', approximately 14 cracks. Most spalls along the deck have been patched with HMA. Noted delaminated areas around spalled areas. Spalls scattered along the center 1/3rd, full length of the deck. Deck ends are spalled/patched at the reference lines and are leaking on the beam end below. Estimate middle 20% of the deck is spalled or delaminated. (08/21) The concrete deck has transverse cracks throughout the deck, spaced every 6'-10', approximately 14 cracks. Most spalls along the deck have been patched with HMA. Noted delaminated areas around spalled areas. Spalls scattered along the center 1/3rd, full length of the deck. Deck ends are spalled/patched at the reference lines and are leaking on the beam end below. (08/20) The concrete deck has transverse cracks throughout the deck, spaced every 6'-10'. Most spalls along the deck have been patched with HMA. Noted some delaminated areas around spalled areas. Spalls scattered along the centerline full length of the deck. (08/18)
2. Expansion Joints	4	4	4	Joints reference lines. Water flows under the cover plate onto beam ends. Loose cover plate at SW corner on sidewalk. Deck spalling along cover plates, worst at west joint. Bottom of joint retainers above beams have pack rust full width. (08/21) Joints reference lines. Water flows under the cover plate onto beam ends. Loose cover plate at SW corner on sidewalk. Deck spalling along cover plates, worst at west joint. (08/20) Joints reference lines. Water flows under the cover plate onto beam ends. Loose cover plate at SW corner on sidewalk. Deck spalling along cover plates, worst at west joint. (08/18)
3. Other Joints	5	4	4	Centerline construction joint spalling along the deck surface. (08/21) Centerline construction joint spalling along the deck surface. (08/20) Centerline construction joint has some spalling along the deck surface. (08/18)
4. Railings	5	5	5	3 tube aluminum, anchor bolts rusted. Missing anchor bolt at a post along south rail near the east end. (08/21) 3 tube aluminum, anchor bolts rusted. Missing anchor bolt at a post along south rail near the east end. (08/20) 3 tube aluminum, anchor bolts rusted. Missing anchor bolt at a post along south rail near the east end. (08/18)
5. Sidewalks or Curbs	5	5	5	Very narrow sidewalks. Some transverse cracking and spalls at the joints. Brush overgrown at the ends causes pedestrians to walk into the street. (08/21) Very narrow sidewalks. Some transverse cracking and spalls at the joints. Brush overgrown at the ends causes pedestrians to walk into the street. (08/20) Very narrow sidewalks. Some transverse cracking and spalls at the joints. Brush overgrown at the ends causes pedestrians to walk into the street. (08/18)
6. Deck Bottom Surface (SIA-58B)	5	5	5	Bottom of the deck has transverse cracks with efflorescence, more in center spans. Bottom of deck soffit has transverse cracks under each sidewalk spaced along the length of the deck. No deck bottom spalling. (08/21) Bottom of the deck has transverse cracks with efflorescence, more in center spans. Bottom of deck soffit cracked under sidewalks. (08/20) Bottom of the deck has transverse cracks with efflorescence, more in center spans. Bottom of deck soffit cracked under sidewalk joint. (08/18)

STR 7699 **BRIDGE SAFETY INSPECTION REPORT**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
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Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
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7. Deck (SIA-58)	5	5	5	Deck has full depth cracks, with spalled & delaminated concrete on top. Estimate 10% of deck spalled/delaminated. Some water is making its way through the cracks. with the presence of efflorescence, though the amount of build-up remains low, as does the adjacent beam deterioration. (08/21) Deck has full depth cracks, with spalled & delaminated concrete on top. Estimate 10% of deck spalled/delaminated. Water is making its way through the cracks. (08/20) Deck has full depth cracks, with spalled & delaminated concrete on top. Estimate 5% of deck spalled/patched. Water is making its way through the cracks. (08/18)
8. Drainage				off ends of the deck (08/21) off ends of deck (08/20) off ends (08/18)

SUPERSTRUCTURE

	08/18	08/20	08/21	
9. Stringer (SIA-59)	5	4	4	The end +/- 3' of beams at abutments are rusted from the leaking joints. The remaining length of the beams is in fair shape with light rust scale along flanges, particularly at deck cracks. East end of interior beams has rust scale under leaking joint, fascia beams have pack rust with section loss to bottom flange at north fascia. West beam ends have pack rust/ laminar rust to bottom flanges and heavy scale to webs and top flanges, full section loss has occurred to bottom flange at north fascia, beam 5S has holes in the top (1" dia.) and bottom of the web (3"x0.5"), Beam 4S has full loss to web beyond the bearing, Beam 3S has 3"x0.5" hole at bottom of web. West beam ends have the most section loss. (08/21) The end +/- 3' of beams at abutments are rusted with scale from the leaking joints. The remaining length of the beams is in good shape with light rust scale along flanges. East end of interior beams has rust scale under leaking joint, fascia beams have pack rust with section loss to bottom flange at north fascia. West beam ends have pack rust/ laminar rust to bottom flanges and heavy scale to webs and top flanges, full section loss has occurred to bottom flange at north fascia, beam 5S has holes in the top (1" dia.) and bottom of the web (3"x0.5"), Beam 4S has full loss to web beyond the bearing, Beam 3S has 3"x0.5" hole at bottom of web. (08/20) The end +/- 3' of beams at abuts are rusted with scale from leaking joint. The remaining length of the beams is in good shape. East end of beams has rust scale under leaking joint. West beam ends have pack rust/ laminar rust to bottom flanges and heavy scale to webs and top flanges. Section loss has occurred to bottom flanges at leaking deck cracks. Spot rusting at leaking cracks in center span. (08/18)
10. Paint (SIA-59A)	4	4	4	paint failed at beam ends and spot locations where cracks are leaking. (08/21) paint failed at beam ends and spot locations where cracks are leaking. (08/20) paint failed at beam ends and spot locations where cracks are leaking. (08/18)
11. Section Loss	2	0	0	Holes in webs Beam 3S, 4S, & 5S. North fascia has full section loss to edge of bottom flange at each end. (08/21) Holes in webs Beam 3S, 4S, & 5S. North fascia has full section loss to edge of bottom flange at each end. (08/20) estimate 5% or less loss under leaking cracks. West end loss estimated at 10%. (08/18)
12. Bearings	3	3	3	Wes tend bearings have laminar rust with section loss. Most bolts are gone. Anchor bolts in place at the east end with section loss. East end fascia bearing has heavy pack rust. (08/21) Westend bearings have laminar rust with section loss. Most bolts are gone. Anchor bolts in place at the east end with section loss. East end fascia bearing has heavy pack rust. (08/20) Westend bearings have laminar rust with section loss. Most bolts are gone. Anchor bolts in place at the east end. East end fascia bearing has heavy scale. (08/18)

SUBSTRUCTURE

	08/18	08/20	08/21

STR 7699 **BRIDGE SAFETY INSPECTION REPORT**

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Feature	**Length / Width / Spans**	**Owner**	
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Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
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13. Abutments (SIA-60)	7	7	7	footing exposed along west abutment, up to 14". No undermining noted. Lots of trash along slopes. (08/21) footing exposed along west abutment, up to 14". No undermining noted. (08/20) footing exposed along west abutment. No undermining noted. (08/18)
14. Piers (SIA-60)	6	6	6	Steel bent piers with minor rust. Some welded repairs to hole sway bracing to column connection. Lower lacing bars & plates were welded, one cut top of the column at pier 1E. Columns bolted to concrete foundations. Cap is bolted to columns. Pier 1W north support footing exposed 3". (08/21) Steel bent piers with minor rust. Some welded repairs to hole sway bracing to column connection. Lower lacing bars & plates were welded, one cut top of the column at pier 1E. Columns bolted to concrete foundations. Cap is bolted to columns. Pier 1W north support footing exposed 3". (08/20) Steel bent piers with minor rust. Some welded repairs to hole sway bracing to column connection. Some lower lacing bars were welded, one cut top of the column at pier 1E. Columns bolted to concrete foundations. Cap is bolted to columns. (08/18)
15. Slope Protection	N	N	N	(08/21) (08/20) (08/18)
16. Channel (SIA-61)	N	N	N	(08/21) Over abandoned railroad. (08/20) Over abandoned railroad. (08/18)
17. Scour Inspection	N	N	N	(08/21) N/A (08/20) N/A (08/18)

APPROACH

	08/18	08/20	08/21	
18. Approach Pavement	5	5	5	HMA with cracks. Some wedging at abutment reference lines. (08/21) HMA with cracks sealed. Some wedging at abutment reference lines. (08/20) HMA with cracks sealed. Some wedging at abutment reference lines. (08/18)
19. Approach Shoulders Sidewalks	3	3	2	NW sidewalk has 3" settlement with additional loss of fill and animal hole under approach sidewalk, NE sidewalk has asphalt wedging. SE quad continues to erode from behind steel sheeting wall sidewalk settled more since the last inspection, the adjacent curb has also settled. Both southside sidewalks are undermined. Approach C&G has settled. The exposed slope in the NW & SE quad need a safety rail. (08/21) NW sidewalk has 3" settlement with additional loss of fill and animal hole under approach sidewalk, NE sidewalk has asphalt wedging. SE quad continues to erode from behind steel sheeting wall sidewalk settled more since the last inspection, the adjacent curb has also settled. Both southside sidewalks are undermined. Approach C&G has settled. The exposed slope in the NW & SE quad need a safety rail. (08/20) NW sidewalk has 3" settlement, NE sidewalk has asphalt wedging. SE quad continues to erode from behind steel sheeting wall sidewalk settled more since last inspection, the adjacent curb has also settled. Both southside sidewalks are undermined. Approach C&G has settled. Exposed slope in the NW & SE quad need a safety rail. (08/18)
20. Approach Slopes				Slopes are vegetated. Steel sheeting in NW & SE quads are rusted and leaning outward. SE quad soil behind the sheeting has settled. Holes in SE sheeting allowing the soil to wash from under sidewalk. Trees and brush overgrowing sidewalk in each quad cause pedestrians to walk into the street. (08/21) Slopes are vegetated. Steel sheeting in NW & SE quads are rusted and leaning outward. SE quad soil behind the sheeting has settled. Holes in SE sheeting allowing the soil to wash from under sidewalk. Trees and brush overgrowing sidewalk in each quad cause pedestrians to walk into the street. (08/20) Slopes are vegetated. Steel sheeting in NW & SE quads are rusted and leaning outward. SE quad soil behind the sheeting has settled. Holes in SE sheeting allowing the soil to wash from under sidewalk. Trees and brush overgrowing sidewalk in each quad cause pedestrians to walk into the street. (08/18)

STR 7699 **BRIDGE SAFETY INSPECTION REPORT**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
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Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

21. Utilities	None noted (08/21) None noted (08/20) None noted (08/18)
22. Drainage Culverts	none noted (08/21) none noted (08/20) none noted (08/18)

MISCELLANEOUS

Guard Rail

Item	Rating
36A. Bridge Railings	0
36B. Transitions	0
36C. Approach Guardrail	0
36D. Approach Guardrail Ends	0

Other Items

Item	Rating
71. Water Adequacy	N
72. Approach Alignment	4
Temporary Support	0 No Temporary Supports
High Load Hit (M)	No
Special Insp. Equipment	
Underwater Insp. Method	0

False Decking (Timber) Removed to Complete Inspection N/A - No False Decking

Critical Feature Inspections (SIA-92)

	Freq	Date
92A. Fracture Critical		
92B. Underwater		
92C. Other Special		
92D. Fatigue Sensitive		

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7699 **STRUCTURE INVENTORY AND APPRAISAL**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.02 E OF MYRTLE AVE	1900 / 1969 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

Bridge History, Type, Materials

27 - Year Built	1900	
106 - Year Reconstructed	1969	
202 - Year Painted		
203 - Year Overlay		
43 - Main Span Bridge Type	4	02
44 - Appr Span Bridge Type		
77 - Steel Type	2	
78 - Paint Type	0	
79 - Rail Type	3	
80 - Post Type	0	
107 - Deck Type	1	
108A - Wearing Surface	1	
108B - Membrane	0	
108C - Deck Protection	0	

Structure Dimensions

34 - Skew	0
35 - Struct Flared	N
45 - Num Main Spans	5
46 - Num Apprs Spans	0
48 - Max Span Length	28.9
49 - Structure Length	100.7
50A - Width Left Curb/SW	3
50B - Width Right Curb/SW	3
33 - Median	0
51 - Width Curb to Curb	24
52 - Width Out to Out	31.8
112 - NBIS Length	Y

Inspection Data

90 - Inspection Date	08/31/2021	
91 - Inspection Freq	12	
92A - Frac Crit Req/Freq	N	
93A - Frac Crit Insp Date		
92B - Und Water Req/Freq	N	
93B - Und Water Insp Date		
92C - Oth Spec Insp Req/Freq	N	
93C - Oth Spec Insp Date		
92D - Fatigue Req/Freq	N	
93D - Fatigue Insp Date		
176A - Und Water Insp Method	0	
58 - Deck Rating	5	
58A/B - Deck Surface/Bottom	4	5
59 - Superstructure Rating	4	
59A - Paint Rating	4	
60 - Substructure Rating	6	
61 - Channel Rating	N	
62 - Culvert Rating	N	

Navigation Data

38 - Navigation Control	N
39 - Vertical Clearance	0
40 - Horizontal Clearance	0
111 - Pier Protection	
116 - Lift Brdg Vert Clear	0

Route Carried By Structure(ON Record)

5A - Record Type	1	
5B - Route Signing	5	
5C - Level of Service	0	
5D - Route Number	00000	
5E - Direction Suffix	0	
10L - Best 3m Unclr-Lt	0	0
10R - Best 3m Unclr-Rt	99	99
PR Number		
Control Section		
11 - Mile Point	0	
12 - Base Highway Network	0	
13 - LRS Route-Subroute	0000008658 09	
19 - Detour Length	3	
20 - Toll Facility	3	
26 - Functional Class	19	
28A - Lanes On	2	
29 - ADT	1972	
30 - Year of ADT	2004	
32 - Appr Roadway Width	29.9	
32A/B - Ap Pvt Type/Width	5	29.99
42A - Service Type On	1	
47L - Left Horizontal Clear	0.0	
47R - Right Horizontal Clear	24.0	
53 - Min Vert Clr Ov Deck	99	99
100 - STRAHNET	0	
102 - Traffic Direct	2	
109 - Truck %	0	
110 - Truck Network	0	
114 - Future ADT	2009	
115 - Year Future ADT	2024	
Freeway	0	

Structure Appraisal

36A - Bridge Railing	0
36B - Rail Transition	0
36C - Approach Rail	0
36D - Rail Termination	0
67 - Structure Evaluation	4
68 - Deck Geometry	4
69 - Underclearance	4
71 - Waterway Adequacy	N
72 - Approach Alignment	4
103 - Temporary Structure	
113 - Scour Criticality	N

Miscellaneous

37 - Historical Significance	5
98A - Border Bridge State	
98B - Border Bridge %	
101 - Parallel Structure	N
EPA ID	
Stay in Place Forms	
143 - Pin & Hanger Code	
148 - No. of Pin & Hangers	

Route Under Structure (UNDER Record)

5A - Record Type		
5B - Route Signing		
5C - Level of Service		
5D - Route Number		
5E - Direction Suffix		
10L - Best 3m Unclr-Lt		
10R - Best 3m Unclr-Rt		
PR Number		
Control Section		
11 - Mile Point		
12 - Base Highway Network		
13 - LRS Route-Subroute		
19 - Detour Length		
20 - Toll Facility		
26 - Functional Class		
28B - Lanes Under		
29 - ADT		
30 - Year of ADT		
42B - Service Type Under	2	
47L - Left Horizontal Clear		
47R - Right Horizontal Clear		
54A - Left Feature		
54B - Left Underclearance	99	99
54C - Right Feature		
54D - Right Clearance	99	99
Under Clearance Year		
55A - Reference Feature	R	
55B - Right Horiz Clearance	99.9	
56 - Left Horiz Clearance	0	
100 - STRAHNET		
102 - Traffic Direct		
109 - Truck %		
110 - Truck Network		
114 - Future ADT		
115 - Year Future ADT		
Freeway		

Proposed Improvements

75 - Type of Work		
76 - Length of Improvement		
94 - Bridge Cost		
95 - Roadway Cost		
96 - Total Cost		
97 - Year of Cost Estimate		

Load Rating and Posting

31 - Design Load	5
41 - Open, Posted, Closed	A
63 - Fed Oper Rtg Method	1
64F - Fed Oper Rtg Load	52.8
64MA - Mich Oper Rtg Method	1
64MB - Mich Oper Rtg	77.5
64MC - Mich Oper Truck	18
65 - Inv Rtg Method	1
66 - Inventory Load	31.6
70 - Posting	5
141 - Posted Loading	
193 - Overload Class	N

STR 7699	SAFETY INSPECTION REPORT - AASHTO ELEMENTS		
Facility	**Latitude / Longitude**	**MDOT Structure ID**	**Structure Condition**
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.02 E OF MYRTLE AVE	1900 / 1969 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

No inspections available for bridge key 614461800071R01

STR 7699 WORK RECOMMENDATIONS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
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Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

WORK RECOMMENDATIONS EP21

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
Ryan Worden	Scott Civil Engineering	12	08/31/2021

RECOMMENDATIONS & ACTION ITEMS

Recommendation Type	Priority	Description
Brush Cut	H	Cut brush around bridge
Slope Repair	H	repair failing sheet walls and seal any wall gaps allowing erosion and settlement of approach sidewalk.
Joint Repair	H	Replace joints
Deep Overlay	H	Place concrete overlay
Full Paint	H	Full paint is needed on beams, piers remain okay.
Super Repair	H	Repair beam ends
Other	H	Remove the bridge is likely the best option since the crossing is no longer needed.

STR 7699	SCOUR CRITICAL BRIDGE ACTION PLAN		
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Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

No plan available for bridge key 614461800071R01

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7699 — LOAD RATING ASSUMPTIONS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
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C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
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Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

Rating Considers Field Condition of Members: Yes **Inspection Date:** 08/14/2012

Deterioration:

Beam end corrosion and spot rusting of away from ends

Most Recent Year Construct / Reconstruct / Overlay: 1969

History of Work Impacting Load Rating:

Does not appear any work has been done since it was built.

Superstructure Component: 4 Steel Continuous **Beam fy:** **ksi** **Beam f'c / fb:** 36.0 **ksi**

Composite: Yes **Number of Beams:** 10 **Shop Drawings Verified:** No

Beam Size(s) & Names (each span): W 12 x 53

Deck: **Thickness (in.):** 9.0 **Fy / f'c:** 60.0 / 4.0 ksi **Deck Design Load > H15:** Yes

Wearing Surface: **Mat'l:** NA **Thickness (in.):** **Unit Weight (pcf.):**

	LEFT	CENTER	RIGHT
Barrier: Type / Weight (plf.):	3 tube/SW / 999.0	/	3 tube/SW / 999.0
Sidewalk: Width / Thick (in.):	/	/	/

Clear Roadway (ft.): 24.0

Additional Loads:

Sidewalk included in railing wt

Unique Factors That Affect Capacity:

Analyzed By: RTW **Date:** 08/20/2012

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7699 — LOAD RATING SUMMARY

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.02 E OF MYRTLE AVE	1900 / 1969 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

Compliance Issue: None
Compliance Verified: No
Analysis Program: Hand Calculations
Analysis Program Version: MCAd
Rating Considers Field Condition of Members: Yes **Inspection Date:** 08/14/2012
Controlling component and failure mode:

Beam moment controls

NEW INVENTORY CODING

NBI Item 63 - Operating Rating Method 1 LFR in US tons
NBI Item 64F - Federal Operating Ratings 52.8

MDOT Item 64MA - Michigan Operating Method 1 LFR in US Tons
MDOT Item 64MB - Michigan Operating Rating 77.5
MDOT Item 64MC - Michigan Operating Truck 18

NBI Item 65 - Inventory Rating Method 1 LFR in US tons
NBI Item 66 - Federal Inventory Rating 31.6

NBI Item 41 - Structure Open Posted Closed A A Open, no restriction
NBI Item 70 - Bridge Posting 5 5 - 100% or more
Posted By No Posting
MDOT Item 141 - Posted Loading

MDOT Item 193A - Michigan Overload Class
MDOT Item 193C - Overload Status N-No Restriction

Analyzed By: RTW **Date:** 08/20/2012
Checked By: RWL **Date:** 08/20/2012

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7699	REQUEST FOR ACTION		
Facility	**Latitude / Longitude**	**MDOT Structure ID**	**Structure Condition**
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.02 E OF MYRTLE AVE	1900 / 1969 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

No inspections available for bridge key 614461800071R01

STR 7699 **OUTSTANDING WORK**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.02 E OF MYRTLE AVE	1900 / 1969 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

WORK RECOMMENDATIONS

DECKS/SLABS

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Deep Overlay				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments
Place concrete overlay (Ryan Worden 09/01/2021)

JOINTS

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Joint Repair				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments
Replace joints (Ryan Worden 09/01/2021)

SUPERSTRUCTURE

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Super Repair				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments
Repair beam ends (Ryan Worden 09/01/2021)

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Full Paint				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments
Full paint is needed on beams, piers remain okay. (Ryan Worden 09/01/2021)

OTHER

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Brush Cut				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments

STR 7699 OUTSTANDING WORK

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
AMITY ST	43.2361 / -86.2394	614461800071R01	Poor Condition(4)
Feature	**Length / Width / Spans**	**Owner**	
C O RAILROAD	100.7 / 31.8 / 5	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.02 E OF MYRTLE AVE	1900 / 1969 / /	Muskegon(21)	A Open, no restriction(A)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	4 Steel Continuous / 02 Multi Str Non Comp	08/31/2021 / EP21	N Not Over Waterway

Cut brush around bridge (Ryan Worden 09/01/2021)

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Slope Repair				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments

repair failing sheet walls and seal any wall gaps allowing erosion and settlement of approach sidewalk. (Ryan Worden 09/01/2021)

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Other				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments

Remove the bridge is likely the best option since the crossing is no longer needed. (Ryan Worden 09/01/2021)

STR 7700 BRIDGE SAFETY INSPECTION REPORT

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

NBI INSPECTION CF8H

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
Ryan Worden	Scott Civil Engineering	12	08/31/2021

GENERAL NOTES

Bridge has been closed. Concrete barrier was placed across each approach. Changed frequency back to 12 months since it is closed.

Weight limit signs in place on both ends of bridge	NO
Required advance warning weight limit signs in place	NO

DECK

	10/20	04/21	08/21	
1. Surface (SIA-58A)	5	5	4	HMA cracks thoughout with active leakage through the deck. Vegetation growing along sidewalks and within HMA cracks. Heavy HMA alligator cracking along reference lines. (08/21) HMA cracks thoughout with active leakage through the deck. Vegetation growing along sidewalks. Heavy HMA alligator cracking along reference lines. (04/21) HMA cracks thoughout, past crack sealing no longer effective as water continues to leak through the deck. Vegetation growing along sidewalks. Heavy HMA alligator cracking along reference lines. (10/20)
2. Expansion Joints	N	N	N	(08/21) (04/21) (10/20)
3. Other Joints	N	N	N	(08/21) (04/21) (10/20)
4. Railings	5	5	5	Rails appear to be precast with visible joints at the posts. Concrete railings have spalled sections with rusting smooth surface reinforcing bars. More spalling along the east railing top horizontal member. One spot on the west. (08/21) Rails appear to be precast with visible joints at the posts. Concrete railings have spalled sections with rusting smooth surface reinforcing bars. More spalling along the east railing top horizontal member. One spot on the west. (04/21) Rails appear to be precast with visible joints at the posts. Concrete railings have spalled sections with rusting smooth surface reinforcing bars. More spalling along the east railing top section. One spot on the west. (10/20)
5. Sidewalks or Curbs	5	5	4	Sidewalks are cracked with many small popouts. No approach sidewalk in any quad. SW sidewalk has an exposed edge and has undermined cause the sidewalk to settle. Spalls noted along the west sidewalk face. Trees and weeds growing in joints. (08/21) Sidewalks are cracked with many small popouts. No approach sidewalk in any quad. SW sidewalk has exposed edge and has undermined cause the sidewalk to settle. Spalls noted along the west sidewalk face. (04/21) Sidewalks are cracked with many small popouts. No approach sidewalk. SW sidewalk has exposed edge and has undermined cause the sidewalk to settle. Spalls noted along the west sidewalk face. (10/20)

STR 7700 **BRIDGE SAFETY INSPECTION REPORT**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

6. Deck Bottom Surface (SIA-58B)	4	4	4	All bays, deck actively leaking along all beam top flanges, also hairline cracks in every bay. Efflorescence buildup on beams bottom flanges with long stalactites along the deck bottom, up to 1.5ft long. Bay 6W has spalls/popouts with exposed steel along the length. Spalling and exposed resteel around scuppers. Active leakage through deck cracks even after days without rain. (08/21) All bays, deck actively leaking along all beam top flanges, also hairline cracks in every bay. Efflorescence buildup on beams bottom flanges with long stalactites along the deck bottom, up to 1.5ft long. Bay 6W has spalls/popouts with exposed steel along the length. Spalling and exposed resteel around scuppers. (04/21) All bays, deck actively leaking along all beam top flanges, also hairline cracks in every bay. Efflorescence buildup on beams bottom flanges with long stalactites along the deck bottom, up to 1.5ft long. Bay 6W has spalls/popouts with exposed steel along the length. Spalling and exposed resteel around scuppers. (10/20)
7. Deck (SIA-58)	4	4	3	Many HMA cracks along the surface. Full depth deck cracks are leaking throughout. Noted cracking in every bay in bottom of deck. Efflorescence throughout. Bay 6W having spalls with exposed steel and delaminated concrete. Deck fascia spalled along bottom south side. Spalling around deck drains. (08/21) Many HMA cracks along the surface. Full depth deck cracks are leaking throughout. Noted cracking in every bay in bottom of deck. Efflorescence throughout. Bay 6W having spalls with exposed steel and delaminated concrete. Deck fascia spalled along bottom south side. Spalling around deck drains. (04/21) Many HMA cracks along the surface, sealant no longer effective. Noted cracking in every bay in bottom of deck. Efflorescence throughout. Bay 6W having spalls with exposed steel and delaminated concrete. Deck fascia spalled along bottom south side. Spalling around deck drains. Active leakage throughout. (10/20)
8. Drainage				poor, scuppers plugged, deck profile is flat. (08/21) poor, scuppers plugged, deck profile is flat. (04/21) poor, scuppers plugged, deck profile is level (10/20)

SUPERSTRUCTURE

	10/20	04/21	08/21

STR 7700 **BRIDGE SAFETY INSPECTION REPORT**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

9. Stringer (SIA-59)	2	2	1	Water continues to penetrate the deck and pack rust continues to grow. All beams are rusted with scale, heavy scale at concrete diaphragms. 6 east beams are the worst with heavy scale along bottom flange. Beam 2E bottom web hole 4.5ft long at the south end. Beam 3E & 4E are considered failed likely holes full length, thus the northbound lane has been closed. Beam 3W has heavy pack rust along bottom of the web with section loss at both ends, north end web is very thin above the bottom flange. Beam 4W near north abutment has a hole along bottom of the web 5ft x 1". Beams 1W,2W,5W&6W have lighter rusting with pack rust forming at backwalls. Concrete diaphragms are cracked and spalled, bottom of west side diaphragms nearly gone with exposed rebar. Many acts as a sponge with water seeping out of cracks when hit with a hammer. Closed bridge due to severe steel deterioration. (08/21) Water continues to penetrate the deck and pack rust continues to grow. All beams are rusted with scale, heavy scale at concrete diaphragms. 6 east beams are the worst with heavy scale along bottom flange. Beam 2E bottom web hole 4.5ft long at the south end. Beam 3E & 4E are considered failed likely holes full length, thus the northbound lane has been closed. Beam 3W has heavy pack rust along bottom of the web with section loss at both ends, north end web is very thin above the bottom flange. Beam 4W near north abutment has a hole along bottom of the web 5ft x 1". Beams 1W,2W,5W&6W have lighter rusting with pack rust forming at backwalls. Concrete diaphragms are cracked and spalled, bottom of west bay diaphragm nearly gone with exposed rebar. Many acts as a sponge with water seeping out of cracks when hit with a hammer. (04/21) Water continues to penetrate the deck and pack rust continues to grow. All beams are rusted with scale, heavy scale at concrete diaphragms. 6 east beams are the worst with heavy scale along bottom flange. Beam 2E bottom web hole 4.5ft long at the south end. Beam 3E & 4E are considered failed likely holes full length, thus northbound lane has been closed. Beam 3W has heavy pack rust along bottom of the web with section loss at both ends, north end web is very thin above the bottom flange. Beam 4W near north abutment has a hole along bottom of the web 5ft x 1". Beams 1W,2W,5W&6W have lighter rusting with pack rust forming at backwalls. Concrete diaphragms are cracked and spalled, bottom of west bay diaphragm nearly gone with exposed rebar. Many act as a sponge with water flowing out of cracks when hit with a hammer. (10/20)
10. Paint (SIA-59A)	0	0	0	20% of the paint is left of the total beam area. (08/21) 30-40% of the paint is left of the total beam area. (04/21) little paint left (10/20)
11. Section Loss	0	0	0	Holes in webs of B2E-B4E. 25% loss of section on B5E. Holes in 4W north end, 5ft section. (08/21) Holes in webs of B2E-B4E. 25% loss of section on B5E. Holes in 4W north end, 5ft section. (04/21) Holes in webs of B2E-B4E. 25% loss of section on B5E. Holes in 4W north end, 5ft section. (10/20)
12. Bearings	5	5	4	Continue to rust mostly embedded in backwalls (08/21) Continue to rust mostly embedded in backwalls (04/21) Continue to rust mostly embedded in backwalls (10/20)

SUBSTRUCTURE

	10/20	04/21	08/21

STR 7700 **BRIDGE SAFETY INSPECTION REPORT**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

13. Abutments (SIA-60)	5	5	5	Existing plans were found at the City. Abutments are on timber piles with steel sheeting toed approximately 29ft below first concrete ledge above the water level. Steel sheet piling has uniform light rust scale above the water. The cantilever sidwalk design does a poor job of holding the approach slopes. South beam seat spalled under beam 3E with rusting rebar. Rust staining and efflorescence from leaking deck. (08/21) Existing plans were found at the City. Abutments are on timber piles with steel sheeting toed approximately 29ft below first concrete ledge above the water level. Steel sheet piling has uniform light rust scale above the water. The cantilever sidwalk design does a poor job of holding the approach slopes. South beam seat spalled under beam 3E with rusting rebar. Rust staining and efflorescence from leaking deck. (04/21) Existing plans were found at the City. Abutments are on timber piles with steel sheeting toed approximately 29ft below first concrete ledge above the water level. Steel sheet piling is rusting, remains underwater with the high lake level. The cantilever design does a poor job of holding the approach slopes and sidewalk. South beam seat spalled under beam 3E with rusting rebar. Rust staining and efflorescence from leaking deck. (10/20)
14. Piers (SIA-60)	N	N	N	(08/21) (04/21) (10/20)
15. Slope Protection	N	N	N	(08/21) (04/21) (10/20)
16. Channel (SIA-61)	5	5	5	Bridge is too small and has poor alignment with stream. Banks are stable. Sand bottom. Flow velocity has increased with the lower lake level. (08/21) Bridge is too small and has poor alignment with stream. Lake level has dropped. Banks are stable. Sand bottom. (04/21) Bridge is too small and has poor alignment with stream. High lake level has slowed the flow through the opening. Banks are stable with water level outside of normal lake level conditions. (10/20)
17. Scour Inspection	5	5	5	Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge. Left Item #113 as is. Channel bottom is deeper under the bridge than downstream. No issues with the sheeting noted. (08/21) Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge. Left Item #113 as is. Channel bottom is deeper under the bridge than downstream. No issues with the sheeting noted. (04/21) Slower velocity helps to stabilize the sand bottom. Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge. (10/20)

APPROACH

	10/20	04/21	08/21	
18. Approach Pavement	5	5	5	Cracks in HMA, 1/2" or less of settlement at abutments, sealant no longer effective. Trees and weeds growing out of cracks along reference lines. (08/21) Cracks in HMA, 1/2" or less of settlement at abutments, sealant no longer effective. (04/21) Cracks in HMA, some settlement at abutments, sealant no longer effective. (10/20)
19. Approach Shoulders Sidewalks	N	N	N	No approach sidewalk beyond the bridge. In the past, a piece of sidewalk was present at the bridge only. (08/21) No approach sidewalk beyond the bridge. In the past, a piece of sidewalk was present at the bridge only. (04/21) No approach sidewalk beyond the bridge. In the past, a piece of sidewalk was present at the bridge only. (10/20)
20. Approach Slopes				slopes look stable with vegetation growth within older erosion areas. No approach railing. (08/21) slopes look stable with vegetation growth within older erosion areas. No approach railing. (04/21) slopes look stable with vegetation growth within older erosion areas. No approach railing. (10/20)

STR 7700 BRIDGE SAFETY INSPECTION REPORT

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
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Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

21. Utilities
Comcast conduit attached to the east railing. Overhead electric and communications. (08/21)
Comcast conduit attached to the east railing. Overhead electric and communications. (04/21)
newer Comcast conduit attached to the east railing. Overhead electric and communications. (10/20)

22. Drainage
Culverts
none noted (08/21)
none noted (04/21)
none noted (10/20)

MISCELLANEOUS

Guard Rail

Item	Rating
36A. Bridge Railings	0
36B. Transitions	0
36C. Approach Guardrail	0
36D. Approach Guardrail Ends	0

Other Items

Item	Rating
71. Water Adequacy	3
72. Approach Alignment	8
Temporary Support	0 No Temporary Supports
High Load Hit (M)	No
Special Insp. Equipment	1
Underwater Insp. Method	2

False Decking (Timber) Removed to Complete Inspection N/A - No False Decking

Critical Feature Inspections (SIA-92)

	Freq	Date
92A. Fracture Critical		
92B. Underwater		
92C. Other Special		
92D. Fatigue Sensitive		

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7700 — STRUCTURE INVENTORY AND APPRAISAL

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

Bridge History, Type, Materials

27 - Year Built	1929	
106 - Year Reconstructed		
202 - Year Painted		
203 - Year Overlay		
43 - Main Span Bridge Type	3	02
44 - Appr Span Bridge Type		
77 - Steel Type	2	
78 - Paint Type	9	
79 - Rail Type	7	
80 - Post Type		
107 - Deck Type	1	
108A - Wearing Surface	6	
108B - Membrane	0	
108C - Deck Protection	0	

Structure Dimensions

34 - Skew	0
35 - Struct Flared	N
45 - Num Main Spans	1
46 - Num Apprs Spans	0
48 - Max Span Length	35.8
49 - Structure Length	37.3
50A - Width Left Curb/SW	5.9
50B - Width Right Curb/SW	5.9
33 - Median	0
51 - Width Curb to Curb	40
52 - Width Out to Out	53.8
112 - NBIS Length	Y

Inspection Data

90 - Inspection Date	08/31/2021	
91 - Inspection Freq	12	
92A - Frac Crit Req/Freq	N	
93A - Frac Crit Insp Date		
92B - Und Water Req/Freq	N	
93B - Und Water Insp Date		
92C - Oth Spec Insp Req/Freq	N	
93C - Oth Spec Insp Date		
92D - Fatigue Req/Freq	N	
93D - Fatigue Insp Date		
176A - Und Water Insp Method	2	
58 - Deck Rating	3	
58A/B - Deck Surface/Bottom	4	4
59 - Superstructure Rating	1	
59A - Paint Rating	0	
60 - Substructure Rating	5	
61 - Channel Rating	5	
62 - Culvert Rating	N	

Navigation Data

38 - Navigation Control	0
39 - Vertical Clearance	0
40 - Horizontal Clearance	0
111 - Pier Protection	
116 - Lift Brdg Vert Clear	0

Route Carried By Structure(ON Record)

5A - Record Type	1	
5B - Route Signing	5	
5C - Level of Service	0	
5D - Route Number	00000	
5E - Direction Suffix	0	
10L - Best 3m Unclr-Lt	0	0
10R - Best 3m Unclr-Rt	99	99
PR Number		
Control Section		
11 - Mile Point	0	
12 - Base Highway Network	0	
13 - LRS Route-Subroute	0000036114 85	
19 - Detour Length	2	
20 - Toll Facility	3	
26 - Functional Class	19	
28A - Lanes On	2	
29 - ADT	599	
30 - Year of ADT	2002	
32 - Appr Roadway Width	40	
32A/B - Ap Pvt Type/Width	5	39.99
42A - Service Type On	1	
47L - Left Horizontal Clear	0.0	
47R - Right Horizontal Clear	39.7	
53 - Min Vert Clr Ov Deck	99	99
100 - STRAHNET	0	
102 - Traffic Direct	2	
109 - Truck %	0	
110 - Truck Network	0	
114 - Future ADT	1000	
115 - Year Future ADT	2022	
Freeway	0	

Structure Appraisal

36A - Bridge Railing	0
36B - Rail Transition	0
36C - Approach Rail	0
36D - Rail Termination	0
67 - Structure Evaluation	2
68 - Deck Geometry	8
69 - Underclearance	N
71 - Waterway Adequacy	3
72 - Approach Alignment	8
103 - Temporary Structure	
113 - Scour Criticality	U

Miscellaneous

37 - Historical Significance	1	
98A - Border Bridge State		
98B - Border Bridge %		
101 - Parallel Structure	N	
EPA ID		
Stay in Place Forms		
143 - Pin & Hanger Code		
148 - No. of Pin & Hangers		

Route Under Structure (UNDER Record)

5A - Record Type		
5B - Route Signing		
5C - Level of Service		
5D - Route Number		
5E - Direction Suffix		
10L - Best 3m Unclr-Lt		
10R - Best 3m Unclr-Rt		
PR Number		
Control Section		
11 - Mile Point		
12 - Base Highway Network		
13 - LRS Route-Subroute		
19 - Detour Length		
20 - Toll Facility		
26 - Functional Class		
28B - Lanes Under		
29 - ADT		
30 - Year of ADT		
42B - Service Type Under	5	
47L - Left Horizontal Clear		
47R - Right Horizontal Clear		
54A - Left Feature		
54B - Left Underclearance	99	99
54C - Right Feature		
54D - Right Clearance	99	99
Under Clearance Year		
55A - Reference Feature	N	
55B - Right Horiz Clearance	99.9	
56 - Left Horiz Clearance	0	
100 - STRAHNET		
102 - Traffic Direct		
109 - Truck %		
110 - Truck Network		
114 - Future ADT		
115 - Year Future ADT		
Freeway		

Proposed Improvements

75 - Type of Work		
76 - Length of Improvement		
94 - Bridge Cost		
95 - Roadway Cost		
96 - Total Cost		
97 - Year of Cost Estimate		

Load Rating and Posting

31 - Design Load	3	
41 - Open, Posted, Closed	K	
63 - Fed Oper Rtg Method	1	
64F - Fed Oper Rtg Load	5	
64MA - Mich Oper Rtg Method	1	
64MB - Mich Oper Rtg	3.7	
64MC - Mich Oper Truck	1	
65 - Inv Rtg Method	1	
66 - Inventory Load	3	
70 - Posting	0	
141 - Posted Loading	03NNNN	
193 - Overload Class		N

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7700 — SAFETY INSPECTION REPORT - CORE ELEMENTS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

NBI INSPECTION — SDCS

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
Ryan Worden	Scott Civil Engineering	12	08/14/2012

CoRE ELEMENTS — (English Units)

Element Number	Element Name	Total Quantity	Unit	State 1	State 2	State 3	State 4	State 5
Decks/Slabs								
13/ 2	Conc Dk HMA No Memb	3552	(SF)	0	0	0	3552	0
				0%	0%	0%	100%	0%
Superstructure								
107/ 2	Pnted Stl Girder /Bm	433	(LF)	0	0	0	281	46
				0%	0%	0%	65%	35%
331/ 2	Concrete Bridge Rail	72	(LF)	49	7	13	3	xxxxx
				68%	10%	18%	4%	xxxxx
Substructure								
215/ 2	Reinf Conc Abut	115	(LF)	115	0	0	0	xxxxx
				100%	0%	0%	0%	xxxxx
217/ 2	Other Mtl Abutment	115	(LF)	0	115	0	0	xxxxx
				0%	100%	0%	0%	xxxxx
Other Elements								
72/ 2	Sidewalk	592	(SF)	484	54	54	0	xxxxx
				82%	9%	9%	0%	xxxxx
Smart Flags								
361/ 2	Scour Smart Flag	1	(EA)	0	1	0	xxxxx	xxxxx
				0%	100%	0%	xxxxx	xxxxx

STR 7700 — WORK RECOMMENDATIONS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

WORK RECOMMENDATIONS — CF8H

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
Ryan Worden	Scott Civil Engineering	12	08/31/2021

RECOMMENDATIONS & ACTION ITEMS

Recommendation Type	Priority	Description
Bridge Repl.	H	Beams and deck are too far gone to repair, replacement or removal is the best option.

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7700 SCOUR CRITICAL BRIDGE ACTION PLAN

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

PLAN OF ACTION AUTHORS

Name	Agency	Phone	Email	Last Modified Date
Leo Evans	City of Muskegon	231-724-6920	leo.evans@shorelinecity.com	
Ryan Worden	Scott Civil Engineering	616-458-8792	wordenr@scottcivileng.com	11/17/2021

SCOUR VULNERABILITY

Item 113 Scour Criticality U **Source of Item 113**

Item 71 Waterway Adequacy 3

Level I Assessment N

Level II Analysis N

Executive Summary Scour Evaluation

Bridge is too small for stream causing faster flow underneath during normal lake level. 2020 high lake level has slowed the flow velocity with constant overbank flooding. The 1929 construction plans have been located. Plans indicate that the abutments are on 39 12" 15-ton piles surrounded by steel sheeting toed approximately 27 feet below normal water surface or 29'-3" below top of sheet elevation. Plans were uploaded to MiBridge.

Calculated Values

Scour Analysis Event Frequency	25 year	50 year	100 year	500 year	Comments
Anticipated Surface Elevation (ft)					
Distance Below Bottom chord (ft)					
Anticipated Flow (cubic ft/sec)					
Anticipated Pressure Flow (Y/N)					

Substructure Information

Foundation	Normally in Water	Normal Water Depth (ft)	In Water (100 yr)	Footing Type	Depth Known	Soil Type
Abutment A	Y		Y	B Footing Timber Piles	N	Non Cohesive
Abutment B	Y		Y	B Footing Timber Piles	N	Non Cohesive

COUNTERMEASURE RECOMMENDATIONS

X Only Monitoring Required **Estimated Cost $**

O Structural/Hydraulic Countermeasures Considered

Countermeasure Comments

Steel sheeting surrounds each abutment along three sides. Sheeting is rusting, most remains underwater.

MONITORING PROGRAM

Recommended Monitoring Requirements

During NOAA (National Weather Service) flash floods and flood warnings of the Muskegon River, make site visits to check for the occurance of the items noted below. Close bridge to traffic if any of the below are witnessed. Schedule a post-flood inspection prior to reopening the bridge.

Type	Frequency/ Amount	Comments
X Regular Inspection	**6**	**Check stream bottom elevation, sheeting, and appraoch pavement for settlement**
O Other Special Inspection		

STR 7700 SCOUR CRITICAL BRIDGE ACTION PLAN

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

O Underwater Inspection
O Stream Bed Cross Sections
O Monitoring Devices (Fixed, Sonar, etc.)
X Flood Monitoring - Initiate monitoring when any of the following occur
X NOAA Flood Warning (This includes both Flash Flood and Flood Warnings)
O Flow Information
O Discharge
O Rainfall
O WS Elevation Measured from
X Pressure Flow
X Debris Accumulation

Items to Watch During Monitoring

During flood warnings check for movement of the steel sheeting at each abutment, pressure flow, overtopping of the roadway, loss of fill from behind each abutment end, and debris accumulation across the upstream bridge opening.

Foundation	Items to Watch
Abutment A	Steel sheeting movement, abutment settlement
Abutment B	Steel sheeting movement, abutment settlement

Inspection Summary

Type	Latest Date Completed	Current Frequency	Inspector	Agency
Routine	08/31/2021	12	WORDENR1132	Scott Civil Engineering
Underwater				
Cross Section				
Scour Inspection	08/16/2010		Ryan Worden	Scott Civil Engineering
High Flow Monitoring				

BRIDGE CLOSURE

Conditions To Consider Bridge Closure

O Water Surface Elevation
X Overtopping of Road or Structure
X Pressure Flow
X High Debris Accumulation
X Observed Structure Movement/Settlement
O Loss of Scour Countermeasures

Contacts Responsible for BRIDGE CLOSURE

Name	Title	Agency	Phone Number	Cell Number
Leo Evans	Director of Public Works	City of Muskegon	231-724-6920	231-750-6369

Contacts Responsible for OPENING Bridge

Name	Title	Agency	Phone Number	Cell Number
Leo Evans	Director of Public Works	City of Muskegon	231-724-6920	231-750-6369

STR 7700 SCOUR CRITICAL BRIDGE ACTION PLAN

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

DETOUR ROUTE

Possible Detour Route

US-31 Business Route to Bayou Avenue

Bridges/Culverts on Detour Route

Detour Bridge Numbers	Feature Intersected	Load Limitations	Scour Rating
7633	S BR MUSKEGON RIVER		8
7611	MUSKEGON RIVER		8
7634	S BR MUSKEGON RIVER		5

SCOUR INSPECTIONS

Date	Type	Freq	Inspector	Agency
08/16/2010	SCOUR		Ryan Worden	Scott Civil Engineering
Comments	The last routine inspection noted that the bridge opening is too small for the stream. The water surface extends beyond each abutment causing faster flow under bridge. Stream has constant eddy currents within flow. Deep hole noted in front of west abutment.			
08/23/2016	ROUTINE	12	Ryan Worden	Scott Civil Engineering
Comments	Sand bottom scour under deck in front of south abutrment, along westside of sheeting.			
Recommendations	Appr. Pavement	Low	Fix approach sidewalk	
	Railing Repair	Medium	Patch concrete.	
	Deck Patching	High	Seal deck to prevent leaking	
	Bridge Repl.	High	Replacement is best option	
	Other	High	repair steel beams	
08/29/2017	ROUTINE	12	Ryan Worden	Scott Civil Engineering
Comments	Sand bottom scour under deck in front of south abutment, along westside of sheeting. No undermining noted.			
Recommendations	Appr. Pavement	Low	Fix approach sidewalk	
	Railing Repair	Medium	Patch concrete.	
	Deck Patching	High	Seal deck to prevent leaking	
	Bridge Repl.	High	Replacement is best option	
	Other	High	repair steel beams	
08/31/2018	ROUTINE	8	Ryan Worden	Scott Civil Engineering
Comments	Sand bottom scours under the deck in front of the south abutment, along westside of sheeting. Flow too fast to probe, recent rain has the flow higher than normal.			
Recommendations	Appr. Pavement	Low	Fix approach sidewalk	
	Railing Repair	Medium	Patch concrete.	
	Deck Patching	High	Seal deck to prevent leaking	
	Bridge Repl.	High	Replacement is best option	
	Other	High	repair steel beams	
04/30/2019	ROUTINE	6	Ryan Worden	Scott Civil Engineering
Comments	Sand bottom scours under the deck in front of the south abutment, along westside of sheeting. Flow too fast to accurately probe.			
Recommendations	Approach Repair	Low	Fix approach sidewalk	
	Railing Repair	Medium	Patch concrete.	
	Deck Patching	High	Seal deck to prevent leaking	

STR 7700 **SCOUR CRITICAL BRIDGE ACTION PLAN**

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

	Bridge Repl.	High	Too costly to repair, replacement is best option	
	Other	High	repair steel beams	
10/19/2019	ROUTINE	6	Ryan Worden	Scott Civil Engineering
Comments	Sand bottom scours under the deck in front of the south abutment, along westside of sheeting. Flow too fast to accurately probe. Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge.			
Recommendations	Bridge Repl.	High	Beams and deck are too far gone to repair, replacement is best option	
04/18/2020	ROUTINE	6	Ryan Worden	Scott Civil Engineering
Comments	Sand bottom scours under the deck in front of the south abutment, along westside of sheeting. Flow too fast to accurately probe. Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge.			
Recommendations	Bridge Repl.	High	Beams and deck are too far gone to repair, replacement is best option	
10/19/2020	ROUTINE	6	Ryan Worden	Scott Civil Engineering
Comments	Slower velocity helps to stabilize the sand bottom. Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge.			
Recommendations	Bridge Repl.	High	Beams and deck are too far gone to repair, replacement or removal is the best option.	
04/23/2021	ROUTINE	6	Ryan Worden	Scott Civil Engineering
Comments	Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge. Left Item #113 as is. Channel bottom is deeper under the bridge than downstream. No issues with the sheeting noted.			
Recommendations	Bridge Repl.	High	Beams and deck are too far gone to repair, replacement or removal is the best option.	
08/31/2021	ROUTINE	12	Ryan Worden	Scott Civil Engineering
Comments	Ex. plans indicate that the abutments are on timber piles and steel sheeting extends 29' below the first concrete ledge. Left Item #113 as is. Channel bottom is deeper under the bridge than downstream. No issues with the sheeting noted.			
Recommendations	Bridge Repl.	High	Beams and deck are too far gone to repair, replacement or removal is the best option.	

HIGH FLOW EVENTS

No Recorded High Flow Events

STR 7700 SCOUR CRITICAL BRIDGE ACTION PLAN

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

SUPPORTING IMAGES

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7700 — LOAD RATING ASSUMPTIONS

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

Rating Considers Field Condition of Members: Yes **Inspection Date:** 08/14/2012

Deterioration:

Corrosion of steel stringer, Holes found in web of B4S & B3S greater than 52" in length

Most Recent Year Construct / Reconstruct / Overlay:

History of Work Impacting Load Rating:

HMA overlay on concrete deck

Superstructure Component: 3 Steel **Beam fy:** 30.0 **ksi** **Beam f'c / fb:** **ksi**

Composite: No **Number of Beams:** 12 **Shop Drawings Verified:** No

Beam Size(s) & Names (each span): CB 213 21" 9" x 92 lbs, 35ft single span

Deck: **Thickness (in.):** 7.0 **Fy / f'c:** / 3.0 ksi **Deck Design Load > H15:** No

Wearing Surface: **Mat'l:** HMA **Thickness (in.):** 8.5 **Unit Weight (pcf.):** 50.0

	LEFT	CENTER	RIGHT
Barrier: Type / Weight (plf.):	concrete / 975.0	/	concrete / 975.0
Sidewalk: Width / Thick (in.):	95.0 / 10.5	/	95.0 / 10.5

Clear Roadway (ft.): 40.0

Additional Loads:

Unique Factors That Affect Capacity:

Load Rating used a section modulus determined by removing bottom flange and 2" of web from the original beam section and applied a 10% section loss to the remaining beam section.

Analyzed By: RTW **Date:** 08/20/2012

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7700 — LOAD RATING SUMMARY

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

Compliance Issue: None
Compliance Verified: No
Analysis Program: Hand Calculations
Analysis Program Version: MCAD
Rating Considers Field Condition of Members: Yes **Inspection Date:** 08/14/2012
Controlling component and failure mode:

Beam Moment controls

NEW INVENTORY CODING

NBI Item 63 - Operating Rating Method	1 LFR in US tons
NBI Item 64F - Federal Operating Ratings	5.0
MDOT Item 64MA - Michigan Operating Method	1 LFR in US Tons
MDOT Item 64MB - Michigan Operating Rating	3.7
MDOT Item 64MC - Michigan Operating Truck	1
NBI Item 65 - Inventory Rating Method	1 LFR in US tons
NBI Item 66 - Federal Inventory Rating	3.0
NBI Item 41 - Structure Open Posted Closed	K K Closed to all traffic
NBI Item 70 - Bridge Posting	0 0 - 59% or less
Posted By	Gross Load
MDOT Item 141 - Posted Loading	03NNNN
MDOT Item 193A - Michigan Overload Class	
MDOT Item 193C - Overload Status	N-No Restriction

Analyzed By: RTW **Date:** 08/20/2012
Checked By: RWL **Date:** 08/20/2012

MICHIGAN DEPARTMENT OF TRANSPORTATION

STR 7700	REQUEST FOR ACTION		
Facility	**Latitude / Longitude**	**MDOT Structure ID**	**Structure Condition**
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

No inspections available for bridge key 614461800205B01

STR 7700 OUTSTANDING WORK

Facility	Latitude / Longitude	MDOT Structure ID	Structure Condition
OTTAWA ST	43.2518 / -86.235	614461800205B01	Critical Condition(1)
Feature	**Length / Width / Spans**	**Owner**	
MUSKEGON RIVER S BRANCH	37.3 / 53.8 / 1	City: MUSKEGON(4618)	
Location	**Built / Recon. / Paint / Ovly.**	**TSC**	**Operational Status**
0.25 MI N OF BAYOU ST	1929 / / /	Muskegon(21)	K Closed to all traffic(K)
Region / County	**Material / Design**	**Last NBI Inspection**	**Scour Evaluation**
Grand(3) / Muskegon(61)	3 Steel / 02 Multi Str Non Comp	08/31/2021 / CF8H	U Unknown Scour

WORK RECOMMENDATIONS

OTHER

Request For	Contact/User	Agency/Company Name	Estimated Quantity	Unit
Bridge Repl.				
Activity	**Material**	**Other Material**	**Actual Quantity**	**Unit**
Personnel Hours	**Equipment**			**Complete Date**

Comments

Beams and deck are too far gone to repair, replacement or removal is the best option. (Ryan Worden 09/01/2021)

APPENDIX C. CULVERT ASSET MANAGEMENT PLAN SUPPLEMENT

Culvert Primer

Culverts are structures that lie underneath roads, enabling water to flow from one side of the roadway to the other (Figure C-1 and Figure C-2). The important distinguishing factor between a culvert and a bridge is the size. Culverts are considered anything under 20 feet while bridges, according to the Federal Highway Administration, are 20 feet or more. While similar in function to storm sewers, culverts differ from storm sewers in that culverts are open on both ends, are constructed as straight-line conduits, and lack intermediate drainage structures like manholes and catch basins. Culverts are critical to the service life of a road because of the important role they play in keeping the pavement layers well drained and free from the forces of water building up on one side of the roadway.

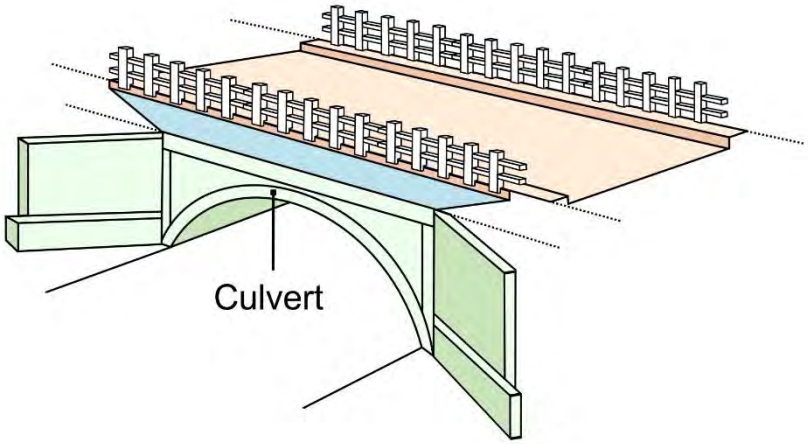


Figure C-1: Diagram of a culvert structure

Figure C-2: Examples of culverts. Culverts allow water to pass under the roadway (left), they are straight-line conduits with no intermediate drainage structures (middle), and they come in various materials (left: metal; middle and right: concrete) and shapes (left: arch; middle: round; right: box).

Culvert Types

Michigan conducted its first pilot data collection on local agency culverts in the state in 2018. Of almost 50,000 culverts inventoried as part of the state-wide pilot project, the material type used for constructing culverts ranged from (in order of predominance) corrugated steel, concrete, plastic, aluminum, and masonry/tile, to timber materials. The shapes of the culverts were (in order of predominance) circular, pipe arch, arch, rectangular, horizontal ellipse, or box. The diameter for the majority of culverts ranged from less than 12 inches to 24 inches; a portion, however, ranged from 30 inches to more than 48 inches.

Culvert Condition

Several culvert condition assessment practices exist. The FHWA has an evaluation method in its 1986 *Culvert Inspection Manual*. In conjunction with descriptions and details in the Ohio Department of Transportation's 2017 *Culvert Inspection Manual* and Wisconsin DOT's *Bridge Inspection Field Manual*, the FHWA method served as the method for evaluating Michigan culverts in the pilot. In 2018, Michigan local agencies participated in a culvert pilot data collection, gathering inventory and condition data; full detail on the condition assessment system used in the data collection can be found in Appendix G of the final report (https://www.michigan.gov/documents/tamc/TAMC_2018_Culvert_Pilot_Report_Complete_634795_7.pdf).

The Michigan culvert pilot data collection used a 1 through 10 rating system, where 10 is considered a new culvert with no deterioration or distress and 1 is considered total failure. Each of the different culvert material types requires the assessment of features unique to that material type, including structural deterioration, invert deterioration, section deformation, blockage(s) and scour. Corrugated metal pipe, concrete pipe, plastic pipe, and masonry culverts require an additional assessment of joints and seams. Slab abutment culverts require an additional assessment of the concrete abutment and the masonry abutment. Assessment of timber culverts only relied on blockage(s) and scour. The assessments come together to generate condition rating categories of good (rated as 10, 9, or 8), fair (rated as 7 or 6), poor (rated as 5 or 4), or failed (rated as 3, 2, or 1).

Culvert Treatments

The *MDOT Drainage Manual* addresses culvert design and treatments. Of most importance to the longevity of culverts is regular cleaning to prevent clogs. More extensive treatments may include re-positioning the pipe to improve its grade and lining a culvert to achieve more service life after structural deterioration has begun.

APPENDIX D. TRAFFIC SIGNALS ASSET MANAGEMENT PLAN SUPPLEMENT

Traffic Signals Primer

Types

Electronic traffic control devices come in a large array of configurations, which include case signs (e.g., keep right/left, no right/left turn, reversible lanes), controllers, detection (e.g., cameras, push buttons), flashing beacons, interconnects (e.g., DSL, fire station, phone line, radio), pedestrian heads (e.g., hand-man), and traffic signals. This asset management plan is only concerned with traffic signals (Figure D-1) as a functioning unit and does not consider other electronic traffic control devices.

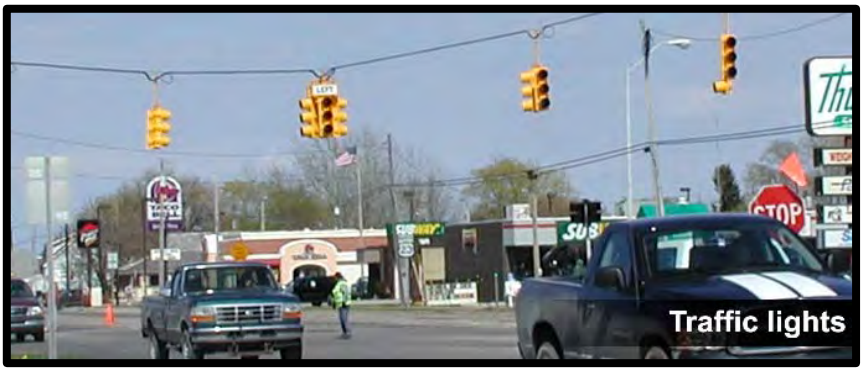


Figure D-1: Example of traffic signals

Condition

Traffic signal assessment considers the functioning of basic tests on a pass/fail basis. These tests include battery backup testing, components testing, conflict monitor testing, radio testing, and underground detection.

Treatments

Traffic signals are maintained in accordance with the *Michigan Manual on Uniform Traffic Control Devices*. Maintenance of traffic signals includes regular maintenance of all components, cleaning and servicing to prevent undue failures, immediate maintenance in the case of emergency calls, and provision of stand-by equipment. Timing changes are restricted to authorized personnel only.

APPENDIX E. GLOSSARY & ACRONYMS

Glossary

Alligator cracking: Cracking of the surface layer of an asphalt pavement that creates a pattern of interconnected cracks resembling alligator hide. This is often due to overloading a pavement, sub-base failure, or poor drainage.[5]

Asset management: A process that uses data to manage and track road assets in a cost-effective manner using a combination of engineering and business principles. Public Act 325 of 2018 provides a legal definition: "an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals".[6]

Biennial inspection: Inspection of an agency's bridges every other year, which happens in accordance with National Bridge Inspection Standards and Michigan Department of Transportation requirements.

Bridge inspection program: A program implemented by a local agency to inspect the bridges within its jurisdiction systematically in order to ensure proper functioning and structural soundness.

Capital preventative maintenance: Also known as CPM, a planned set of cost-effective treatments to address of fair-rated infrastructure before the structural integrity of the system has been severely impacted. These treatments aim to slow deterioration and to maintain or improve the functional condition of the system without significantly increasing the structural capacity. Light capital preventive maintenance is a set of treatments designed to seal isolated areas of the pavement from water, such as crack and joint sealing, to protect and restore pavement surface from oxidation with limited surface thickness material, such as fog seal; generally, application of a light CPM treatment does not provide a corresponding increase in a segment's PASER score. Heavy capital preventive maintenance is a set of surface treatments designed to protect pavement from water intrusion or environmental weathering without adding significant structural strength, such as slurry seal, chip seal, or thin (less than 1.5-inch) overlays for bituminous surfaces or patching or partial-depth (less than 1/3 of pavement depth) repair for concrete surfaces.

Chip seal: An asphalt pavement treatment method consisting of, first, spraying liquid asphalt onto the old pavement surface and, then, a single layer of small stone chips spread onto the wet asphalt layer.

City major: A road classification, defined in Michigan Public Act 51, that encompasses the generally more important roads in a city or village. City major roads are designated by a municipality's governing body and are subject to approval by the State Transportation Commission. These roads do not include roads under the jurisdiction of a county road commission or trunkline highways.

City minor: A road classification, defined in Michigan Public Act 51, that encompasses the generally less important roads in a city or village. These roads include all city or village roads that are not city major road and do not include roads under the jurisdiction of a county road commission.

[5] https://en.wikipedia.org/wiki/Crocodile_cracking
[6] Inventory-based Rating System for Gravel Roads: Training Manual

Composite pavement: A pavement consisting of concrete and asphalt layers. Typically, composite pavements are old concrete pavements that were overlaid with HMA in order to gain more service life.

Concrete joint resealing: Resealing the joints of a concrete pavement with a flexible sealant to prevent moisture and debris from entering the joints. When debris becomes lodged inside a joint, it inhibits proper movement of the pavement and leads to joint deterioration and spalling.

Concrete pavement: Also known as rigid pavement, a pavement made from portland cement concrete. Concrete pavement has an average service life of 30 years and typically does not require as much periodic maintenance as HMA.

Cost per lane mile: Associated cost of construction, measured on a per lane, per mile basis. Also see *lane-mile segment*.

County local: A road classification, defined in Michigan Public Act 51, that encompasses the generally less important and low-traffic roads in a county. This includes all county roads that are not classified as county primary roads.

County primary: A road classification, defined in Michigan Public Act 51, that encompasses the generally more important and high-traffic roads in a county. County primary roads are designated by board members of the county road commissions and are subject to approval by the State Transportation Commission.

CPM: See *Capital preventive maintenance*.

Crack and seat: A concrete pavement treatment method that involves breaking old concrete pavement into small chunks and leaving the broken pavement in place to provide a base for a new surface. This provides a new wear surface that resists water infiltration and helps prevent damaged concrete from reflecting up to the new surface.

Crack seal: A pavement treatment method for both asphalt and concrete pavements that fills cracks with asphalt materials, which seals out water and debris and slows down the deterioration of the pavement. Crack seal may encompass the term “crack filling”.

Crush and shape: An asphalt pavement treatment method that involves pulverizing the existing asphalt pavement and base and then reshaping the road surface to correct imperfections in the road’s profile. Often, a layer of gravel is added along with a new wearing surface such as an HMA overlay or chip seal.

Crust: A very tightly compacted surface on an unpaved road that sheds water with ease but takes time to be created.

Culvert: A pipe or structure used under a roadway that allows cross-road drainage while allowing traffic to pass without being impeded; culverts span up to 20 feet.[7]

Dowel bar retrofit repair: A concrete pavement treatment method that involves cutting slots in a cracked concrete slab, inserting steel bars into the slots, and placing concrete to cover the new bars and fill the slots. It aims to reinforce cracks in a concrete pavement.

[7] Adapted from Inventory-based Rating System for Gravel Roads: Training Manual

Dust control: A gravel road surface treatment method that involves spraying chloride or other chemicals on the gravel surface to reduce dust loss, aggregate loss, and maintenance. This is a relatively short-term fix that helps create a crusted surface.

Expansion joint: Joints in a bridge that allow for slight expansion and contraction changes in response to temperature. Expansion joints prevent the build up of excessive pressure, which can cause structural damage to the bridge.

Federal Highway Administration: Also known as FHWA, this is an agency within the U.S. Department of Transportation that supports state and local governments in the design, construction, and maintenance of the nation's highway system.[8]

Federal-aid network: Portion of road network that is comprised of federal-aid routes. According to Title 23 of the United States Code, federal-aid-eligible roads are "highways on the federal-aid highways systems and all other public roads not classified as local roads or rural minor collectors".[9] Roads that are part of the federal-aid network are eligible for federal gas-tax monies.

FHWA: See *Federal Highway Administration*.

Flexible pavement: See *hot-mix asphalt pavement*.

Fog seal: An asphalt pavement treatment method that involves spraying a liquid asphalt coating onto the entire pavement surface to fill hairline cracks and prevent damage from sunlight and oxidation. This method works best for good to very good pavements.

Full-depth concrete repair: A concrete pavement treatment method that involves removing sections of damaged concrete pavement and replacing it with new concrete of the same dimensions in order to restore the riding surface, delay water infiltration, restore load transfer from one slab to the next, and eliminate the need to perform costly temporary patching.

Geographic divides: Areas where a geographic feature (e.g., river, lake, mountain) limits crossing points of the feature.

Grants: Competitive funding gained through an application process and targeted at a specific project type to accomplish a specific purpose. Grants can be provided both on the federal and state level and often make up part of the funds that a transportation agency receives.

Gravel surfacing: A low-cost, easy-to-maintain road surface made from aggregate and fines.

Heavy capital preventive maintenance: See *Capital preventive maintenance*.

HMA: See *hot-mix asphalt pavement*.

Hot-mix asphalt overlay: Also known as HMA overlay, this a surface treatment that involves layering new asphalt over an existing pavement, either asphalt or concrete. It creates a new wearing surface for traffic and to seal the pavement from water, debris, and sunlight damage, and it often adds significant structural strength.

Hot-mix asphalt pavement: Also known as HMA pavement, this type of asphalt creates a flexible pavement composed of aggregates, asphalt binder, and air voids. HMA is heated for placement and

[8] Federal Highway Administration webpage https://www.fhwa.dot.gov/
[9] Inventory-based Rating System for Gravel Roads: Training Manual

compaction at high temperatures. HMA is less expensive to construct than concrete pavement, however it requires frequent maintenance activities and generally lasts 18 years before major rehabilitation is necessary. HMA makes up the vast majority of local-agency-owned pavements.

IBR: See *IBR element*, *IBR number*, and/or *Inventory-based Rating System*™.

IBR element: A feature used in the IBR System™ for assessing the condition of roads. The system relies on assessing three elements: surface width, drainage adequacy, and structural adequacy.[10]

IBR number: The 1-10 rating determined from assessments of the weighted IBR elements. The weighting relates each element to the intensity road work needed to improve or enhance the IBR element category.[11]

Interstate highway system: The road system owned and operated by each state consisting of routes that cross between states, make travel easier and faster. The interstate roads are denoted by the prefix "I" or "U.S." and then a number, where odd routes run north-south and even routes run east-west. Examples are I-75 or U.S. 2.[12]

Inventory-based Rating System™: Also known as the IBR System™, a rating system designed to assess the capabilities of gravel and unpaved roads to support intended traffic volumes and types year round. It assesses roads based on how three IBR elements, or features—surface width, drainage adequacy, and structural adequacy—compare to a baseline, or "good", road.[13]

Investment Reporting Tool: Also known as IRT, a web-based system used to manage the process for submitting required items to the Michigan Transportation Asset Management Council. Required items include planned and completed maintenance and construction activity for roads and bridges and comprehensive asset management plans.

IRT: See *Investment Reporting Tool*.

Jurisdiction: Administrative power of an entity to make decisions for something. In Michigan, the three levels of jurisdiction classification for transportation assets are state highways, county roads, and city and village streets. State highways are under the jurisdiction of the Michigan Department of Transportation, county roads are under the jurisdiction of the road commission for the county in which the roads are located, and city and village streets are under the jurisdiction of the municipality in which the roads are located.

Jurisdictional borders: Borders between two road-owning-agency jurisdictions, or where the roads owned by one agency turn into roads owned by another agency. Examples of jurisdictional borders are township or county lines.

Lane-mile segment: A segment of road that is measured by multiplying the centerline miles of a roadway by the number of lanes present.

Lane-mile-years: A network's total lane-miles multiplied by one year; a method to quantify the measurable loss of pavement life.

[10] Inventory-based Rating System for Gravel Roads: Training Manual
[11] Inventory-based Rating System for Gravel Roads: Training Manual
[12] https://www.fhwa.dot.gov/interstate/faq.cfm#question3
[13] Adapted from Inventory-based Rating System for Gravel Roads: Training Manual

Light capital preventive maintenance: See *Capital preventive maintenance*.

Limited access areas: Areas—typically remote areas—serviced by few or seasonal roads that require long detours routes if servicing roads are closed.

Main access to key commercial districts: Areas where large number or large size business will be significantly impacted if a road is unavailable.

Maintenance grading: A surface treatment method for unpaved roads that involves re-grading the road to remove isolated potholes, washboarding, and ruts, and then restoring the compacted crust layer.

MDOT: See *Michigan Department of Transportation.*

MDOT's Local Bridge Program Call for Projects: A call for project proposals for replacement, rehabilitation, and/or preventive maintenance of local bridges that, if granted, receives bridge funding from the Michigan Department of Transportation. The Call for Projects is made by the Local Bridge Program.

MGF: See *Michigan Geographic Framework*.

Michigan Department of Transportation: Also known as MDOT, this is the state of Michigan's department of transportation, which oversees roads and bridges owned by the state or federal government in Michigan.

Michigan Geographic Framework: Also known as MGF, this is the state of Michigan's official digital base map that contains location and road information necessary to conduct state business. The Michigan Department of Transportation uses the MGF to link transportation assets to a physical location.

Michigan Public Act 51 of 1951: Also known as PA 51, this is a Michigan legislative act that served as the foundation for establishing a road funding structure by creating transportation funding distribution methods and means. It has been amended many times.[14]

Michigan Public Act 325 of 2018: Also known as PA 325, this legislation modified PA 51 of 1951 in regards to asset management in Michigan, specifically 1) re-designating the TAMC under Michigan Infrastructure Council (MIC); 2) promoting and overseeing the implementation of recommendations from the regional infrastructure asset management pilot program; 3) requiring local road three-year asset management plans beginning October 1, 2020; 4) adding asset classes that impact system performance, safety or risk management, including culverts and signals; 5) allowing MDOT to withhold funds if no asset management plan submitted; and 6) prohibiting shifting finds from a country primary to a county local, or from a city major to a city minor if no progress toward achieving the condition goals described in its asset plan.[15]

Michigan Public Act 499 of 2002: Also known as PA 499, this legislation requires road projects for the upcoming three years to be reported to the TAMC.

Michigan Transportation Asset Management Council: Also known as the TAMC, a council comprised of professionals from county road commissions, cities, a county commissioner, a township official, regional and metropolitan planning organizations, and state transportation department personnel. The

[14] Inventory-based Rating System for Gravel Roads: Training Manual
[15] Inventory-based Rating System for Gravel Roads: Training Manual

council reports directly to the Michigan Infrastructure Council.[16] The TAMC provides resources and support to Michigan's road-owning agencies, and serves as a liaison in data collection requirements between agencies and the state.

Michigan Transportation Fund: Also known as MTF, this is a source of transportation funding supported by vehicle registration fees and the state's per-gallon gas tax.

Microsurface treatment: An asphalt pavement treatment method that involves applying modified liquid asphalt, small stones, water, and portland cement for the purpose of protecting a pavement from damage caused by water and sunlight.

Mill and hot-mix asphalt overlay: Also known as a mill and HMA overlay, this is a surface treatment that involves the removal of the top layer of pavement by milling and the replacement of the removed layer with a new HMA layer.

Mix-of-fixes: A strategy of maintaining roads and bridges that includes generally prioritizes the spending of money on routine maintenance and capital preventive maintenance treatments to impede deterioration and then, as money is available, performing reconstruction and rehabilitation.

MTF: See *Michigan Transportation Fund*.

National Bridge Inspection Standards: Also known as NBIS, standards created by the Federal Highway Administration to locate and evaluate existing bridge deficiencies in the federal-aid highway system to ensure the safety of the traveling public. The standards define the proper safety for inspection and evaluation of all highway bridges.[17]

National Center for Pavement Preservation: Also known as the NCPP, a center that offers education, research, and outreach in current and innovative pavement preservation practices. This collaborative effort of government, industry, and academia entities was established at Michigan State University.

National Functional Class: Also known as NFC, a federal grouping system for public roads that classifies roads according to the type of service that the road is intended to provide.

National highway system: Also known as NHS, this is a network of roads that includes the interstate highway system and other major roads managed by state and local agencies that serve major airports, marine, rail, pipelines, truck terminals, railway stations, military bases, and other strategic facilities.

NBIS: See *National Bridge Inspection Standards*.

NCPP: See *National Center for Pavement Preservation*.

NCPP Quick Check: A system created by the National Center for Pavement Preservation that works under the premise that a one-mile road segment loses one year of life each year that it is not treated with a maintenance, rehabilitation, or reconstruction project.

NFC: See *National Functional Class*.

Non-trunkline: A local road intended to be used over short distances but not recommended for long-distance travel.

[16] Inventory-based Rating System for Gravel Roads: Training Manual
[17] https://www.fhwa.dot.gov/bridge/nbis/

Other funds: Expenditures for equipment, capital outlay, debt principal payment, interest expense, contributions to adjacent governmental units, principal, interest and bank fees, and miscellaneous for cities and villages.

PA: See *Michigan Public Act 51*, *Michigan Public Act 325*, and/or *Michigan Public Act 499*.

Partial-depth concrete repair: A concrete pavement treatment method that involves removing spalled or delaminated areas of concrete pavement, usually near joints and cracks, and replacing with new concrete. This is done to provide a new wearing surface in isolated areas, to slow down water infiltration, and to help delay further freeze-thaw damage.

PASER: See *Pavement Surface Evaluation and Rating system*.

Pavement reconstruction: A complete removal of the old pavement and base and construction of an entirely new road. This is the most expensive rehabilitation of the roadway and also the most disruptive to traffic patterns.

Pavement Surface Evaluation and Rating system: Also known as the PASER system, the PASER system rates surface condition on a 1-10 scale, where 10 is a brand new road with no defects, 5 is a road with distress but that is structurally sound and requires only preventative maintenance, and 1 is a road with extensive surface and structural distresses that is in need of total reconstruction. This system provides a simple, efficient, and consistent method for evaluating the condition of paved roads.[18]

Pothole: A defect in a road that produces a localized depression.[19]

Preventive maintenance: Planned treatments to an existing asset to prevent deterioration and maintain functional condition. This can be a more effective use of funds than the costly alternative of major rehabilitation or replacement.

Proactive preventive maintenance: Also known as PPM, a method of performing capital preventive maintenance treatments very early in a pavement's life, often before it exhibits signs of pavement defect.

Public Act 51: See *Michigan Public Act 51 of 1951*

Public Act 325: See *Michigan Public Act 325 of 2018*

Public Act 499: See *Michigan Public Act 499 of 2002*

Reconstruction and rehabilitation programs: Programs intended to reconstruct and rehabilitate a road.

Restricted load postings: A restriction enacted on a bridge structure when is incapable of transporting a state's legal vehicle loads.

Rights-of-way ownership: The owning of the right-of-way, which is the land over which a road or bridge travels. In order to build a road, road agencies must own the right-of-way or get permission to build on it.

Rigid pavement: See *concrete pavement*.

[18] Adapted from Inventory-based Rating System for Gravel Roads: Training Manual
[19] Inventory-based Rating System for Gravel Roads: Training Manual

Road infrastructure: An agency's road network and assets necessary to make it function, such as traffic signage and ditches.

Road: The area consisting of the roadway (i.e., the travelled way or the portion of the road on which vehicles are intended to drive), shoulders, ditches, and areas of the right of way containing signage.[20]

Roadsoft: An asset management software suit that enables agencies to manage road and bridge related infrastructure. The software provides tools for collecting, storing, and analyzing data associated with transportation infrastructure. Built on an optimum combination of database engine and GIS mapping tools, Roadsoft provides a quick, smooth user experience and almost unlimited data handling capabilities.[21]

Ruts/rutting: Deformation of a road that usually forms as a permanent depression concentrated under the wheel path parallel to the direction of travel.[22]

Scheduled maintenance: Low-cost, day-to-day activities applied to bridges on a scheduled basis that mitigates deterioration.[23]

Sealcoat pavement: A gravel road that has been sealed with a thin asphalt binder coating that has stone chips spread on top.

Service life: Time from when a road or treatment is first constructed to when it reaches a point where the distresses present change from age-related to structural-related (also known as the critical distress point).[24]

Slurry seal: An asphalt pavement treatment method that involves applying liquid asphalt, small stones, water, and portland cement in a very thin layer with the purpose of protecting an existing pavement from being damaged by water and sunlight.

Structural improvement: Pavement treatment that adds strength to the pavement. Roads requiring structural improvement exhibit alligator cracking and rutting and are considered poor by the TAMC definitions for condition.

Subsurface infrastructure: Infrastructure maintained by local agencies that reside underground, for example, drinking water distribution systems, wastewater collection systems, and storm sewer systems.

TAMC: See *Michigan Transportation Asset Management Council*.

TAMC pavement condition dashboard: Website for viewing graphs of pavement and bridge conditions, traffic and miles travelled, safety statistics, maintenance activities, and financial data for Michigan's cities and villages, counties, and regions, as well as the state of Michigan.

TAMC's good/fair/poor condition classes: Classification of road conditions defined by the Michigan Transportation Asset Management Council based on bin ranges of PASER scores and similarities in defects and treatment options. Good roads have PASER scores of 8, 9, or 10, have very few defects, and require minimal maintenance. Fair roads have PASER scores of 5, 6, or 7, have good structural support but a deteriorating surface, and can be maintained with CPM treatments. Poor roads have PASER scores

[20] Inventory-based Rating System for Gravel Roads: Training Manual
[21] Inventory-based Rating System for Gravel Roads: Training Manual
[22] Paving Class Glossary
[23] Inventory-based Rating System for Gravel Roads: Training Manual
[24] Inventory-based Rating System for Gravel Roads: Training Manual

of 1, 2, 3, or 4, exhibit evidence that the underlying structure is failing, such as alligator cracking and rutting. These roads must be rehabilitated with treatments like heavy overlay, crush and shape, or total reconstruction.

Tax millages: Local tax implemented to supplement an agency's budget, such as road funding.

Thin hot-mix asphalt overlay: Application of a thin layer of hot-mix asphalt on an existing road to re-seal the road and protect it from damage caused by water. This also improves the ride quality and provides a smoother, uniform appearance that improves visibility of pavement markings.[25]

Transportation infrastructure: All of the elements that work together to make the surface transportation system function including roads, bridges, culverts, traffic signals, and signage.

Trigger: When a PASER score gives insight to the preferred timeline of a project for applying the correct treatment at the correct time.

Trunkline abbreviations: The prefixes *M*-, *I*-, and *US* indicate roads in Michigan that are part of the state trunkline system, the Interstate system, and the US Highway system. These roads consist of anything from 10-lane urban freeways to two-lane rural highways and even one non-motorized highway; they cover 9,668 centerline miles. Most of the roads are maintained by MDOT.

Trunkline bridges: Bridge present on a trunkline road, which typically connects cities or other strategic places and is the recommended rout for long-distance travel.[26]

Trunkline maintenance funds: Expenditures under a maintenance agreement with MDOT for maintenance activities performed on MDOT trunkline routes.

Trunkline: Major road that typically connects cities or other strategic places and is the recommended route for long-distance travel.[27]

Washboarding: Ripples in the road surface that are perpendicular to the direction of travel.[28]

Wedge/patch sealcoat treatment: An asphalt pavement treatment method that involves correcting the damage frequently found at the edge of a pavement by installing a narrow, 2- to 6-foot-wide wedge along the entire outside edge of a lane and layering with HMA. This extends the life of an HMA pavement or chip seal overlay by adding strength to significantly settled areas of the pavement.

Worst-first strategy: Asset management strategy that treats only the problems, often addressing the worst problems first, and ignoring preventive maintenance. This strategy is the opposite of the "mix of fixes" strategy. An example of a worst-first approach would be purchasing a new automobile, never changing the oil, and waiting till the engine fails to address any deterioration of the car.

[25] [second sentence] http://www.kentcountyroads.net/road-work/road-treatments/ultra-thin-overlay
[26] https://en.wikipedia.org/wiki/Trunk_road
[27] https://en.wikipedia.org/wiki/Trunk_road
[28] Inventory-based Rating System for Gravel Roads: Training Manual

List of Acronyms

CPM: capital preventive maintenance

FHWA: Federal Highway Administration

HMA: hot-mix asphalt

I: trunkline abbreviation for routes on the Interstate system

IBR: Inventory-based Rating

M: trunkline abbreviation for Michigan state highways

MDOT: Michigan Department of Transportation

MTF: Michigan Transportation Fund

NBIS: National Bridge Inspection Standards

NCPP: National Center for Pavement Preservation

NHS: National Highway System

PA 51: Michigan Public Act 51 of 1951

PASER: Pavement Surface Evaluation and Rating

R&R: reconstruction and rehabilitation programs

TAMC: (Michigan) Transportation Asset Management Council

US: trunkline abbreviation for routes on the US Highway system

APPENDIX F. MAPS FROM FIGURES

PASER Ratings West

PASER Ratings East

Unpaved Roads West

Unpaved Roads East

List of Planned Projects

Planned Projects West

Planned Projects East

Culverts West

Culverts East

Signals West

Signals East

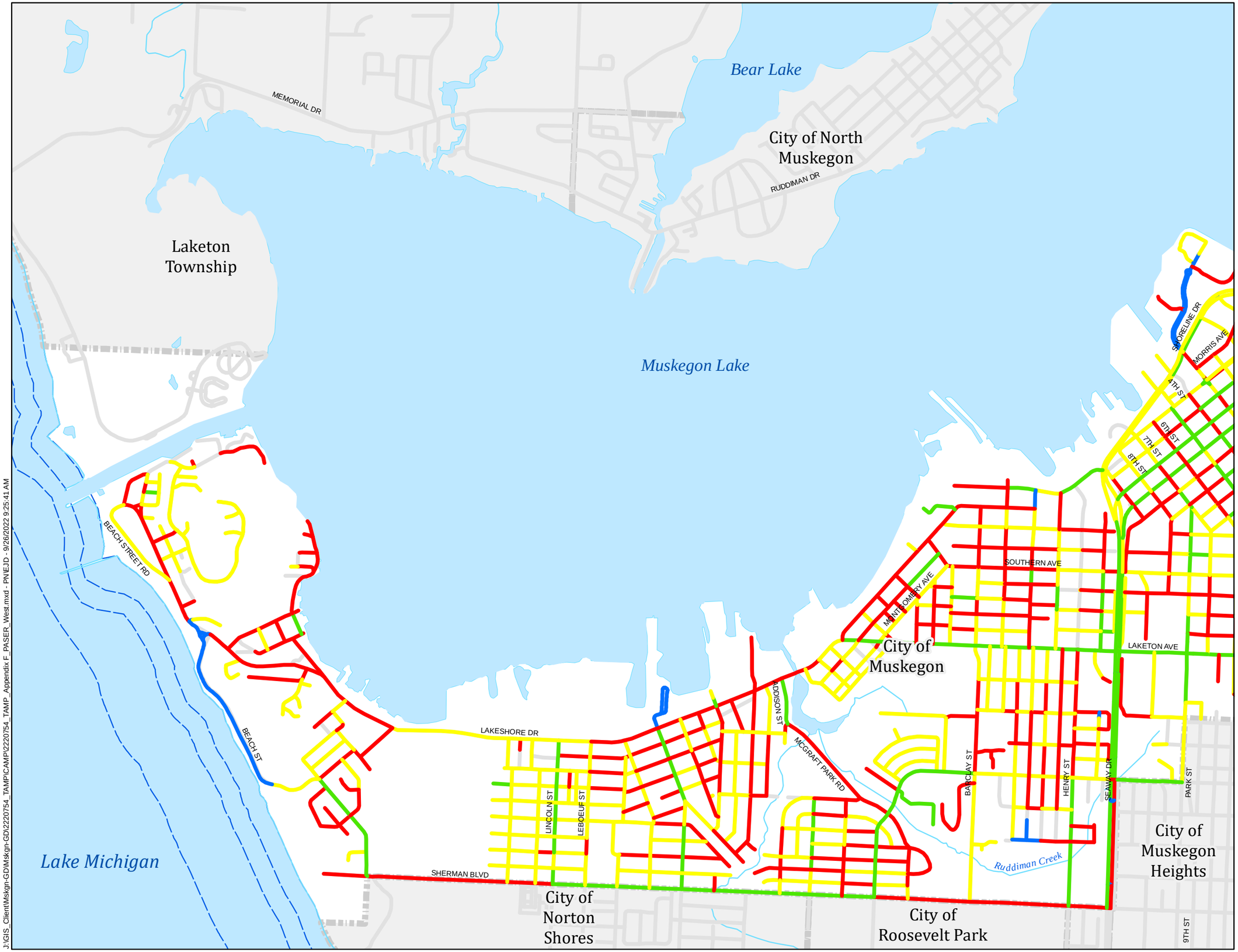
Key Routes

CITY OF MUSKEGON
MUSKEGON COUNTY, MI

PASER RATINGS
SEPTEMBER 2022

Prein&Newhof
2220754

WEST



LEGEND
- Unrated
- 1-4 Poor
- 5-7 Fair
- 8-10 Good

0 750 1,500 3,000 Feet

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CITY OF MUSKEGON
MUSKEGON COUNTY, MI

PASER RATINGS
SEPTEMBER 2022
Prein&Newhof
2220754
EAST

LEGEND
- Unrated
- 1-4 Poor
- 5-7 Fair
- 8-10 Good

0 750 1,500 3,000 Feet

Muskegon Lake
Four Mile Creek
Ryerson Creek
Ruddiman Creek
City of Muskegon
City of Muskegon Heights
Muskegon Township
M 120
S M 120
US 31 BR
ACCESS HWY
MACARTHUR RD
QUARTERLINE RD
BROADMOOR ST
N US 31
S US 31
HARVEY ST
HOME ST
SKYLINE DR
SHORELINE DR
MORRIS AVE
WESTERN AVE
CLAY AVE
WEBSTER AVE
MUSKEGON AVE
4TH ST
7TH ST
6TH ST
APPLE AVE
SANFORD ST
IRWIN AVE
SOUTHERN AVE
NIMS ST
CRESTON ST
LAKETON AVE
HENRY ST
KEATING AVE
INDUSTRIAL BLVD
PORT CITY BLVD
EVANSTON AVE
BLACK CREEK RD
SHERIDAN RD
OLTHOFF DR
SEAWAY DR
PARK ST
6TH ST
HOYT ST
PECK ST
GETTY ST
9TH ST
SHERMAN BLVD

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CITY OF MUSKEGON
MUSKEGON COUNTY, MI

UNPAVED ROADS

SEPTEMBER 2022

Prein&Newhof

2220754

WEST

Bear Lake

Muskegon Lake

Lake Michigan

Laketon Township

City of North Muskegon

City of Muskegon

City of Muskegon Heights

City of Norton Shores

City of Roosevelt Park

Ruddiman Creek

MEMORIAL DR

RUDDIMAN DR

BEACH STREET RD

BEACH ST

LAKESHORE DR

SHERMAN BLVD

LINCOLN ST

LEBOEUF ST

ADDISON ST

MCGRAFT PARK RD

MONTGOMERY AVE

SOUTHERN AVE

LAKETON AVE

BARCLAY ST

HENRY ST

SEAWAY DR

PARK ST

9TH ST

SHORELINE DR

MORRIS AVE

4TH ST

6TH ST

7TH ST

6TH ST

LEGEND

Unpaved

0 750 1,500 3,000 Feet

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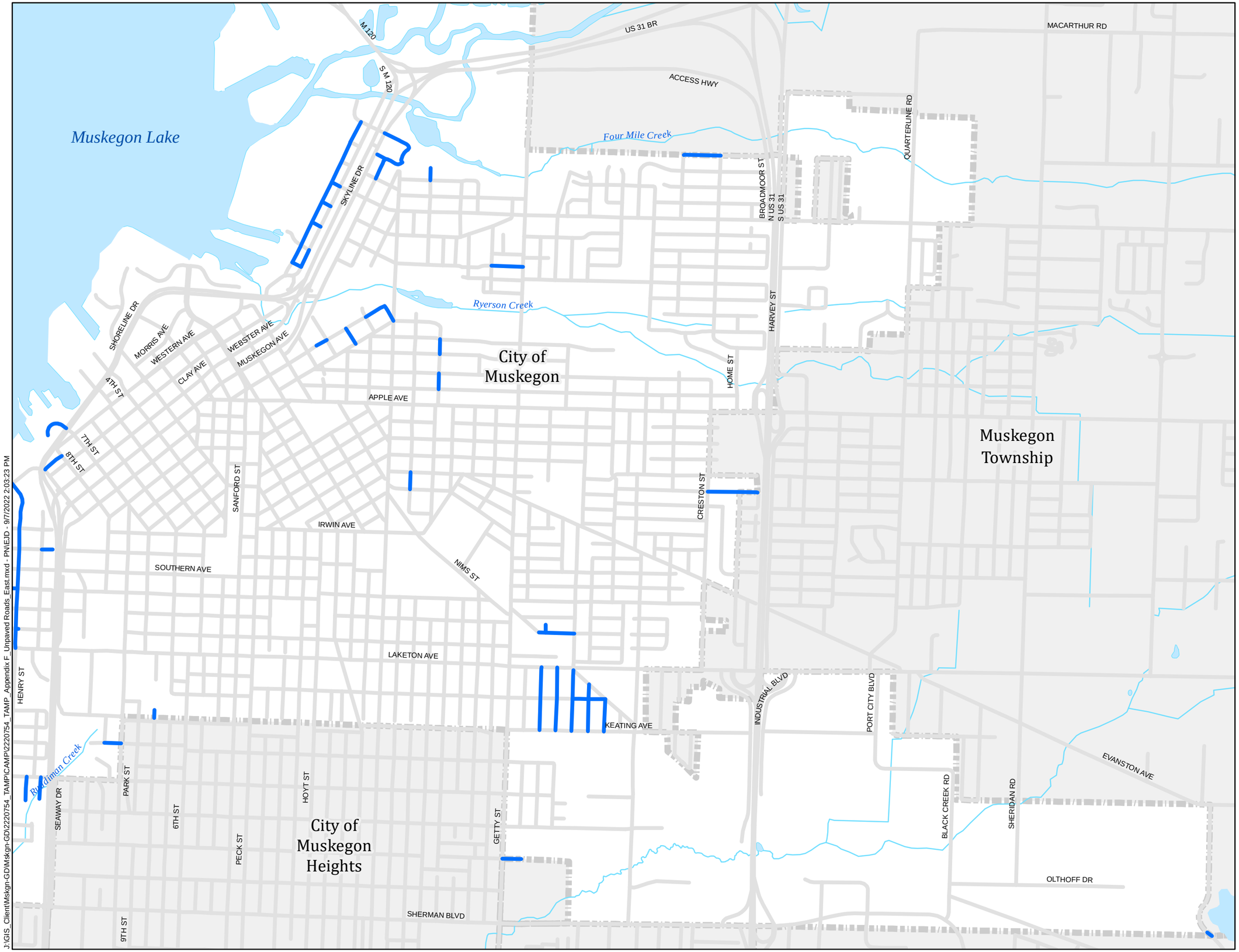

CITY OF MUSKEGON
MUSKEGON COUNTY, MI

UNPAVED ROADS

SEPTEMBER 2022

Prein&Newhof
2220754

EAST

LEGEND

Unpaved

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List of Planned Projects

Project Name	Project Cost	Project Description	Fiscal Year	Status	Treatment Description	Surface Before	Surface After	Length	Funding
Second St, Houston to Muskegon	$500,000	Reconstruct	2025	Planned	Reconstruction	Asphalt	Asphalt	0.1	Local
Southern, Lakeshore to Division	$950,000	Reconstruct	2025	Planned	Reconstruction	Asphalt	Asphalt	0.75	TIP + Match
Ottawa St Bridge	$500,000	Remove Bridge	2024	Funded	Complete Removal of Bridge				Bridge Program (State) + Match
Sanford, Apple to Laketon	$2,100,000	SRF Water & Sewer project	2023	Funded	Reconstruction	Asphalt	Asphalt	1	SRF/DWRF + Match
Glenside Phase II	$1,800,000	SRF Water & Sewer project	2024	Planned	Reconstruction	Asphalt	Asphalt	0.275	SRF/DWRF + Match
Sherman, Seaway to Barclay	$2,300,000	Reconstruct with concrete	2024	Planned	Reconstruction	Asphalt	Concrete	0.5	TIP & EGLE (Scrap Tire Grant)
Peck St, Keating to Laketon	$1,100,000	Reconstruct	2024	Planned	Reconstruction	Asphalt	Asphalt	0.25	Local
Amity, Myrtle to Fork	$600,000	Removal of bridge, place road at grade	2025	Planned	Reconstruction	Asphalt	Asphalt		Bridge Program (State) + Match
Roberts, Barney to Laketon	$800,000	Rehabilitation (Pavement Inlay)	2023	Funded	Reconstruction	Asphalt	Asphalt	1	MEDC Grant + Local Match
Houston, 9th to 3rd	$1,400,000	Recostruct including water main replacement	2023	Bid	Reconstruction	Asphalt	Asphalt	0.5	Local
Terrace St, Apple to Shoreline	$2,000,000	Remove SB lanes, reconstruct to 2-Lane in old NB lanes	2023	Bid	Reconstruction	Asphalt	Asphalt	0.5	TIP + Local Match
Olthoff Dr, Extension East	$1,000,000	Extension with water and sewer extensions also, to serve new development	2023	Planned			Asphalt	0.5	MEDC, TEDF, Local

CITY OF MUSKEGON
MUSKEGON COUNTY, MI

PLANNED PROJECTS
SEPTEMBER 2022

Prein&Newhof

2220754

WEST

Bear Lake

Muskegon Lake

Lake Michigan

Ruddiman Creek

MEMORIAL DR

RUDDIMAN DR

SHORELINE DR

MORRIS AVE

4TH ST

6TH ST

7TH ST

8TH ST

SOUTHERN AVE

MONTGOMERY AVE

LAKETON AVE

ADDISON ST

LAKESHORE DR

MCGRAFT PARK RD

BARCLAY ST

HENRY ST

SEAWAY DR

PARK ST

9TH ST

BEACH STREET RD

BEACH ST

LINCOLN ST

LEBOEUF ST

SHERMAN BLVD

Laketon Township

City of North Muskegon

City of Muskegon

City of Muskegon Heights

City of Norton Shores

City of Roosevelt Park

LEGEND

Planned Projects

0 750 1,500 3,000 Feet

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CITY OF MUSKEGON
MUSKEGON COUNTY, MI

PLANNED PROJECTS
SEPTEMBER 2022
Prein&Newhof
2220754
EAST

LEGEND
Planned Projects

Muskegon Lake
Four Mile Creek
Ryerson Creek
Ruddiman Creek
City of Muskegon
Muskegon Township
City of Muskegon Heights
M 120
S M 120
US 31 BR
ACCESS HWY
MACARTHUR RD
SKYLINE DR
BROADMOOR ST
N US 31
S US 31
QUARTERLINE RD
HARVEY ST
HOME ST
CRESTON ST
SHORELINE DR
MORRIS AVE
WESTERN AVE
WEBSTER AVE
MUSKEGON AVE
CLAY AVE
4TH ST
7TH ST
8TH ST
APPLE AVE
SANFORD ST
IRWIN AVE
SOUTHERN AVE
NIMS ST
LAKETON AVE
HENRY ST
KEATING AVE
INDUSTRIAL BLVD
PORT CITY BLVD
EVANSTON AVE
BLACK CREEK RD
SHERIDAN RD
OLTHOFF DR
SHERMAN BLVD
SEAWAY DR
PARK ST
6TH ST
PECK ST
HOYT ST
GETTY ST
9TH ST

0 750 1,500 3,000 Feet

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CITY OF MUSKEGON
MUSKEGON COUNTY, MI

MAP OF CULVERTS

SEPTEMBER 2022

Prein&Newhof

2220754

WEST

Bear Lake

Muskegon Lake

Lake Michigan

Laketon Township

City of North Muskegon

City of Muskegon

City of Muskegon Heights

City of Norton Shores

City of Roosevelt Park

MEMORIAL DR

RUDDIMAN DR

BEACH STREET RD

BEACH ST

LAKESHORE DR

SHERMAN BLVD

SOUTHERN AVE

LAKETON AVE

MONTGOMERY AVE

ADDISON ST

MCGRAFT PARK RD

LINCOLN ST

LEBOEUF ST

BARCLAY ST

HENRY ST

SEAWAY DR

PARK ST

9TH ST

SHORELINE DR

MORRIS AVE

4TH ST

6TH ST

7TH ST

8TH ST

Ruddiman Creek

LEGEND

Rated Culvert

Unrated Culvert

0 750 1,500 3,000 Feet

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CITY OF MUSKEGON
MUSKEGON COUNTY, MI

MAP OF CULVERTS
SEPTEMBER 2022

Prein&Newhof
2220754

EAST

LEGEND
- Rated Culvert
- Unrated Culvert

N

0 750 1,500 3,000 Feet

Muskegon Lake
Four Mile Creek
Ryerson Creek
Ruddiman Creek
City of Muskegon
Muskegon Township
City of Muskegon Heights
M 120
S M 120
US 31 BR
ACCESS HWY
MACARTHUR RD
SKYLINE DR
QUARTERLINE RD
BROADMOOR ST
N US 31
S US 31
HARVEY ST
HOME ST
CRESTON ST
SHORELINE DR
MORRIS AVE
WESTERN AVE
CLAY AVE
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LAKETON AVE
HENRY ST
KEATING AVE
INDUSTRIAL BLVD
PORT CITY BLVD
EVANSTON AVE
BLACK CREEK RD
SHERIDAN RD
OLTHOFF DR
SHERMAN BLVD
9TH ST
PARK ST
HOYT ST
6TH ST
PECK ST
GETTY ST
SEAWAY DR

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CITY OF MUSKEGON
MUSKEGON COUNTY, MI

TRAFFIC SIGNAL LOCATIONS
SEPTEMBER 2022

Prein&Newhof

2220754

WEST

Bear Lake

Muskegon Lake

Lake Michigan

Laketon Township

City of North Muskegon

City of Muskegon

City of Muskegon Heights

City of Norton Shores

City of Roosevelt Park

Ruddiman Creek

MEMORIAL DR

RUDDIMAN DR

SHORELINE DR

MORRIS AVE

4TH ST

6TH ST

7TH ST

8TH ST

9TH ST

MUCT-BA

BEACH STREET RD

BEACH ST

SOUTHERN AVE

MONTGOMERY AVE

MUCT-04

MUCT-07

LAKETON AVE

LAKESHORE DR

NEW

ADDISON ST

MCGRAFT PARK RD

MUCT-BB

BARCLAY ST

MUCT-03

HENRY ST

SEAWAY DR

PARK ST

LINCOLN ST

LEBOEUF ST

MUCT-29

MUCT-30

MUCT-26

MUCT-28

SHERMAN BLVD

LEGEND

Traffic Signal

0 750 1,500 3,000 Feet

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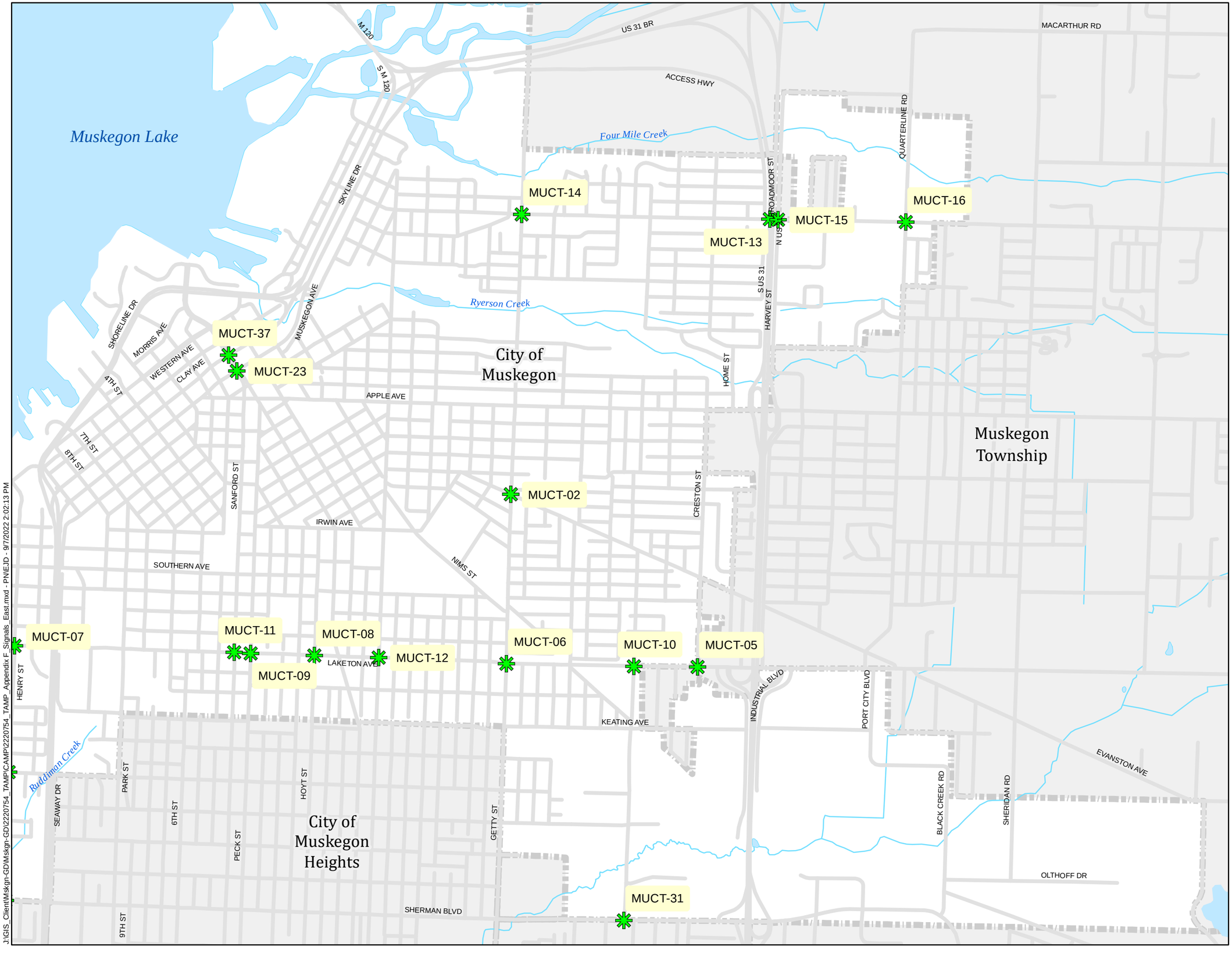
CITY OF MUSKEGON
MUSKEGON COUNTY, MI

TRAFFIC SIGNAL LOCATIONS
SEPTEMBER 2022

Prein&Newhof

2220754

EAST



LEGEND

Traffic Signal

0 750 1,500 3,000 Feet

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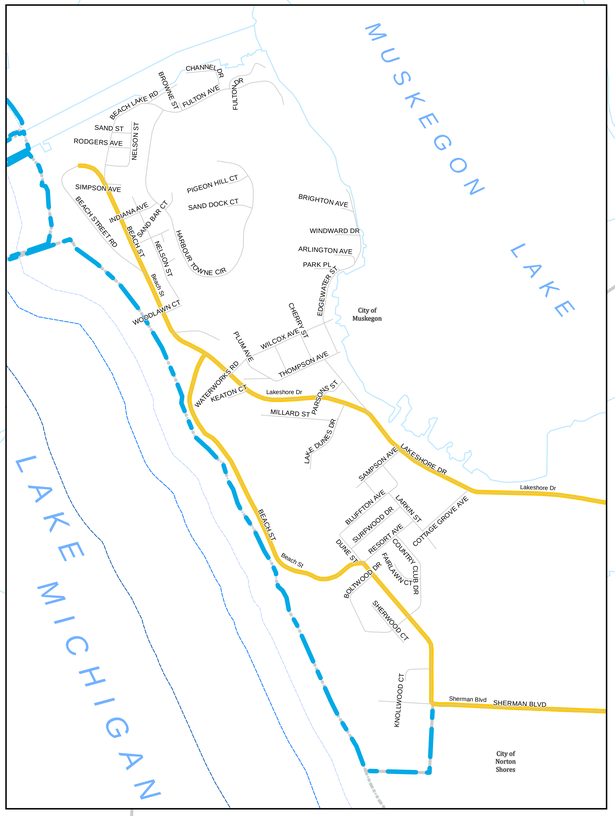

0 250 500 1,000 1,500 2,000 Feet

LEGEND

City of Muskegon Boundary

City of Muskegon Key Route

CITY OF MUSKEGON

KEY ROUTES

AUGUST 2022

Prein&Newhof

2220754