City of Rochester Hills 2021 Transportation Asset Management Plan

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

Adopted [CC Approval Date]

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EXECUTIVE SUMMARY

As conduits for commerce and connections to vital services, roads and bridges are some of the most important assets in any community, and other assets like culverts, traffic signs, traffic signals, and utilities support and affect roads and bridges. The City of Rochester Hills's (CoRH) roads, bridges, and support systems are some of the most valuable and extensive public assets, 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. This asset management plan is intended to report on how CoRH is meeting its obligations to maintain the public assets for which it is responsible.

This plan identifies CoRH's assets and condition and how CoRH maintains and plans to improve the overall condition of those assets. An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of CoRH'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 CoRH'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 CoRH's assets. Further, this plan gives taxpayers information to make informed decisions about investing in CoRH'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 Rochester Hills 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 Rochester Hills (CoRH) has adopted an "asset management" business process to overcome the challenges presented by having limited financial, staffing, and other resources while needing to meet road users' expectations. CoRH is responsible for maintaining and operating over 266.7 centerline miles of roads and four (4) bridge structures. It is also responsible for 237 culverts and 13 traffic signals.

This 2021 plan identifies CoRH's transportation assets and their condition as well as the strategy that CoRH uses to maintain and upgrade particular assets given CoRH's condition goals, priorities of network's road users, and resources. An updated plan is to be released approximately every three (3) 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 Allan E. Schneck, P.E., Director of Department of Public Services, at 1000 Rochester Hills Drive, Rochester Hills, MI 48309 or at 248-

656-4685 and/or schnecka@rochesterhills.org. A copy of this plan can be accessed on our website at www.rochesterhills.org.

1. PAVEMENT ASSETS

CoRH is responsible for 266.7 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 minor road network.

Inventory of Assets

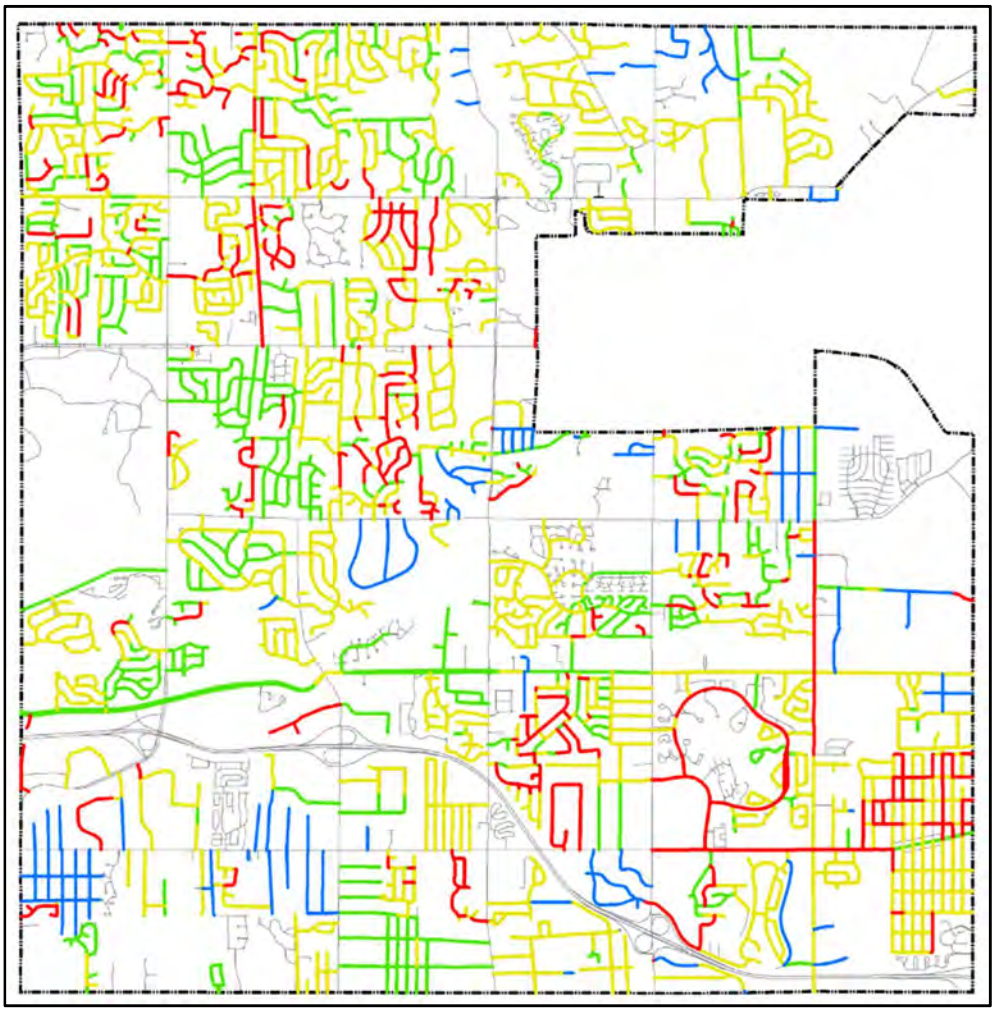

Figure 1: Map showing location or roads managed by CoRH and the current condition for paved roads in green for good (PASER 10, 9, 8), yellow for fair (PASER 7, 6, 5), and red for poor (PASER 4, 3, 2, 1) and for unpaved roads in blue

Of CoRH's 266.7 miles of road, 45.8 miles are classified as city major and 220.9 miles are classified as city minor (Figure 1 identifies these paved roads in green, yellow, and red with the colors being determined based on the road segment's condition). The minor road total includes 21.1 miles of unpaved roads (Figure 1 identifies these unpaved roads in blue).

CoRH manages zero (0) 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.

More detail about these road assets can be found in CoRH's Roadsoft database or by contacting City of Rochester Hills Department of Public Services – Engineering Division.

Types

CoRH has multiple types of pavements in its jurisdiction, including asphalt, concrete, and unpaved roads (i.e., gravel and/or earth). Figure 2 shows a breakdown of these pavement types for all of CoRH's road assets.

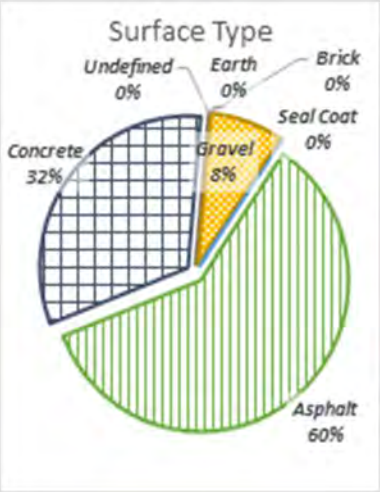

Figure 2: Pavement type by percentage maintained by CoRH. Undefined pavements have not been inventoried in CoRH's asset management system to date, but will be included as data becomes available.

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. CoRH collects PASER data every two (2) years on 100 percent of those portions of its city major and city minor networks that are eligible for federal funding. In addition, CoRH uses its own staff and resources to collect PASER data on 100 percent of its city major and city minor networks that are not eligible for federal funding.

Currently, the city major network has 36% of its roads in good condition, 42% in fair condition, and 22% in poor condition, and the city minor network has 27% of its roads in good condition, 59% in fair condition, and 14% in poor condition (Figure 3 and Figure 4). CoRH's 2024 goal for the city major network is to have 38% of roads in good condition, 43% in fair condition, and 19% in poor condition, and for the city minor network is to have 29% of roads in good condition, 59% in fair condition, and 12% in poor condition (Figure 3 and Figure 4). Figure 3 and Figure 4 illustrate the historical and current

condition (solid bars) of CoRH's city major and city minor networks, respectively; they also illustrate the projected trend (shaded bars), the overall trend in condition (trendlines), and CoRH's goal (final solid bar).

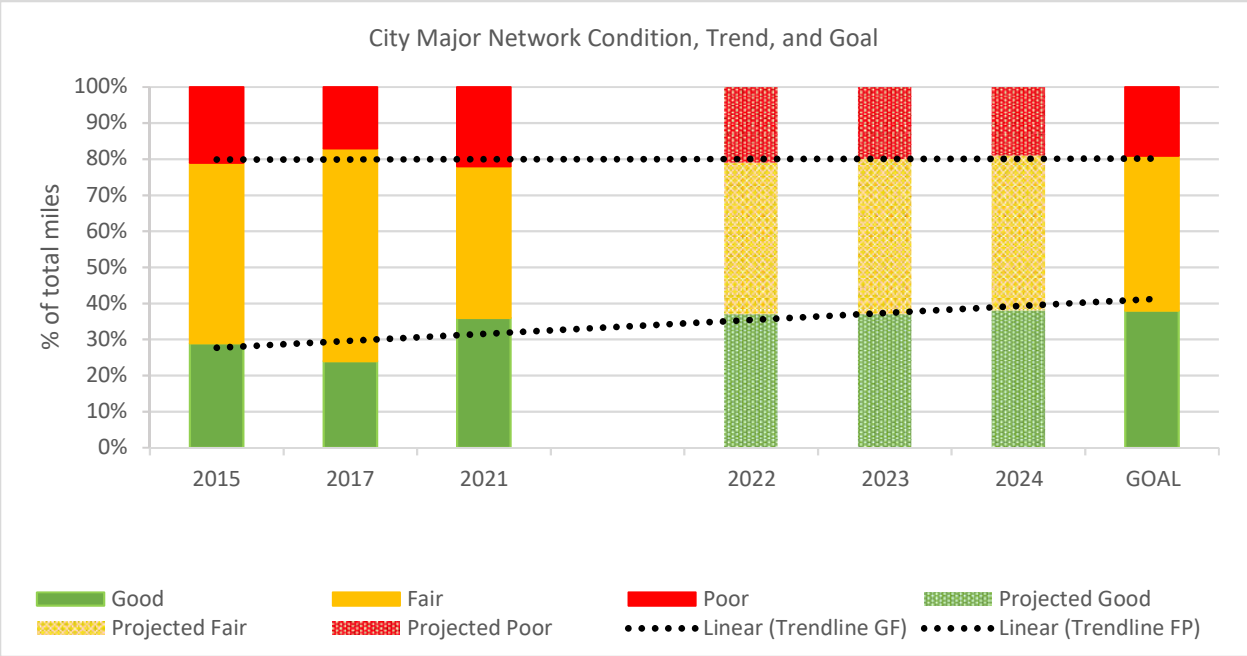

Figure 3: city major network condition, goals, and trend

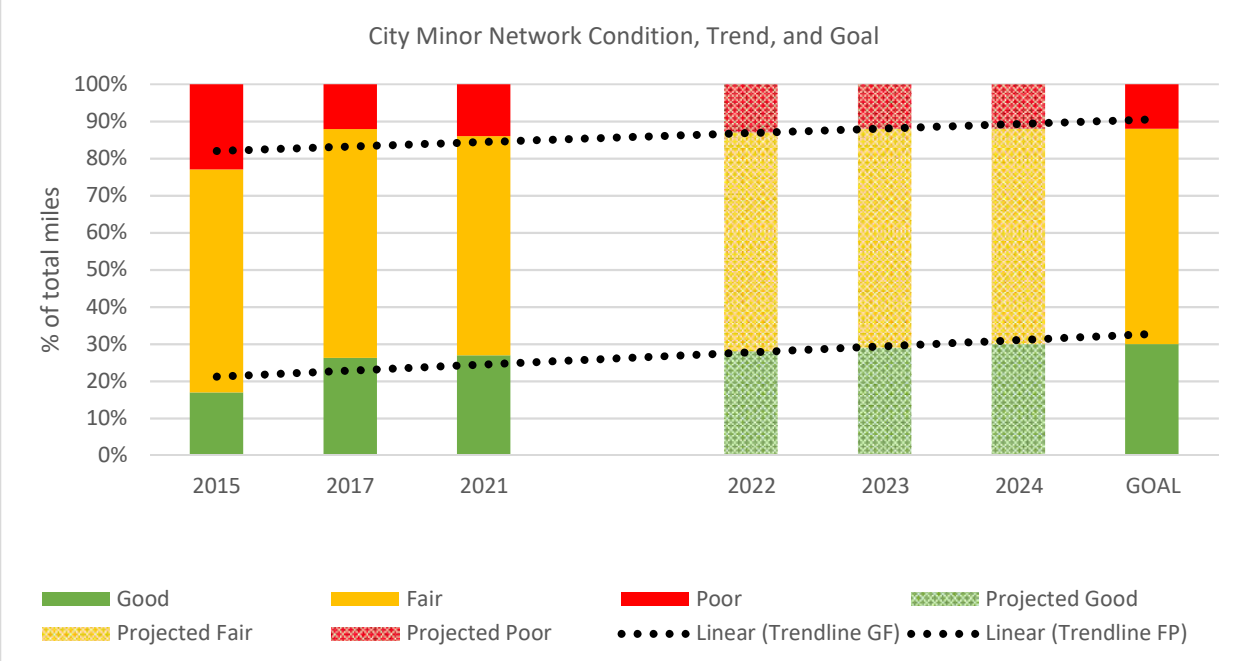

Figure 4: city minor network condition, goals, and trend

Modelled Trends, Gap Analysis, and Planned Projects

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

Network 1: City Major (45.8 miles)

Treatment	Annual Miles of Treatment	Years of Life	Trigger-Reset	Pavement Condition Forecast		Additional Work Necessary to Overcome Deficit	
				Annual Miles of Treatment	Trigger-Reset	Annual Miles of Treatment	Trigger-Reset
Crack Seal	3.25	2	6-7, 7	3.25	6-7, 7		6-7, 7
HMA Rehab.	0.667	10	3, 4-9	1.8	4-5, 9		4-5, 9
HMA Reconstruction	0.667	18	1, 2, 3-10	0.25	1-4, 10		1-4, 10
Concrete Reconstruction	2.039	25	1, 2, 3-10	0.174	1-4, 10		1-4, 10

Network 2: City Minor (220.9 miles)

Treatment	Annual Miles of Treatment	Years of Life	Trigger-Reset	Pavement Condition Forecast		Additional Work Necessary to Overcome Deficit	
				Annual Miles of Treatment	Trigger-Reset	Annual Miles of Treatment	Trigger-Reset
Crack Seal	19	2	6-7, 7	19	6-7, 7		6-7, 7
HMA Rehab.	3.46	10	4-5, 9	4.8	4-5, 9		4-5, 9
HMA Reconstruction	0.5	18	1-4, 10	---	1-4, 10		1-4, 10
Concrete Reconstruction	1.8	25	1-4, 10	1.3	1-4, 10		1-4, 10

Modelled Trends & Gap Analysis

The Roadsoft network analysis of CoRH's planned projects for the city major and city minor networks from CoRH's currently-available budget does allow CoRH to reach its pavement condition goals given the projects planned for the next three (3) years.

Unpaved Road Condition Trends

Currently, the CoRH does not rate its unpaved roads. The city improves unpaved roads on an as-needed basis to provide service or to address safety concerns. The expected condition trend for the city's unpaved road network will be to improve or maintain at their current condition for the next three (3) years.

Planned Projects

CoRH has projects planned for the next three (3) years. These projects are identified in Figure 5.

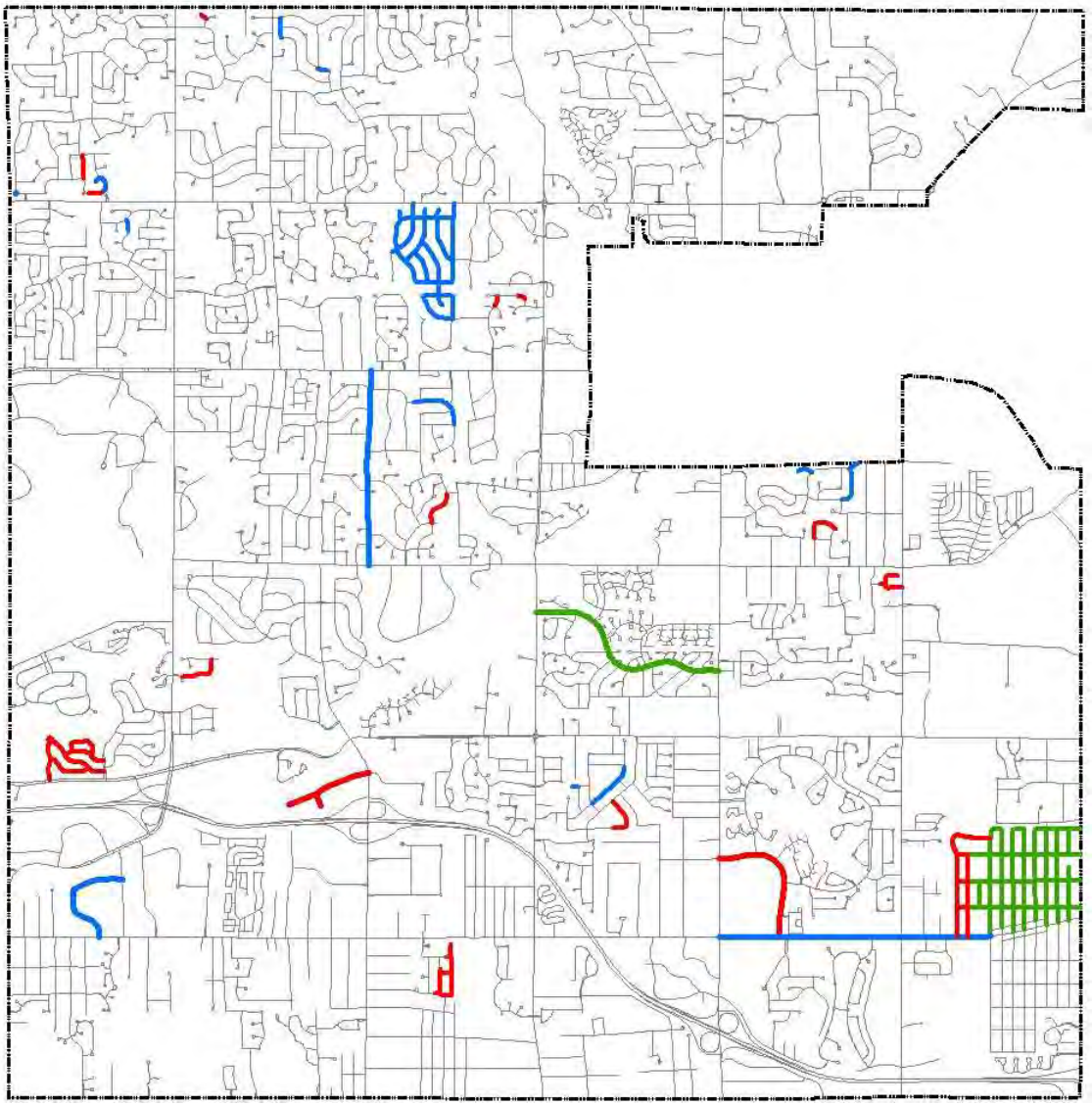

Figure 5 : Map illustrating planned projects for pavement assets. 2022 planned projects are in blue, 2023 in red, and 2024 in green.

The total cost of the projects illustrated in Figure 5 is approximately $24,120,250.

2. BRIDGE ASSETS

CoRH is responsible for four (4) bridges that provide safe service to road users across the agency network. CoRH has implemented 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

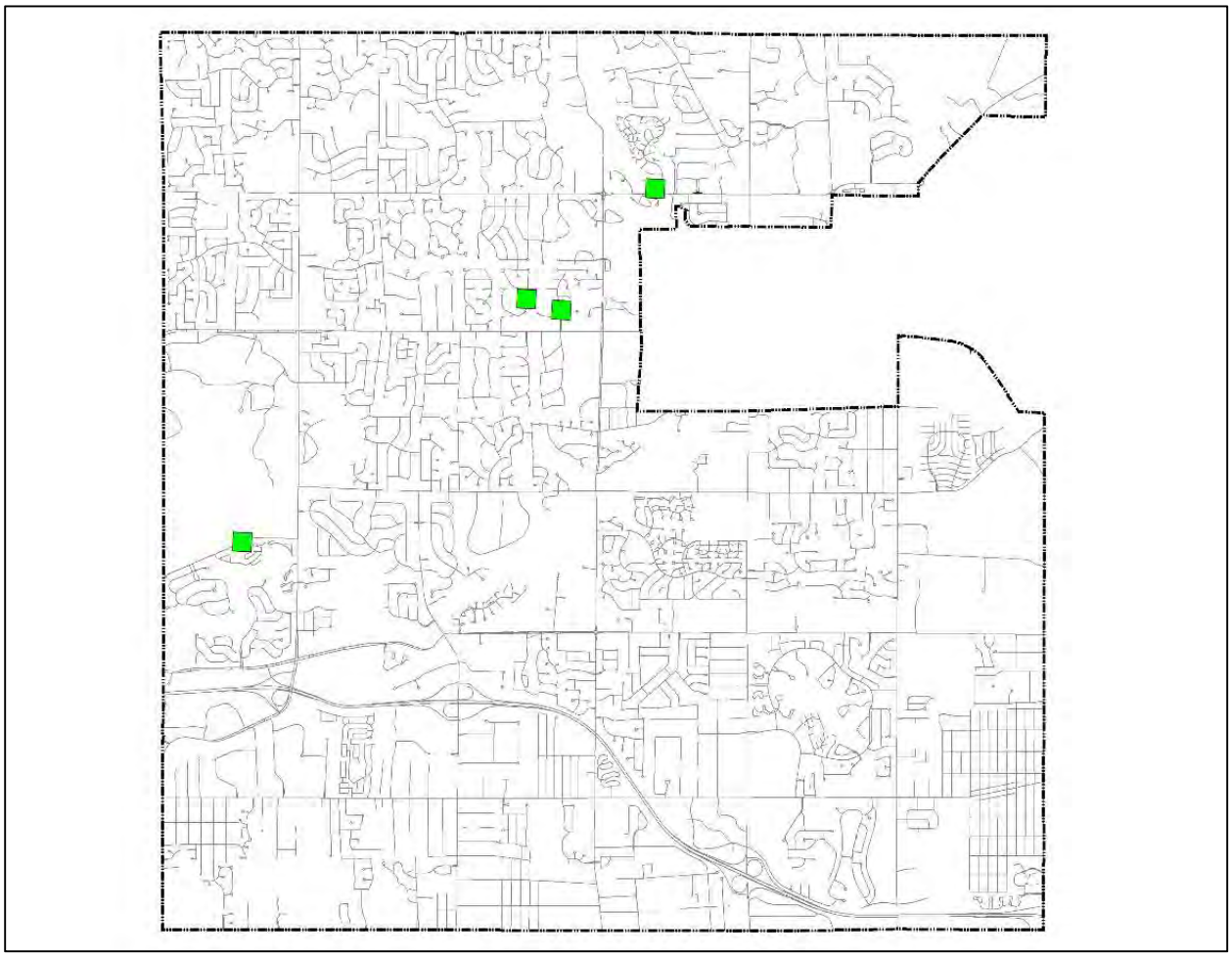

Figure 6: Map illustrating locations of CoRH's bridge assets

CoRH has four (4) total bridges in its road and bridge network; these bridges connect various points of the road network, as illustrated in Figure 6. 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 CoRH's MiBRIDGE database or by contacting City of Rochester Hills Department of Public Services – Engineering Division.

Table 2: Type, Size, and Condition of CoRH's Bridge Assets								
	Total Number of Bridges	Total Deck Area (sq ft)	Condition: Structurally Deficient, Posted, or Closed			2020 Condition		
Bridge Type			Struct. Deficient	Posted	Closed	Poor	Fair	Good
Concrete – Culvert	3	3512	0	0	0	0	0	3
Prestressed concrete – Box beam/girders—multiple	1	2820	0	0	0	0	0	1
Total SD/Posted/Closed			**0**	**0**	**0**			
Total	**4**	**6332**				**0**	**0**	**4**
Percentage (%)			**0%**	**0**	**0**	**0**	**0**	**100**

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 CoRH's bridge network based on the NBIS is four (4) structures rated good, zero (0) structures rated fair, and zero (0) structures rated poor (Table 2).

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. CoRH has zero (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. CoRH has zero (0) structures that are closed (Table 2).

The goal of the program is the preservation and safety of CoRH's bridge network.

Figure 7 illustrates the baseline condition, projected trend, and goal that CoRH has for its good/fair and its structurally deficient bridges.

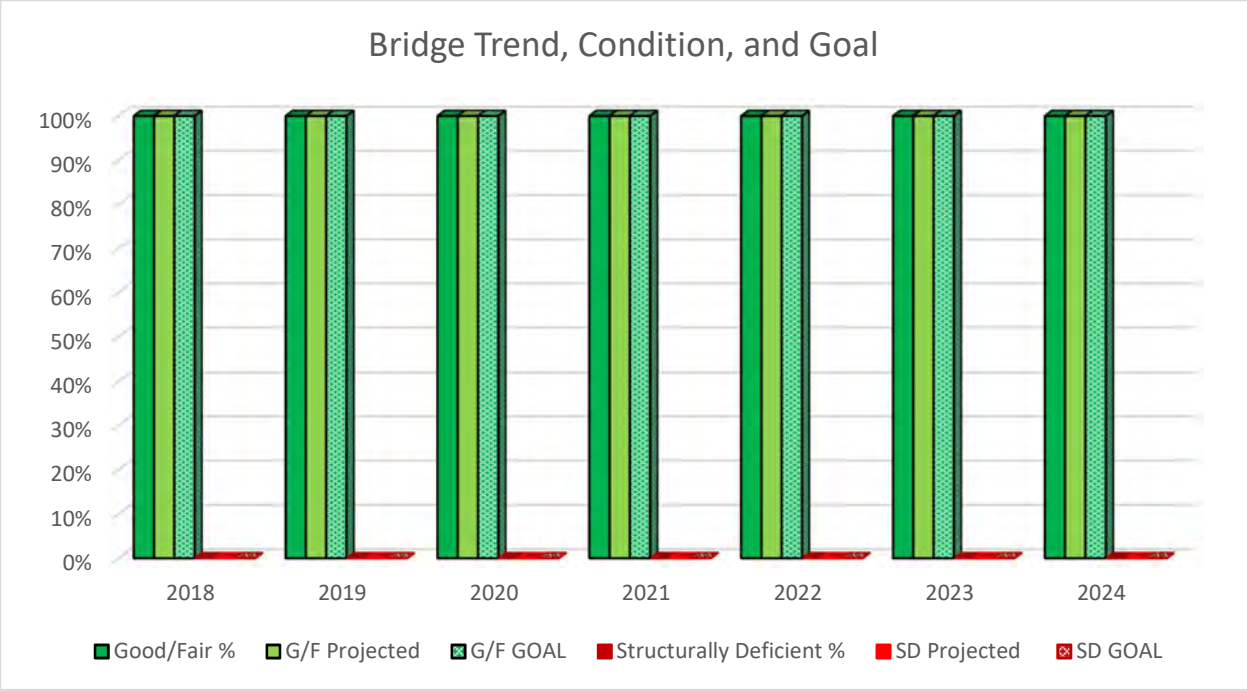

Figure 7: Condition, projected trend, and goal for CoRH's good/fair and structurally deficient bridges

Programmed/Funded Projects, Gap Analysis, and Planned Projects

CoRH will receive $86,000 in total funding for the years 2022-2024. Preventive maintenance is a more effective use of these funds than the costly alternative of major rehabilitation or replacement. Since CoRH recognizes that limited funds are available for improving the bridge network, it seeks to identify those bridges that will benefit from a planned maintenance program, and it plans to spend $29,000 a year for the next three (3) years on preventive maintenance of bridges. CoRH plans to replace zero (0) bridges within the next three (3) years. By performing the aforementioned preventive maintenance of bridge structures, CoRH will achieve its goal of keeping its overall bridge network at the same condition.

The CoRH completed rehabilitation and capital preventative maintenance on all four (4) of its bridges in 2019 at a cost of $364,407.90 and currently does not have any planned bridge projects to take place within the next three (3) years other than scheduled and preventative maintenance items. In-house maintenance crews will perform much of this work.

3. CULVERT ASSETS

Inventory of Assets

At present, CoRH tracks inventory data of its culvert assets only. CoRH has inventoried 237 culverts, with 236 culverts inspected and rated.

At present, CoRH tracks inventory and condition data of its culvert assets. CoRH has inventoried 237 culverts, which is 100 percent of the actual 237 culverts that CoRH owns. Of CoRH's 236 tracked and rated culverts, CoRH has 59 culverts considered good, 159 culverts considered fair, 12 culverts considered poor, and 6 culverts considered failed based on the culvert rating system that CoRH uses (see Appendix C *Culvert Asset Management Plan Supplement*).

More detail about these culvert assets can be found in CoRH's Roadsoft database or by contacting City of Rochester Hills Department of Public Services – Engineering Divison.

Goals

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

Planned Projects

The CoRH's policy is to evaluate culverts for replacement or repair when they are located within the limits of a planned rehabiliation or reconstruction road project.

4. SIGNAL ASSETS

Inventory of Assets

At present, CoRH has an inventory of 13 traffic signals with 100 percent ownership and 55 additional signals the city co-owns or shares in the cost of maintenance. Maintenance and replacement of all traffic signals in the city is performed by Road Commission for Oakland County (RCOC).

More detail about these traffic signal assets can be obtained by contacting City of Rochester Hills Department of Public Services – Engineering Division.

Goals

The goal of CoRH's asset management program is the preservation of its traffic signals. CoRH is responsible for preserving inventoried traffic signals as well as any un-inventoried traffic signals along its entire road network.

Planned Projects

CoRH's policy is to evaluate traffic signal assets based on condition assessment for replacement or repair during any reconstruction, rehabilitation, preventive maintenance, or schedule maintenance activities on the roadway affected by the particular signal. It also conducts replacements or repairs for those traffic signal assets reported as non-functional or as performing with reduced function. CoRH adheres to regular maintenance and servicing policies outlined in the *Michigan Manual of Uniform Traffic Control Devices*.

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, CoRH 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 CoRH's financial status can be found on our website at www.rochesterhills.org/fiscal or by request submitted to our agency contact (listed in this plan).

Anticipated Revenues & Expenses

CoRH receives funding from the following sources:

- **State funds** – CoRH'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. 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. CoRH has local tax millages in its road-funding budget. One (1) local street millage up to 1.0965 mill (limited to 1.0868 mill by Headlee rollback) for ten (10) years through FY 2030 for local street improvements and maintenance.
- **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 CoRH to construct or maintain its roads, or roads under joint or neighboring jurisdictions, including state trunkline maintenance and non-maintenance services and preservation.

CoRH 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] 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

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

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 CoRH'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 revenues and expenditures for CoRH.

Table 3: Annual Fiscal-Year Revenues & Expenditures per 2019 Fiscal Year

Revenues		Expenditures		
Item	**Estimated $**	**Item**	**Estimated $**	**Percent of Total**
State funds	$8,593,268	Construction & capacity improvement (CCI)	$20,464,142.00	79
Federal funds	$0	Preservation & structural improvement (PSI)	$3,276,223.00	13
Contributions from local units	$15,127,451	Routine maintenance	$1,166,470.00	4
Interest, rents, and other	$994,021	Winter maintenance	$1,021,039.00	4
Charges for services	$0	Trunkline maintenance	$0.00	0
		Administrative	$85,788.00	0
		Other	$0.00	0
TOTAL	$24,714,740	TOTAL	$26,013,662.00	

https://www.mcgi.state.mi.us/mitrp/Data/PaserDashboard.aspx

[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 CoRH 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. Key transportation links include:

- **Geographic divides:** Areas where a geographic feature (river, lake, hilly terrain, or limited access road) limits crossing points of the feature; bridge failures, in particular, can create loss of access to entire regions of the state
- **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
- **Limited access areas:** Roads and bridges that serve remote or limited access areas that result in long detours if closed
- **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
- Our road network includes the following critical assets: Butler bridge over Galloway Creek, Kings Cove bridge over Paint Creek, Rochdale bridge over Sargent Creek, and Shagbark bridge over Sargent Creek. Overall, all four (4) bridges are in good condition with a rating of eight (8) but did receive a scour critical rating of three (3) during the last inspection which took place in 2020. Inspections take place on “even years’ and repairs on “odd years”. Necessary repairs and preventative maintenance as identified in the 2020 inspection report are scheduled for 2021.

CoRH's road network includes the following critical assets: Hamlin Road, E. Auburn Road (Rochester Rd to Dequindre), John R Road, Barclay Circle, Hampton Circle, Butler Road, Old Perch Road, Brewster Road, and Tienken Road (Adams west to city limits). Roads within the city not under city jurisdiction but are critical to road users and considered critical assets are: Livernois Road, Tienken Road, Walton Boulevard, Dequindre Road, South Boulevard, Adams Road, Crooks Road, and Avon Road, all owned and maintained by Road Commission for Oakland County (RCOC), and M-59, Auburn Road, and Rochester Road, owned and maintained by Michigan Department of Transportation (MDOT). Figure 8 illustrates the key transportation links in the city's road and bridge network.

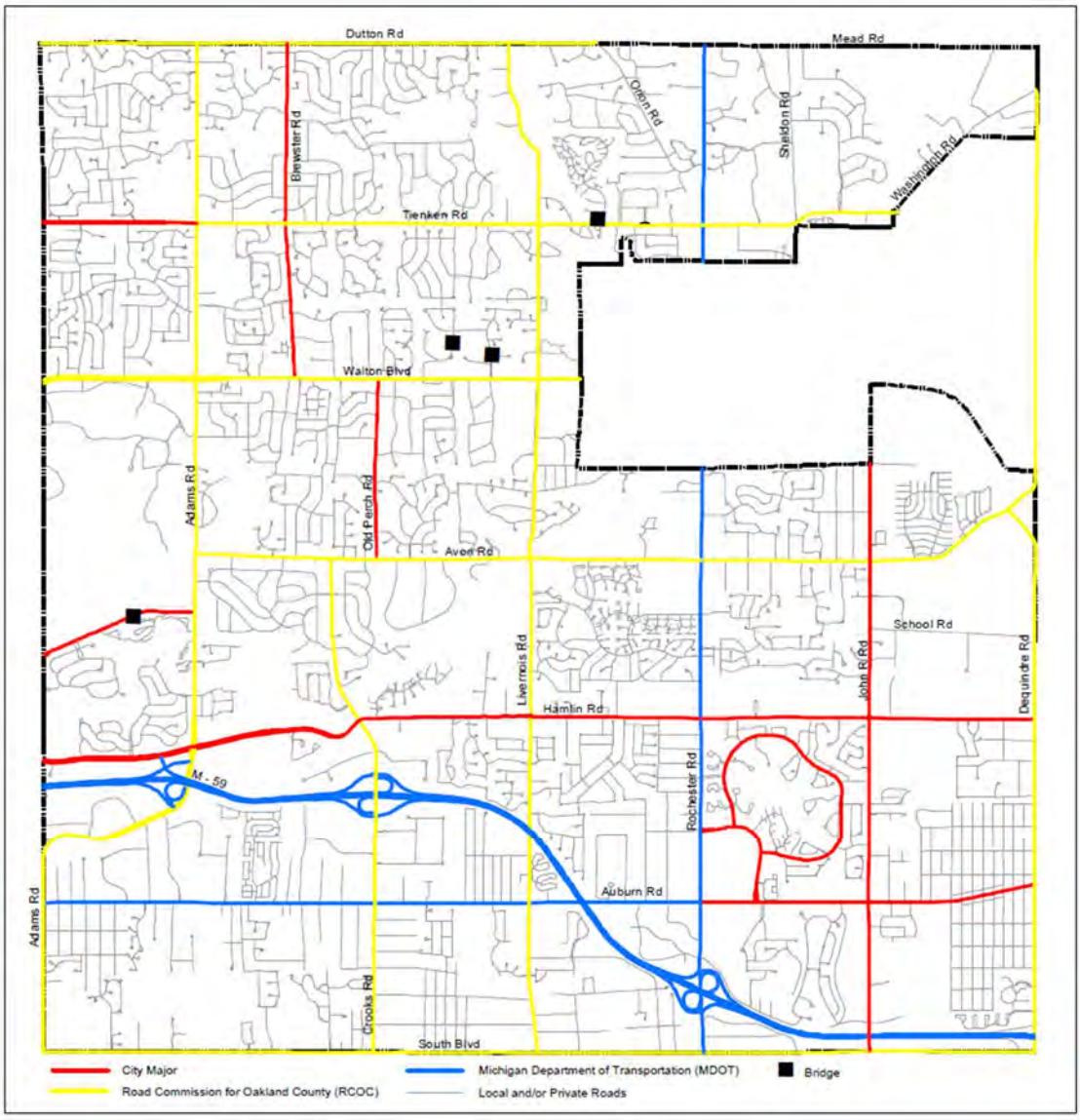

Figure 8: Key transportation links in CoRH's road and bridge network

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. CoRH communicates with both public and private infrastructure owners to coordinate work in the following ways:

INTERNAL COORDINATED PLANNING

CoRH maintains drinking water, sanitary, and storm sewer assets in addition to transportation assets. CoRH 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 CoRH owns are listed in the city's Capital Improvement Plan (CIP). The three (3) sub-surface utility projects are coordinated with the transportation infrastructure plans to maximize value and minimize service disruptions and cost to the public.

CoRH 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.

COORDINATION WITH OUTSIDE AGENCIES

CoRH meets with multiple outside agencies to share upcoming planned projects. CoRH attends a biannual coordination meeting hosted by MDOT to coordinate and mitigate disruption to transportation services. Mitigation measures could include rescheduling and coordinating projects to maximize value and minimize disruptions and cost to the public. This meeting is also attended by RCOC and various other agencies.

The CoRH also attends quarterly Oakland County Water Resource Commission meetings where projects are discussed.

Coordination with private utility companies is becoming more prevalent but does not happen on an annual basis. There are multiple private utility companies within the city with various priorities and it can be difficult to plan projects accordingly. However, the CoRH maintains communication with private utility companies and coordinates projects when feasible.

8. PROOF OF ACCEPTANCE

PUBLIC ACT 325

CERTIFICATION OF TRANSPORTATION ASSET MANAGEMENT PLAN

Certification Year: _____

Local Road-owning Agency Name: _____

Beginning October 2019 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, bridge, culvert, and traffic signal 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 chairperson of the local road-owning agency or the county executive and chief financial officer of the local road-owning agency.

Signature		Signature	
Printed Name		Printed Name	
Title	Date	Title	Date

Due every three years based on agency submission schedule

Submittal Date: _____

See attached council meeting minutes and/or resolution.

A. PAVEMENT ASSET MANAGEMENT PLAN

An attached pavement asset management plan follows.

City of Rochester Hills
2021 Pavement
Asset Management Plan

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

Adopted [CC Approval Date]

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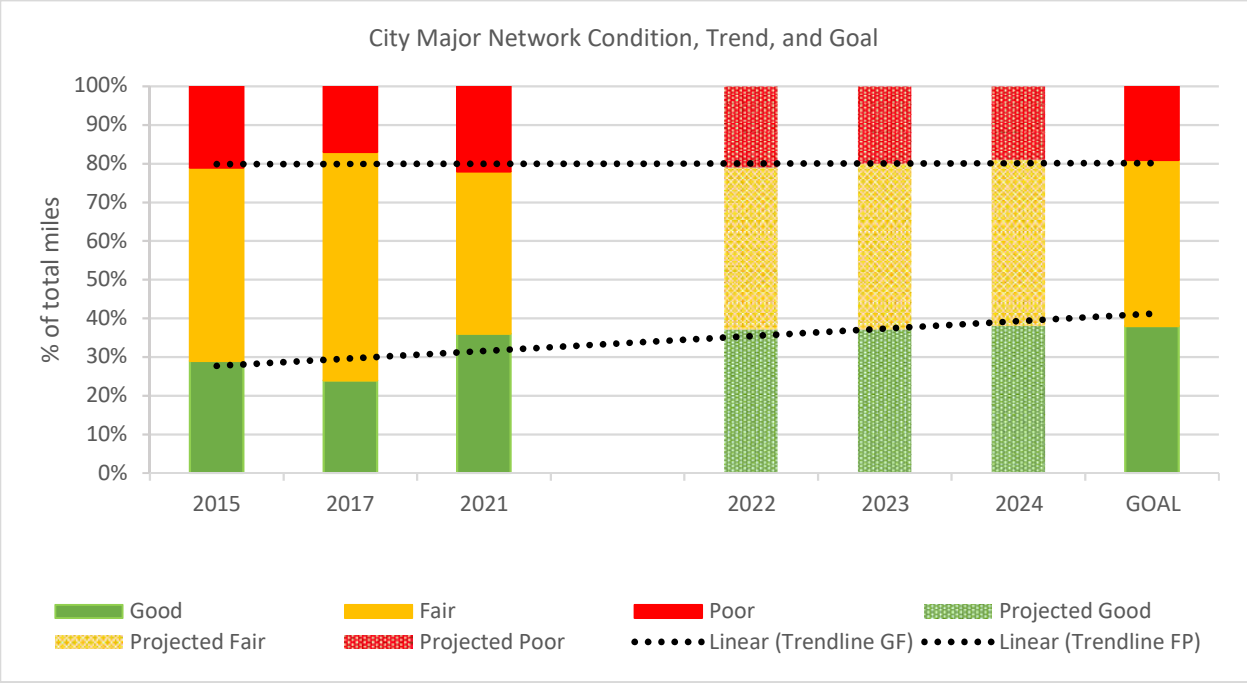
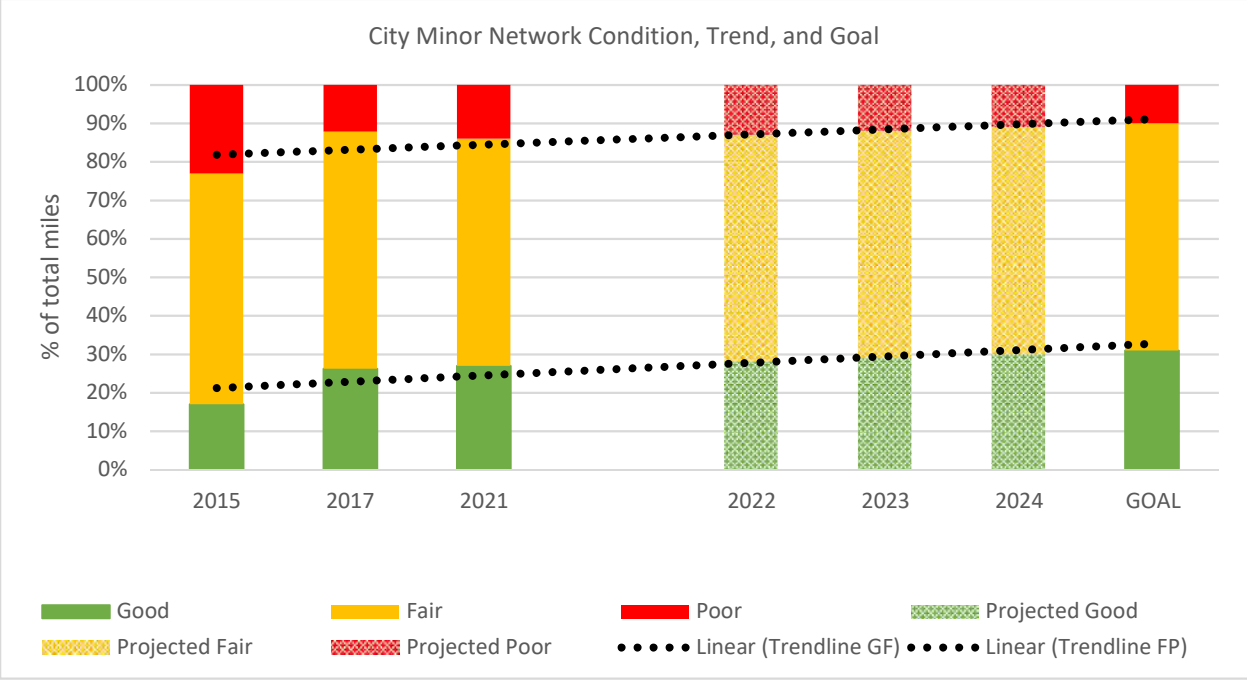
This plan overviews CoRH's road assets and condition, and explains how CoRH works to maintain and improve the overall condition of those assets. These explanations can help answer the following questions:

- What types of road assets CoRH has in its jurisdiction, who owns them, and the different options for maintaining these assets.
- What tools and processes CoRH uses to track and manage road assets and funds.
- What condition CoRH's road assets are in 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 agency transportation assets are funded and where those funds come from.
- How funds are used and the costs incurred during CoRH's road assets' normal life cycle.
- What condition CoRH can expect of its road's 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 CoRH's road assets.

CoRH owns and/or manages 266.7 centerline miles of roads. This road network can be divided into the city major network, the city minor network, and the unpaved road network based on the different factors these roads have that influence asset management decisions. A summary of CoRH historical and current network conditions, projected trends, and goals for city major network and city minor network can be seen in the two figures, below:


City Major Network Condition, Trend, and Goal
% of total miles
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2015
2017
2021
2022
2023
2024
GOAL
Good
Fair
Poor
Projected Good
Projected Fair
Projected Poor
Linear (Trendline GF)
Linear (Trendline FP)


City Minor Network Condition, Trend, and Goal
% of total miles
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2015
2017
2021
2022
2023
2024
GOAL
Good
Fair
Poor
Projected Good
Projected Fair
Projected Poor
Linear (Trendline GF)
Linear (Trendline FP)

An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of CoRH's obligations towards meeting these requirements. This asset management plan also helps demonstrate CoRH's responsible use of public funds by providing elected and appointed officials as well as the general public with inventory and condition information of CoRH's road assets, and gives taxpayers the information they need to make informed decisions about investing in its 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). CoRH 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 Rochester Hills (CoRH) has adopted an "asset management" business process to overcome the challenges presented by having limited financial, staffing, and other resources while needing to meet road users' expectations. CoRH is responsible for maintaining and operating over 266.7 centerline miles of roads.

This plan outlines how CoRH determines its strategy to maintain and upgrade road asset condition given agency goals, priorities of its road users, and resources provided. An updated plan is to be released approximately every three (3) years to reflect changes in road conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to Allan E. Schneck, P.E., Director of Department of Public Services, at 1000 Rochester Hills Drive, Rochester Hills, Michigan 48309 or at schnecka@rochesterhills.org and/or (248)656-4685. Key terms used in this plan are defined in CoRH's

comprehensive transportation asset management plan (also known as the "compliance plan") used for compliance with PA 325 of 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 25 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 20 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 have 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. CoRH 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

CoRH 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. CoRH 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, composite, sealcoat, and brick-and-block paved roads. Broad use of the PASER system means that data collected at CoRH 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 proactive preventative maintenance (PPM). 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 comparison. The TAMC’s definitions provide a statewide standard for all of Michigan’s road-owning agencies to use for 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, CoRH collects 100 percent of its paved non-federal-aid-eligible network using its own staff and resources.

Unpaved Road Condition Rating System (IBR System™)

The condition of unpaved roads can be rapidly changing, which makes it difficult to obtain a consistent surface condition rating over the course of weeks or even days. The PASER system works well on most paved roads, which have a relatively-stable surface condition over several months, but it is difficult to adapt to unpaved roads. To address the need for a reliable condition assessment system for unpaved roads, the TAMC adopted the Inventory Based Rating (IBR) System™, and CoRH will begin using the IBR System™ for rating its unpaved roads. Information about the IBR System™ can be found at http://ctt.mtu.edu/inventory-based-rating-system.

Figure 2: *Top*– Road with IBR number of 1 road that has poor surface width, poor drainage adequacy, and poor structural adequacy. *Middle*– Road IBR number of 7 that has fair surface width, fair drainage adequacy, and fair structural adequacy. *Bottom*– Road with IBR number of 9 road that has good surface width, good drainage adequacy, and good structural adequacy.

The IBR System™ gathers reliable condition assessment data for unpaved road by evaluating three features—surface width, drainage adequacy, and structural adequacy—in comparison to a baseline, or generally considered “good”, road. These three assessments come together to generate an overall 1-10 IBR number. A high IBR number reflects a road with wide surface width, good drainage, and a well-designed and well-constructed base, whereas a low IBR number reflects a narrow road with no ditches and little gravel. A good, fair, or poor assessment of each feature is not an endorsement or indictment of a road’s suitability for use but simply provides context on how these road elements compare to a baseline condition.

Figure 2 illustrates the range over which features may be assessed. The top example in Figure 2 shows an unpaved road with a narrow surface width, little or no drainage, and very little gravel thickness. Using the IBR System™, these assessments would yield an IBR number of “1” for this road. The middle example in Figure 2 shows a

road with fair surface width, fair drainage adequacy, and fair structural adequacy. These assessments would yield an IBR number of "7" for this road. The bottom example in Figure 2 shows a road with good surface width, good drainage adequacy, and good structural adequacy. These assessments would yield an IBR number of "9" for this road.

Unpaved roads are constructed and used differently throughout Michigan. A narrow, unpaved road with no ditches and very little gravel (low IBR number) may be perfectly acceptable in a short, terminal end of the road network, for example, on a road segment that ends at a lake or serves a limited number of unoccupied private properties. However, high-volume unpaved roads that serve agricultural or other industrial activities with heavy trucks and equipment will require wide surface width, good drainage, and a well-designed and well-constructed base structure (high IBR number). Where the unpaved road is and how it is used determines how the road must be constructed and maintained: just because a road has a low IBR number does not necessarily mean that it needs to be upgraded. The IBR number are not an endorsement or indictment of the road's suitability for use but rather, an indication of a road's capabilities to support different traffic volumes and types in all weather.

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, and capital preventive maintenance used by CoRH—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 3). Every pavement has to eventually be reconstructed and it is usually done as a last resort after more cost-effective treatments are done, 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

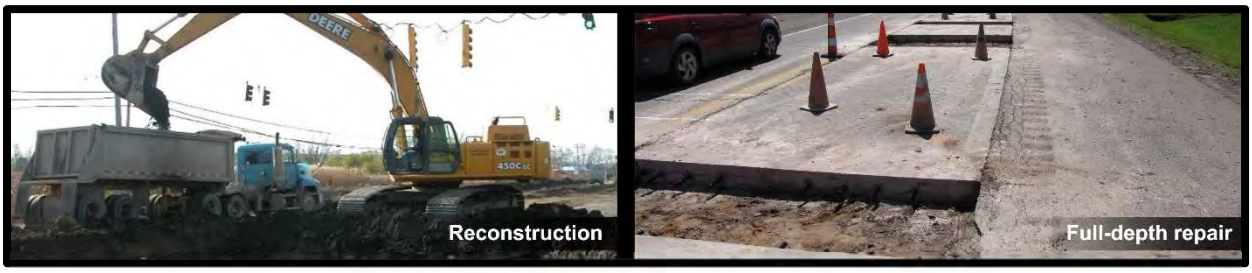


Figure 3: Examples of reconstruction treatments—(left) reconstructing a road and (right) road prepared for full-depth repair.

maximize service life and performance. The following descriptions outline the main reconstruction treatments used by CoRH.

Concrete Reconstruction

A full-depth concrete reconstruction removes all poor condition concrete pavement, including curb and gutter, and replaces with eight inches of new concrete (Figure 3). It is typically the full width of a street from intersection to intersection. Along with new concrete, edge drain is also installed to help improve drainage. The purpose of reconstruction is to restore the riding surface, stop and prevent water infiltration, and eliminate the need to perform costly temporary repairs. This type of reconstruction lasts approximately 25 years and typically costs $1,400,000 per mile.

Hot-Mixed Asphalt (HMA) Reconstruction

A full-depth HMA reconstruction removes all poor condition HMA pavement and replaces it with new asphalt pavement. Normally only the driving surface of the road is replaced, the existing curb and gutter (if in good condition) remain. This type of reconstruction is designed to last a minimum of 20 years and typically costs $1,000,000 per mile.

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 3). 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 12 years and the cost varies depending on the amount of work required.

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 15 years at a cost of $10,000 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

Figure 4: 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.

either rehabilitated with a structural treatment. Examples of structural improvement treatments include HMA overlay with or without milling, and crush and shape (Figure 4). The following descriptions outline the main structural improvement treatments used by CoRH.

Hot-mixed Asphalt (HMA) Overlay with Milling

HMA overlay with milling consists of removing the top few inches of pavement and overlaying new asphalt over the remaining existing asphalt, as shown in Figure 4. This technique helps prevent structural problems from being quickly reflected up to the new surface. Milling is also done to keep roads at the same height of curb and gutter that is not being raised or reinstalled in the project. This type of structural improvement lasts approximately 10 years and costs $350,000 per 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. 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 main CPM treatments used by CoRH.

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 5). CoRH 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 (2) years and costs $6,500 per lane mile. Even though it does not last very long compared to other treatments, it does not cost very much compared to other treatments. This makes it a very cost effective treatment when CoRH looks at what crack filling costs per year of the treatment's life.

Figure 5: Example of crack sealing capital preventative maintenance

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 6). 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 four (4) to six (6) times per year and each grading costs $800 per mile.

Dust Control (for Unpaved Roads)

Dust control typically involves spraying chloride or other chemicals on a gravel surface to reduce dust loss, aggregate loss, and maintenance (Figure 6). 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 done two (2) to four (4) times per year and each application costs $1,250 per mile.

Figure 6: Examples of capital preventative maintenance treatments cont'd (left) gravel road undergoing maintenance grading, (right) gravel road receiving dust control application (dust control photo courtesy of Weld County, Colorado, weldgov.com)

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 CoRH is responsible for a total of 266.7 centerline miles of public roads, as shown in Figure 7.

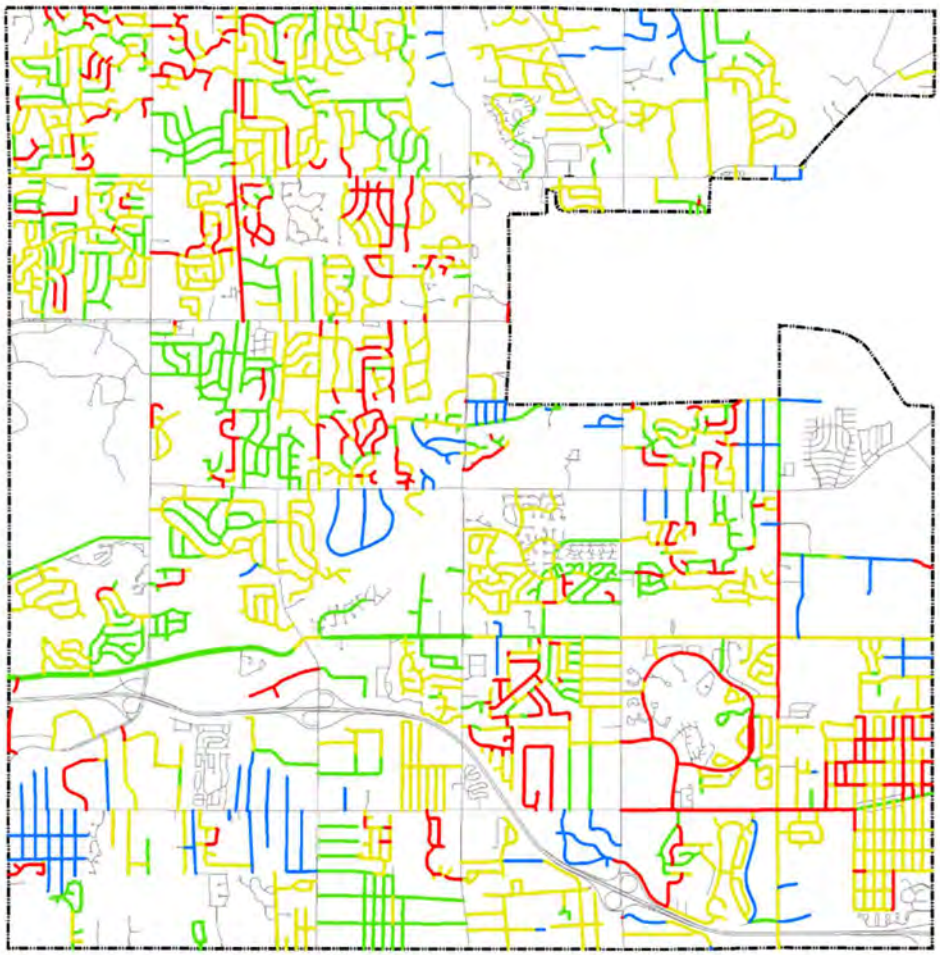


Figure 7: Map showing location of CoRH's paved roads (i.e., those managed by CoRH) and their current condition for paved roads with green for good (i.e., PASER 10, 9, 8), yellow for fair (i.e., PASER 7, 6, 5), and red for poor (i.e., PASER 4, 3, 2, 1), as well as the location of CoRH's unpaved roads 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 CoRH as either city major or city minor roads. State statute prioritizes expenditures on the city major road network.

Figure 8 illustrates the percentage of roads owned by CoRH that are classified as city major and city minor roads.

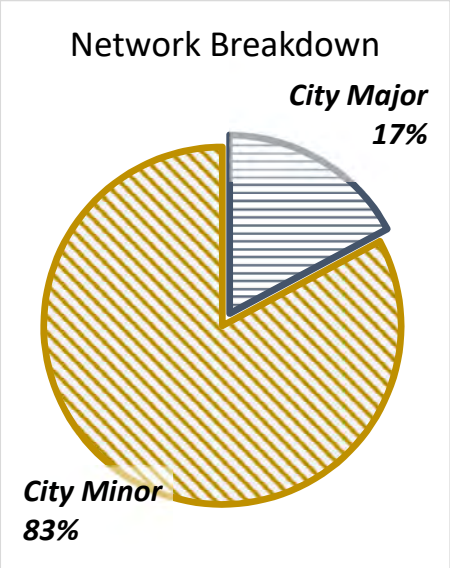


Figure 8: Percentage of city major and city minor roads for CoRH.

The CoRH's road network breaks down to 45.8 miles of city major, 199.8 miles of paved city minor, and 21.1 miles of unpaved city minor roads.

CoRH manages zero (0) 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. Most NHS roads in Michigan are managed by MDOT.

Types

CoRH has multiple types of pavements in its jurisdiction, including: asphalt, concrete, and unpaved roads (i.e., gravel and/or 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 CoRH has in its network.

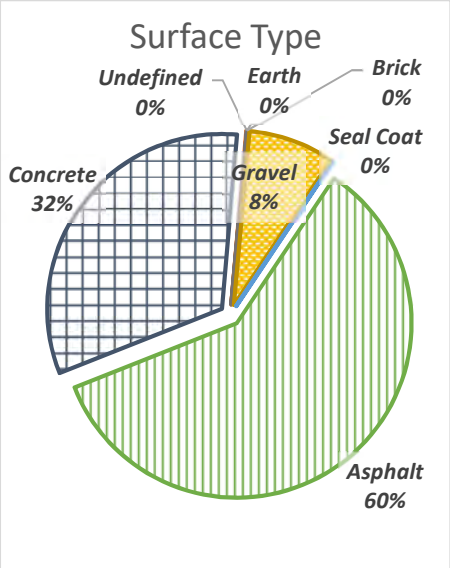


Figure 9: Pavement type by percentage maintained by CoRH Undefined pavements have not been inventoried in CoRH's asset management system to date, but will be included as data becomes available.

Locations

Locations and sizes of each asset can be found in CoRH'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. 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. CoRH 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 CoRH 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

CoRH 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. CoRH 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.

CoRH collects 100 percent of its PASER data every two years on all federal-aid-eligible roads in Michigan. In addition, CoRH collects 100 percent of its paved non-federal-aid-eligible network using its own staff and resources.

CoRH's 2021 paved city major road network has 36 percent of roads in the TAMC good condition category, 42 percent in fair, and 22 percent in poor (Figure 10A). The paved city minor road network has 27 percent in good, 59 percent in fair, and 14 percent in poor (Figure 10B).

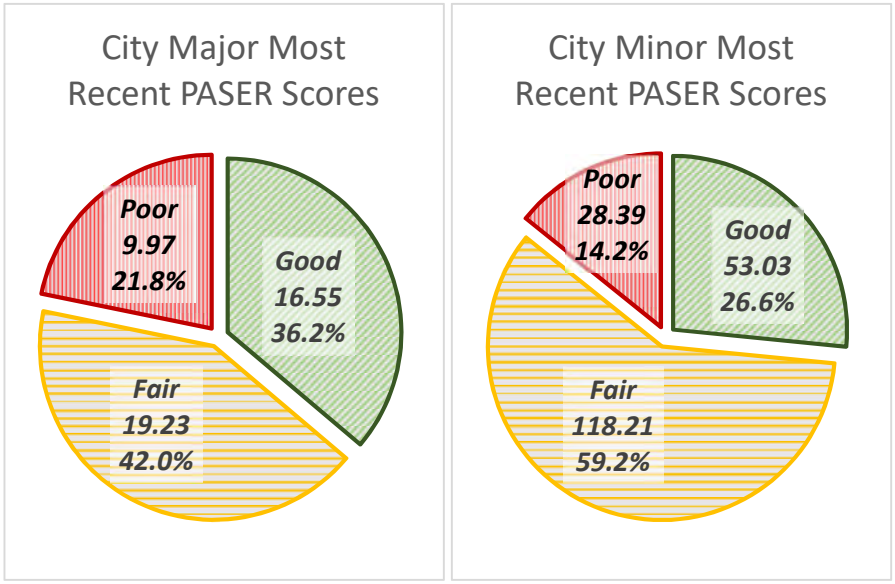


Figure 10: (A) Left: CoRH paved city major road network conditions by percentage of good, fair, or poor, and (B) Right: paved city minor road network conditions by percentage of good, fair, or poor

In comparison, the statewide federal aid (FA) paved city major road network has 21 percent of roads in the TAMC good condition category, 40 percent in fair, and 39 percent in poor (Figure 11A). The statewide non-federal aid (NFA) paved city minor road network has 16 percent in good, 30 percent in fair, and 54 percent in poor (Figure 11B). Comparing Figure 10A and Figure 11A shows that CoRH's paved city major road network is better than similarly-classified roads in the rest of the state, and Figure 10B and Figure 11B also show CoRH's paved city minor road network is better 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.

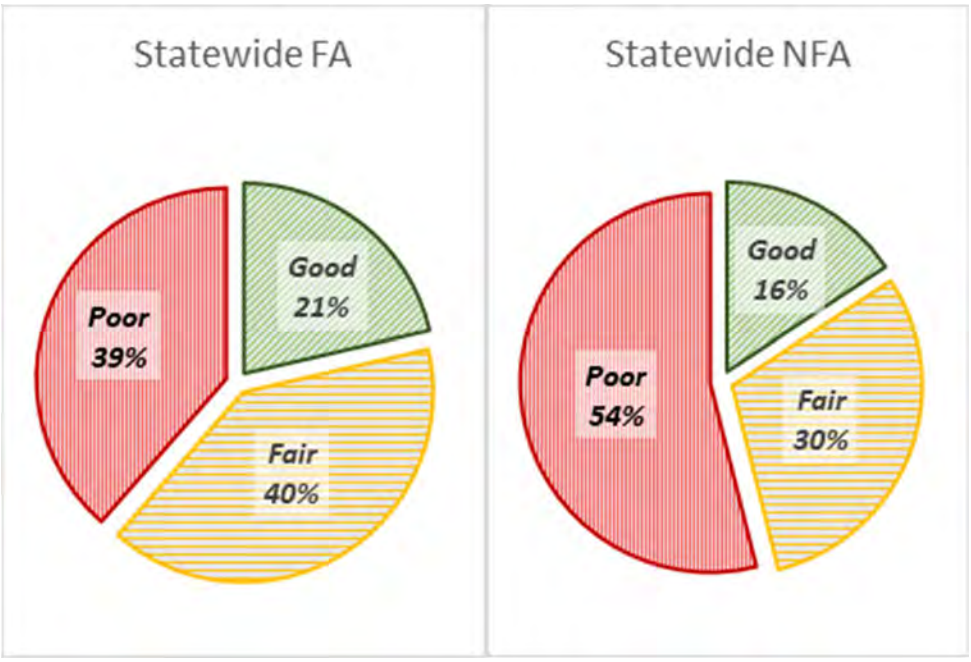


Figure 11: (A) Left: 2018-2019 Statewide paved city major road network conditions by percentage of good, fair, or poor, and (B) Right: 2019 Statewide paved city minor road network conditions by percentage of good, fair, or poor

One of the greatest factors for the differences in good, fair, and poor percentages between the rest of the state and the city is budget. The City of Rochester Hills invests $5,000,000 every year into reconstructing and improving its local road network. This investment has allowed the city to decrease the amount of "poor" rated roads within its jurisdiction. The city also practices capital preventive maintenance by striving to crack seal newly over-laid and reconstructed HMA roads within two years after construction. This practice helps to preserve the integrity and prolong the life of its roads.

Figure 12 and Figure 13 show the number of miles for CoRH's roads with PASER scores expressed in TAMC definition categories for the paved city major road network (Figure 12) and the paved city minor road network (Figure 13). CoRH 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.

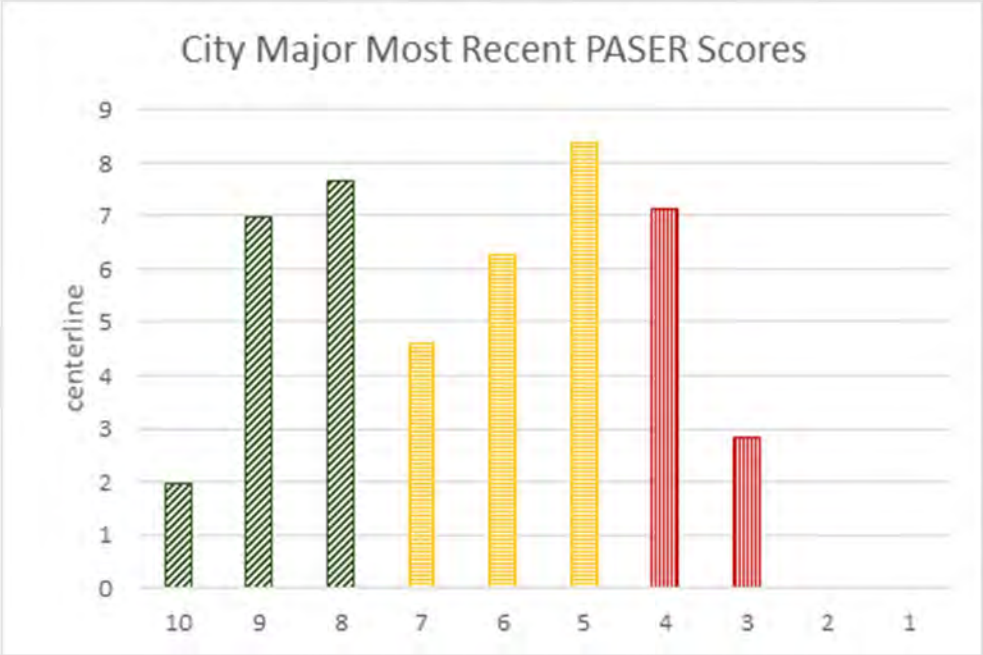


Figure 12: CoRH paved city major road network conditions. Bar graph colors correspond to good/fair/poor TAMC designations.

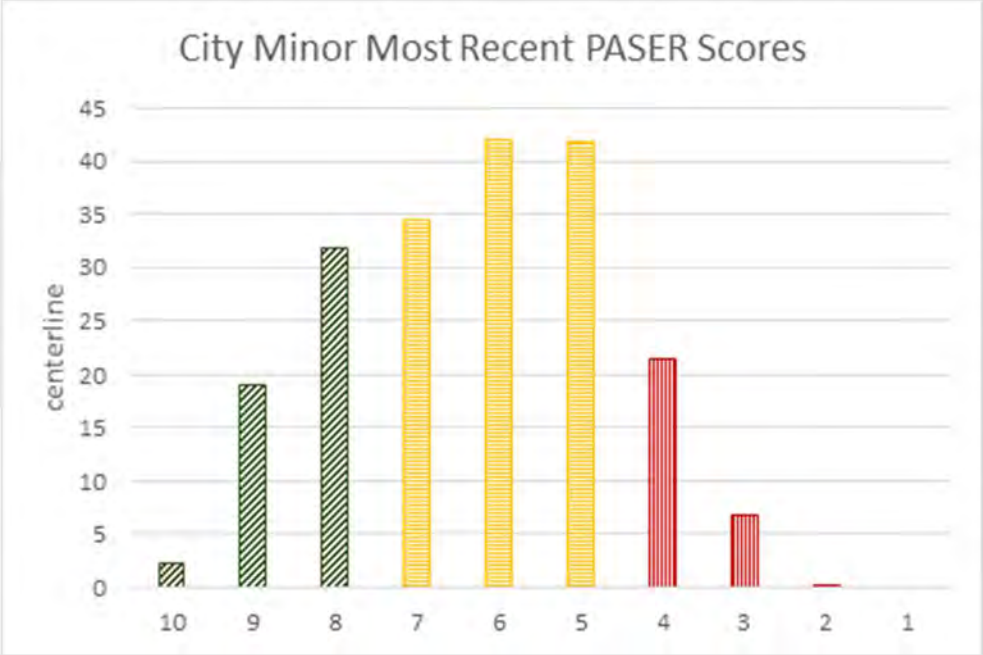


Figure 13: CoRH paved city minor network condition by PASER rating. Bar graph colors correspond to good/fair/poor TAMC designations.

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/.

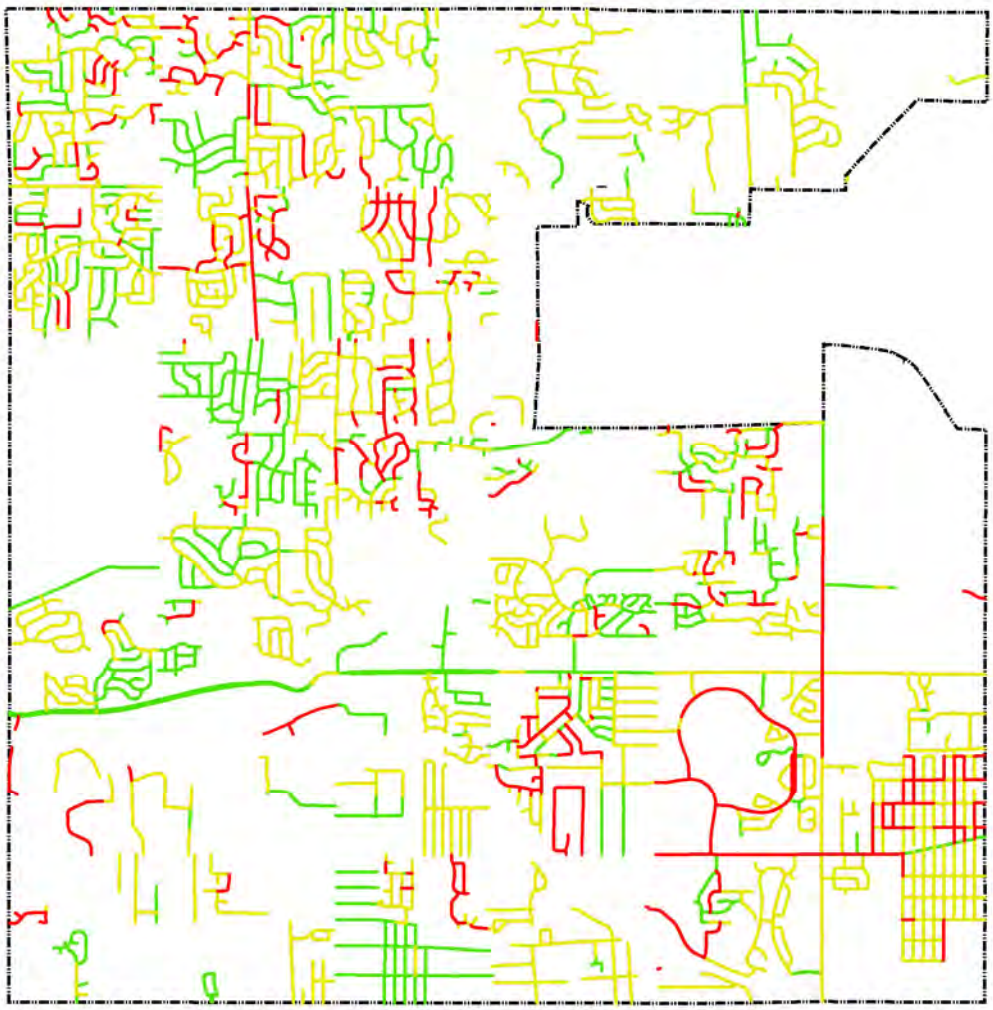


Figure 14: Map of the current paved road condition in good (PASER 10, 9, 8) shown in green, fair (PASER 7, 6, 5) shown in yellow, and poor (PASER 4, 3, 2, 1) shown in red. Only paved roads owned by CoRH are shown.

Historically, the overall quality of CoRH's paved city major roads have been increasing, as can be observed in Figure 15. From 2015 to 2021, the major road network has increased in good condition from 29% to 36%. In the next three (3) years, the city has multiple major asphalt roads budgeted through its Capital Improvement Project (CIP) to continue improving its major road network.

Comparing CoRH'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, shows a different trend locally as in the rest of the state.

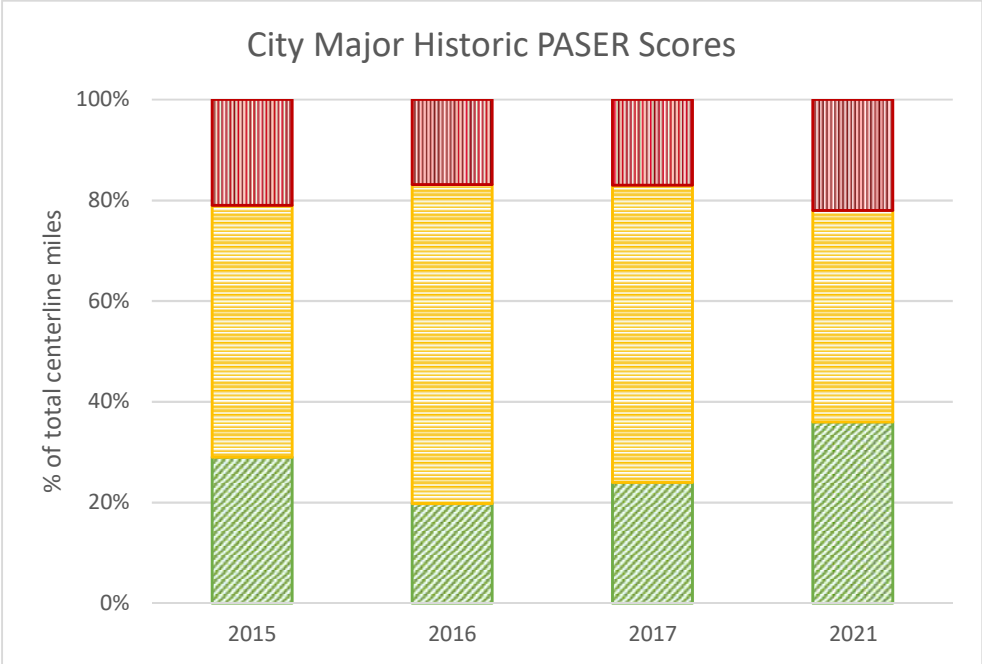


Figure 15: Historical CoRH paved city major road network condition trend

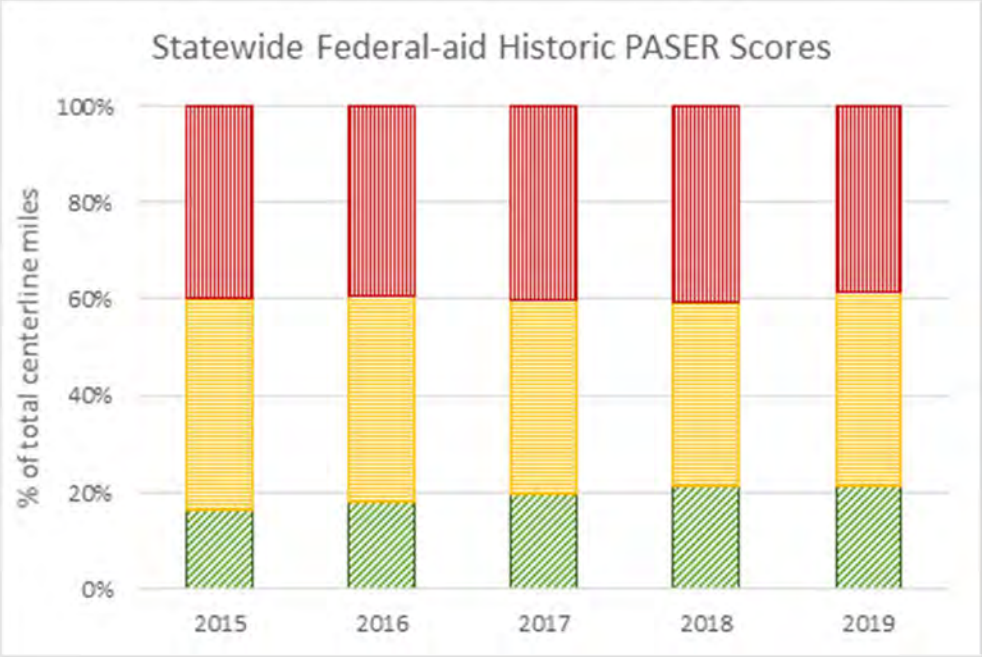


Figure 16: Historical statewide city major road network condition trend

Historically, the overall quality of CoRH's paved city minor roads have been increasing compared to the rest of the state because although they lack a source of state and federal funding and therefore must be

supported locally, The CoRH supports its city minor road network by budgeting $5,000,000 each year to improve its local roads.

The decrease in overall condition of the city's paved city minor road system can be observed in Figure 21 by noting the slight increase in roads in poor condition. Between 2015 and 2020 the percentage of roads in poor condition decreased from 17% of the network to 12% of the network. In 2021, the percentage of roads in poor condition increased slightly to 14%. This can be attributed to utilizing funding towards reconstruction of concrete roads instead of structural improvements, like overlay and milling. The costs to reconstruct a road outweigh the costs to overlay, so where the city could overlay eight (8) miles of asphalt roads it can only reconstruct two (2) miles utilizing the same amount of funding. This change in practice affects the overall rating condition of the city's network short term, but is essential in order to improve the condition of the city's concrete road network. To offset the risk of asphalt roads decreasing in condition, the city is planning a HMA program over the next three (3) years to tackle poor condition asphalt roads in its network.

Comparing CoRH's paved city minor road condition trends illustrated in Figure 17 with overall statewide condition trends for all paved city minor roads illustrated in Figure 18 indicates a different trend locally as in the rest of the state. This change in condition trends can be directly attributed to the funding CoRH is able to invest in its city minor road network.

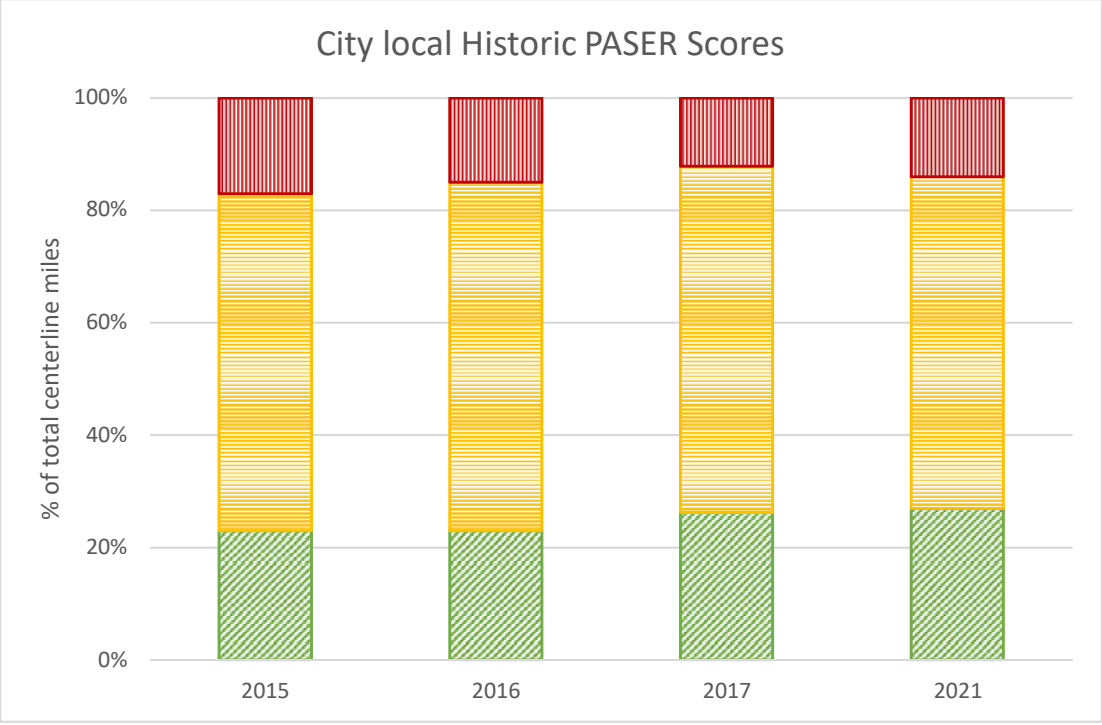


Figure 17: Historical CoRH paved city minor road network condition trend

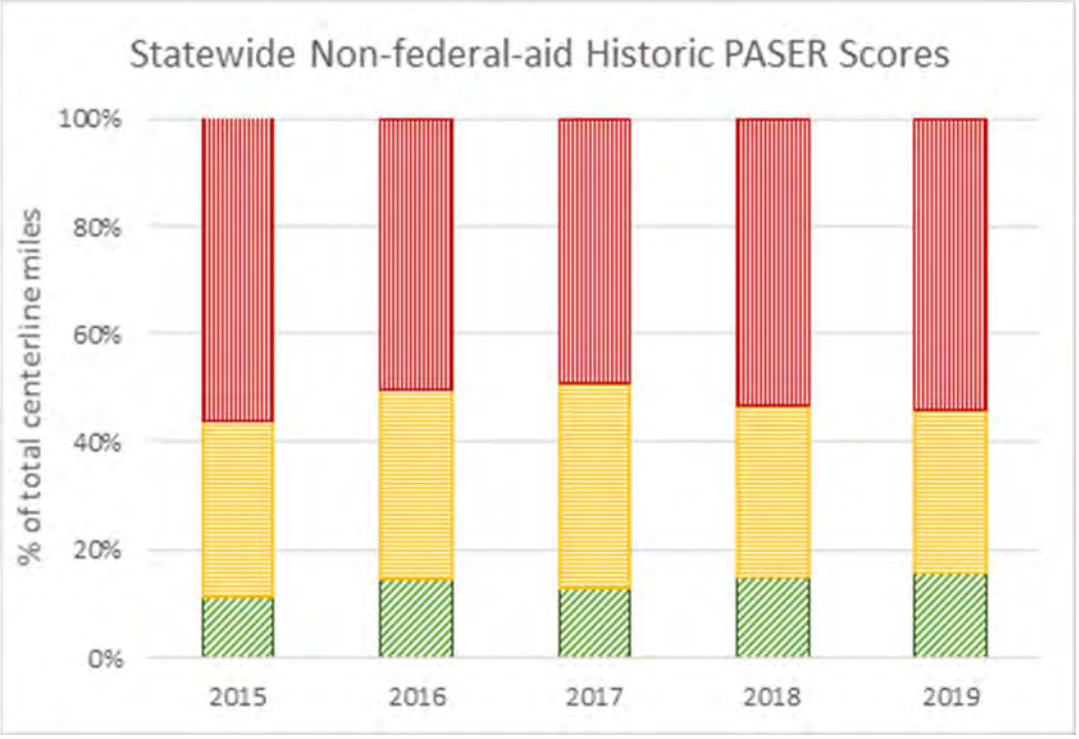


Figure 18: Historical statewide paved city minor road network condition trend

Unpaved Roads

The condition of unpaved roads can be rapidly changing, which makes it difficult to obtain a consistent surface condition rating over the course of weeks or even days. The TAMC adopted the Inventory Based Rating (IBR) System™ for rating unpaved roads, and CoRH plans to start using the IBR System™ for rating its unpaved roads in the next three years. More information regarding the IBR System™ can be found in Introduction's Pavement Primer.

Unpaved roads in the city's network make up less than 10% of the city's total road network and are all residential. Sometimes unpaved roads may be incorporated into a project to become paved. This occurs through a Special Assessment District (SAD), a special financing district set up to fund the capital costs of a public improvement that provides special benefits to property owners in a subdivision or a defined neighborhood.

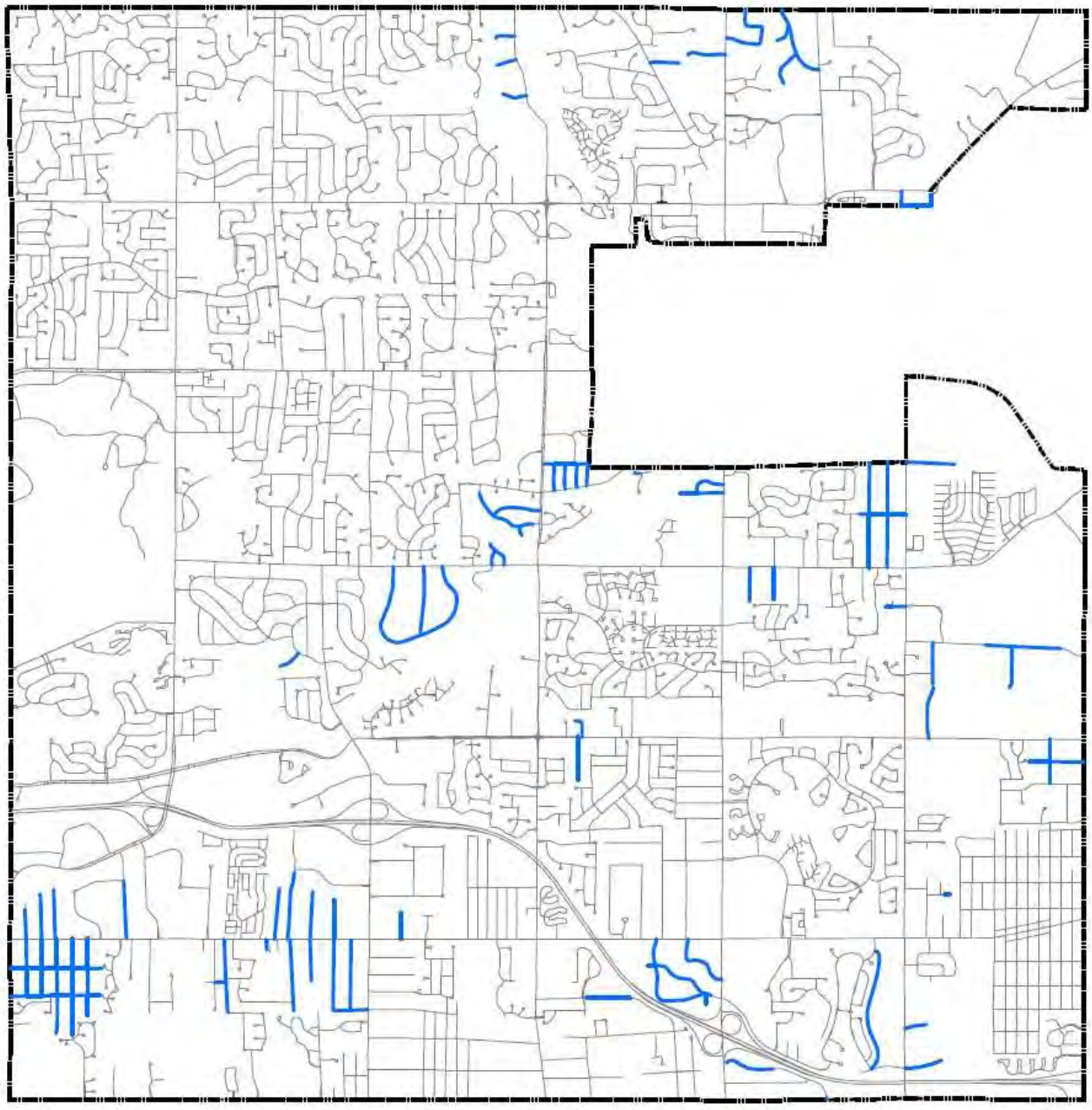


Figure 19: Map of gravel roads owned by CoRH are shown in blue.

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. CoRH 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.

Goals for Paved City Major Roads

The overall goal for CoRH's paved city major road network is to maintain or improve road conditions network-wide at 2021 levels. The baseline condition for this goal is illustrated in Figure 20.

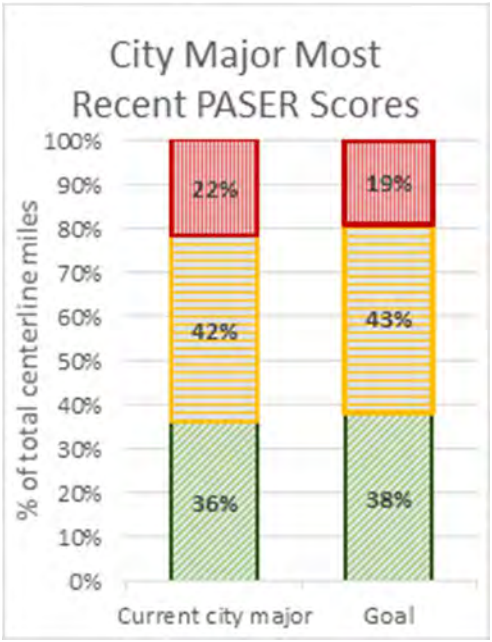


Figure 20: CoRH's 2021 city major road network condition by percentage of good/fair/poor

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

1. Prevent its good and fair (PASER 10 - 5) paved city major from becoming poor (PASER 4 - 1).
2. Move three (3) percent of paved city major roads out of the poor category.

Goals for Paved City Minor Roads

The overall goal for CoRH's paved city minor road network is to maintain or improve road conditions network-wide at 2021 levels. The baseline condition for this goal is illustrated in Figure 21.

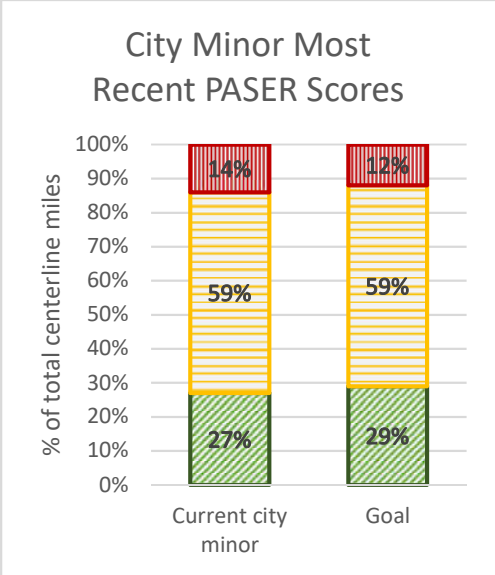


Figure 21: CoRH 2021 paved city minor road network condition by percentage of good/fair/poor

CoRH's network-level pavement condition strategy for paved city minor roads is:

1. Prevent its good and fair (PASER 10 - 5) paved city minor roads from becoming poor (PASER 4 - 1).
2. Move two (2) percent of paved city minor roads out of the poor category.

Goals for Unpaved Roads

The overall goal for CoRH's unpaved road network is to maintain or improve road conditions network-wide at 2021 levels.

Our unpaved roads will be maintained at their current structural and drainage adequacy assessments. Surface widths, drainage, and structural adequacy will be addressed on an as-needed basis to provide service or to address safety issues.

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, CoRH 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.

CoRH 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 CoRH's financial resources can be found in the *2. Financial Resources* section.

Treatments and strategies that counter pavement-damaging forces include reconstruction, structural improvement, capital preventive maintenance, and maintenance. For a complete discussion on the pavement treatment tools, refer to the *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

CoRH 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.

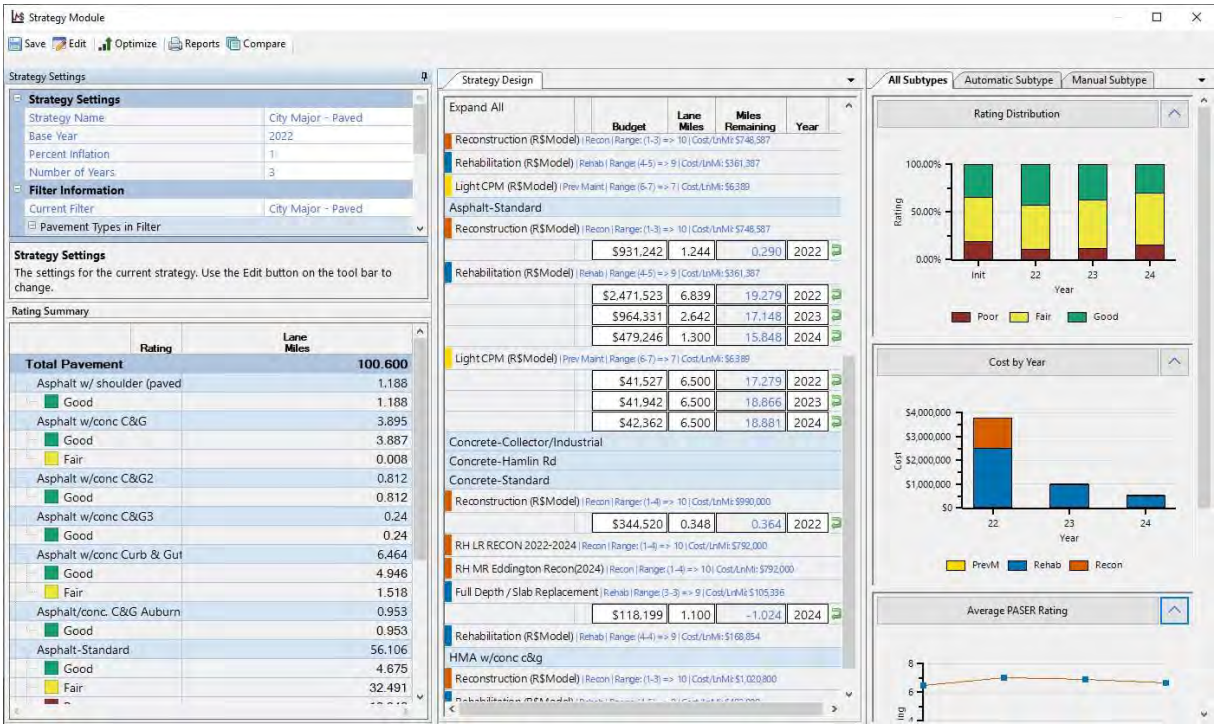


Figure 22: Pavement condition forecast model in the software program Roadsoft.

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 2022-2024. See Appendix A of this plan for details on planned projects. Full model inputs and outputs are included in Appendix C.

Table 2: Roadsoft Modelled Trends, Planned Projects, and Gap Analysis for CoRH's Road Assets—Modelled Trends: Roadsoft Annual Work Program for the Paved City Major Road Network Forecast

Treatment Name	Annual Miles of Treatment	Years of Life	Trigger-Reset
Crack Seal	3.25	2	6, 7, 8
HMA Mill and Overlay	1.8	10	3, 4-9
HMA Reconstruction	0.25	20	1, 2, 3-10

Results from the Roadsoft network condition model for the city major roads are shown in Figure 23. The Roadsoft network analysis of CoRH's planned projects from its currently-available budget does allow CoRH to reach its pavement condition goals given the projects planned for the next three years.

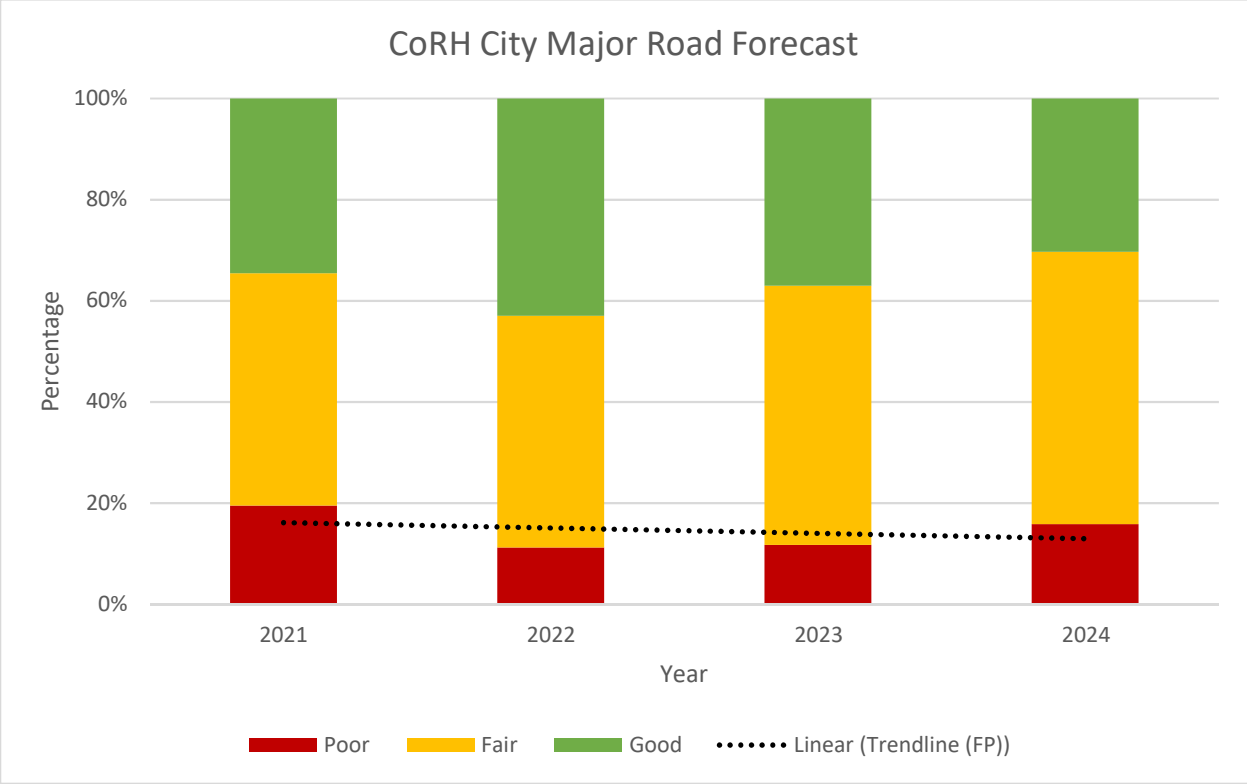


Figure 23: Forecast good/fair/poor changes to CoRH network condition from planned projects on the city major road network.

The 2021 condition ratings shown in Figure 23 differ slightly from the current PASER ratings for 2021 because of how road ratings are analyzed and estimated to "deteriorate" over time. The current rating of each road segment is an estimated rating based on the deterioration curve model set in Roadsoft. However, the Roadsoft network analysis still shows an overall decrease of 3% of roads within the poor category by 2024.

Paved City Minor Road

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

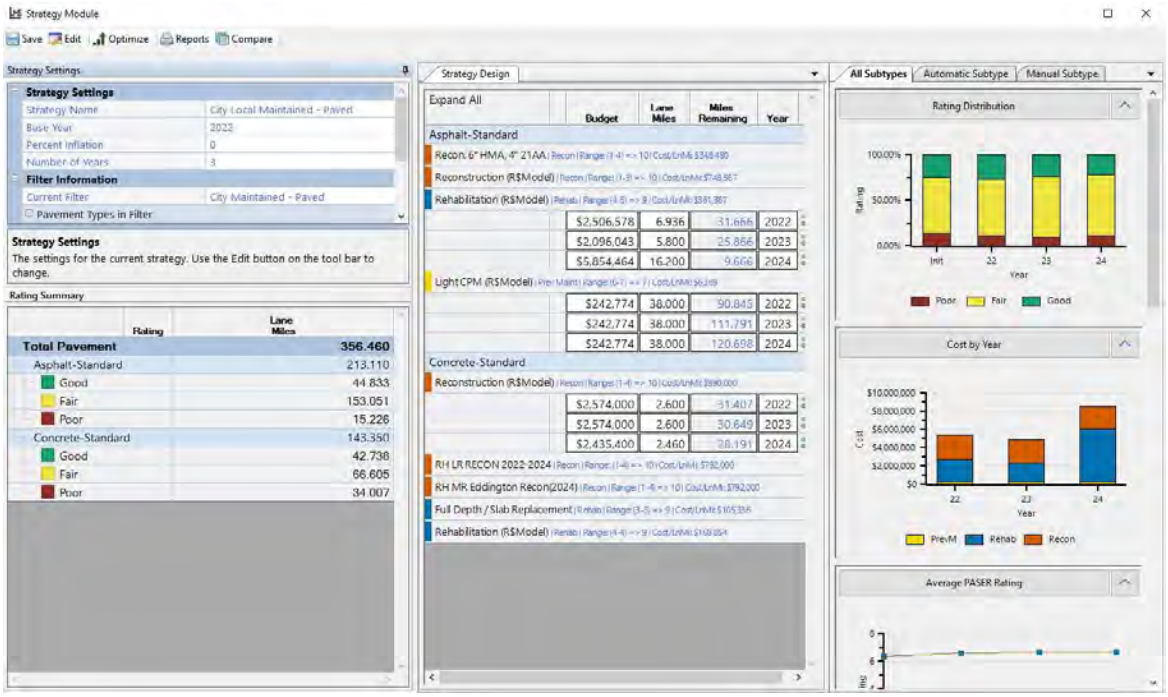


Figure 24: Pavement condition forecast model in the software program Roadsoft.

Table 3 illustrates the network-level model inputs for Roadsoft on the paved city minor road network. Other pavement types in this network were neglected due to their small numbers relative to HMA and concrete pavements. The treatments outlined in Table 3 are the average treatment volume of planned projects scheduled to be completed in 2022-2024. Details on planned projects are included in Appendix B, and full model inputs and outputs are included in Appendix C.

Table 3: Roadsoft Modelled Trends, Planned Projects, and Gap Analysis for CoRH's Road Assets—Modelled Trends: Roadsoft Annual Work Program for the Paved City Minor Road Network Forecast

Treatment Name	Annual Miles of Treatment	Years of Life	Trigger-Reset
Crack Seal	19	2	6, 7, 8
HMA Mill and Overlay	4.8	10	3, 4-9
HMA Reconstruction	---	18	1, 2, 3-10
Concrete Reconstruction	1.3	25	1, 2, 3-10

Results from the Roadsoft network condition model for the paved city minor roads are shown in Figure 25. The Roadsoft network analysis of CoRH's planned projects from its currently available budget does allow CoRH to reach its pavement condition goal given the projects planned for the next three (3) years.

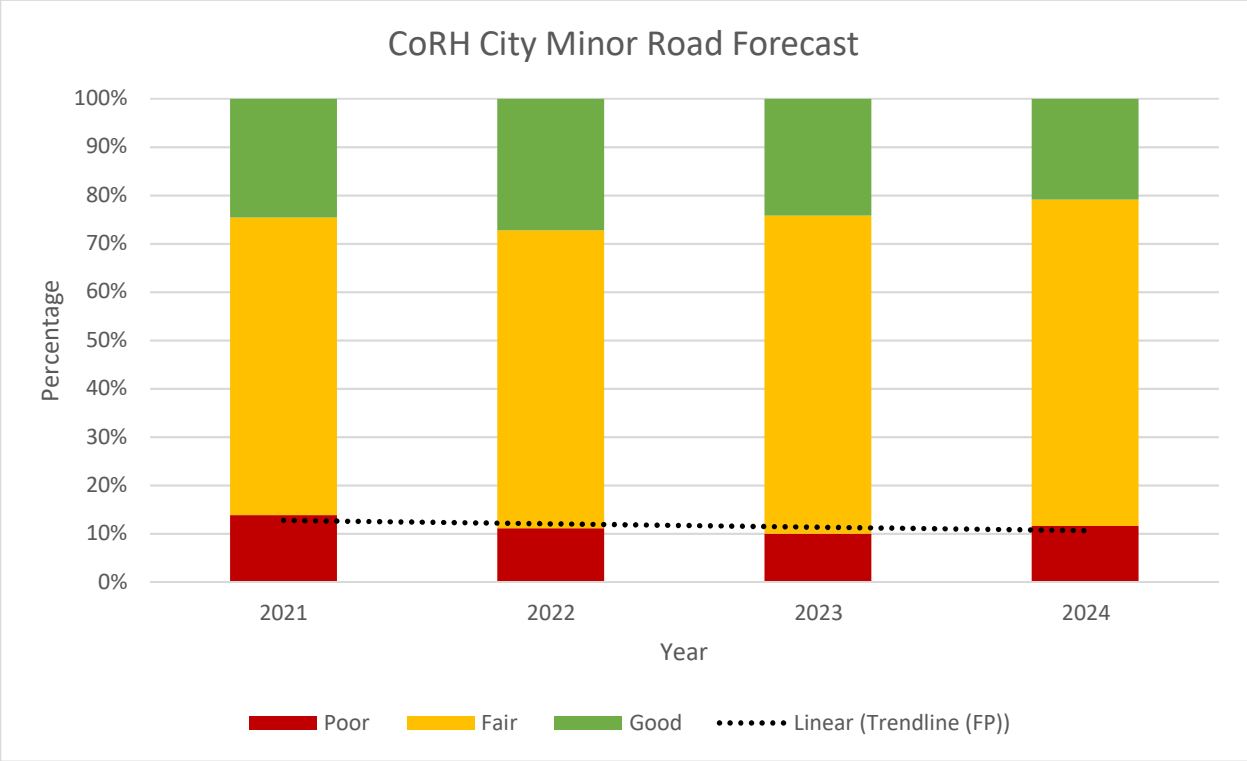


Figure 25: Forecast good/fair/poor changes to CoRH network condition from planned projects on the paved city minor road network.

The 2021 condition ratings shown in Figure 25 differ slightly from the current PASER ratings for 2021 because of how road ratings are analyzed and estimated to "deteriorate" over time. The current rating of each road segment is an estimated rating based on the deterioration curve model set in Roadsoft. The Roadsoft network analysis shows an overall increase of roads in the good/fair category from 86% to 88% and a decrease of 2% of roads within the poor category by 2024 for city minor roads.

Planned Projects

CoRH 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 (3) 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 CoRH to alter initial plans. Project planning information is used to predict the future condition of the road networks that CoRH

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.

For 2022-2024, CoRH plans to do the following projects:

Paved City Major Projects

CoRH is currently planning the construction and maintenance projects listed in Appendix A for the paved city major road network. The locations of these projects are shown in Figure 26, Figure 27, and Figure 28. The total cost of these projects is approximately $8,820,250.

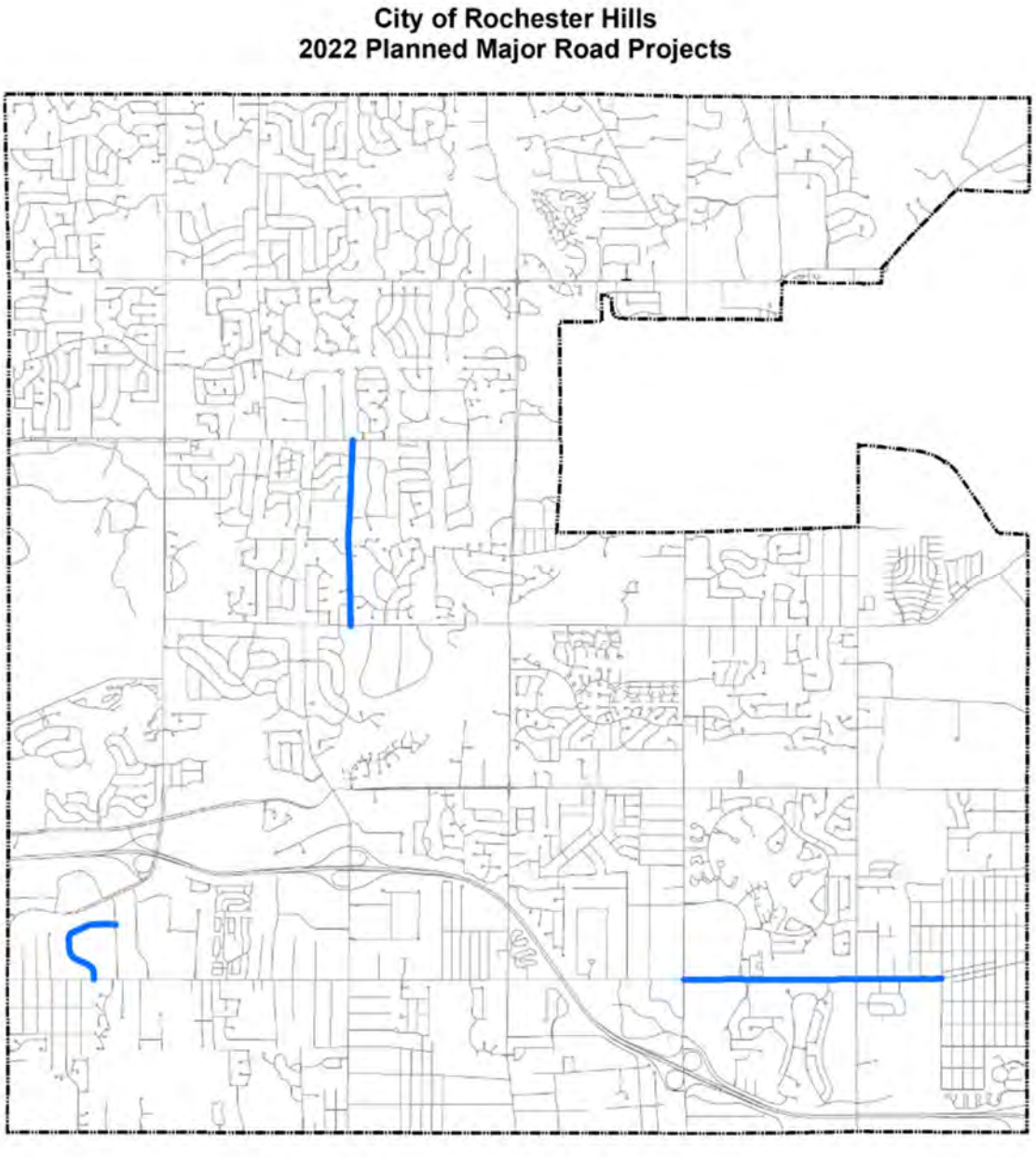


Figure 26: Map showing paved city major road projects planned for 2022.

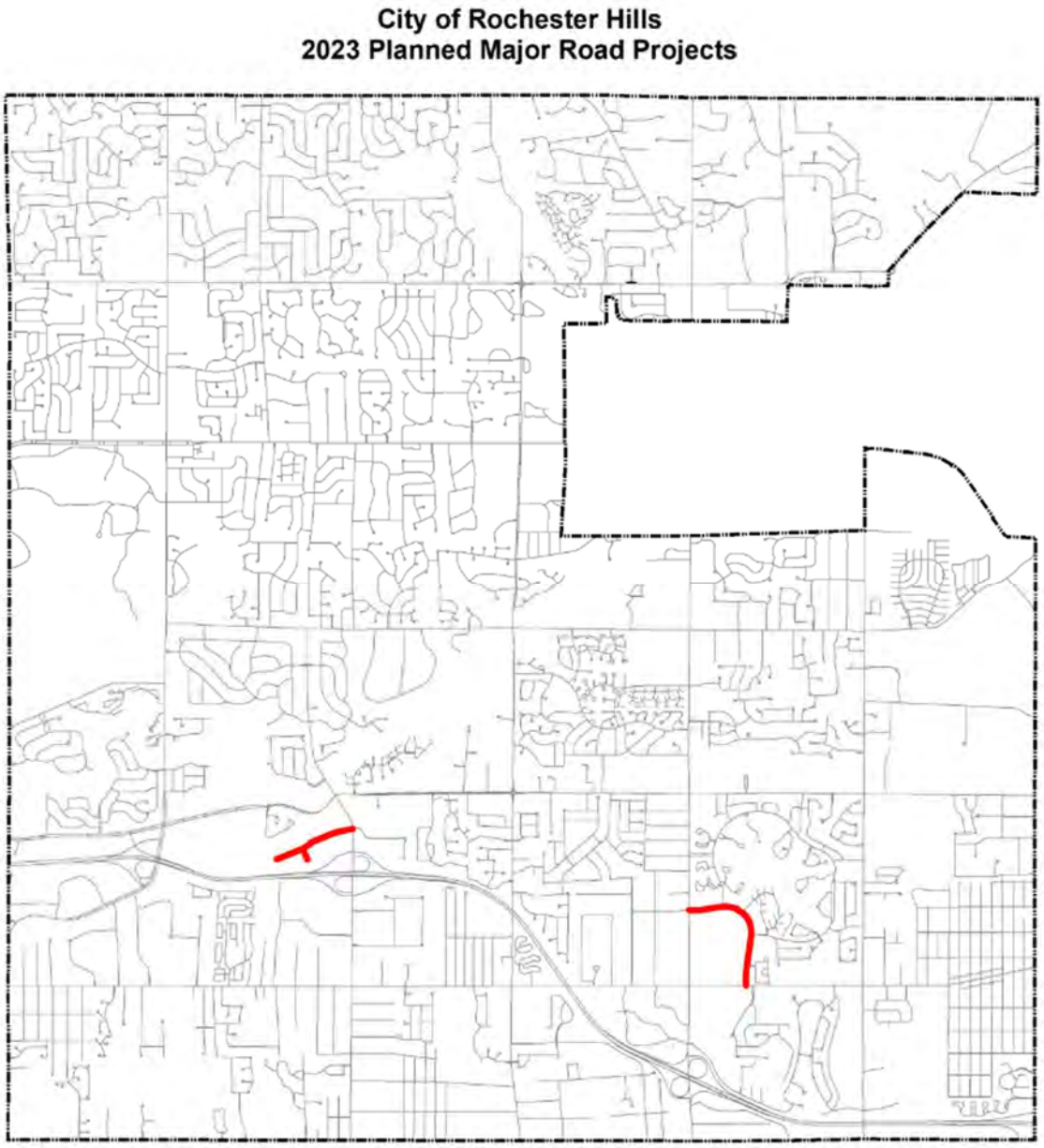


Figure 27: Map showing paved city major road projects planned for 2023.

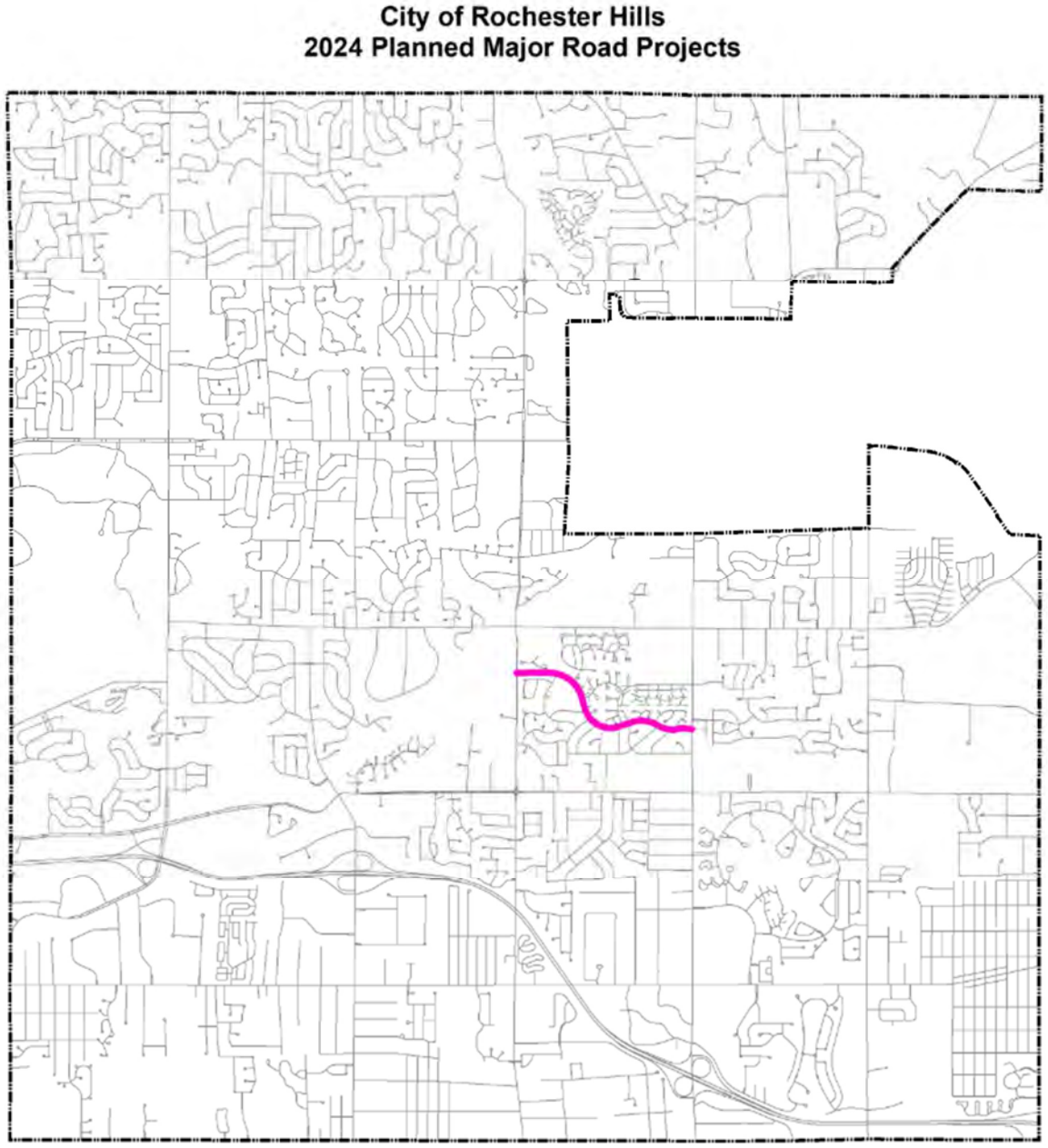


Figure 28: Map showing paved city major road projects planned for 2024.

Paved City Minor Projects

CoRH is currently planning the construction and maintenance projects listed in Appendix B for the paved city minor road network. The locations of these projects are shown in Figure 29, Figure 30, and Figure 31. The total cost of these projects is approximately $15,300,000.

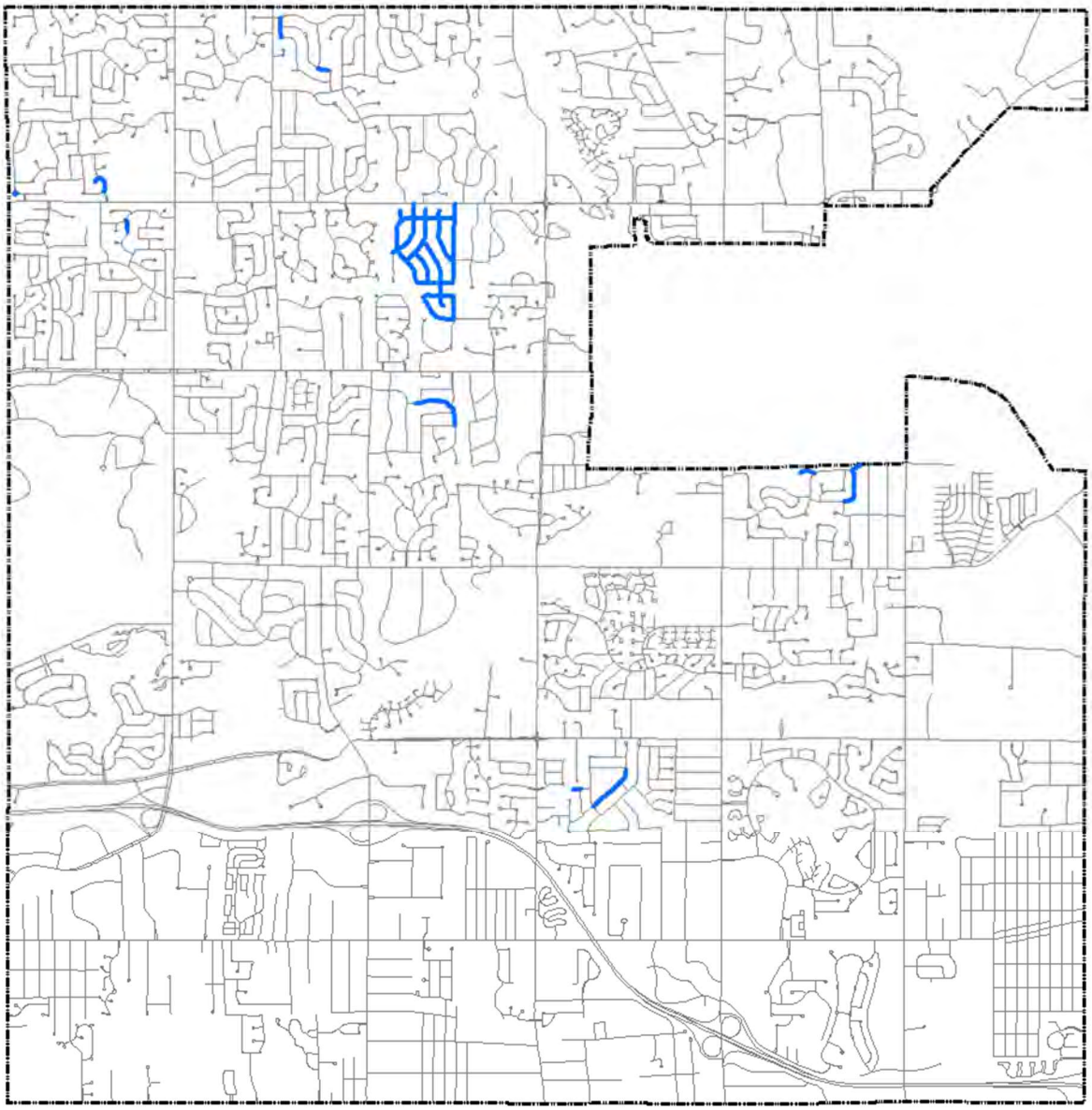


Figure 29: Map showing paved city minor road projects planned for 2022.

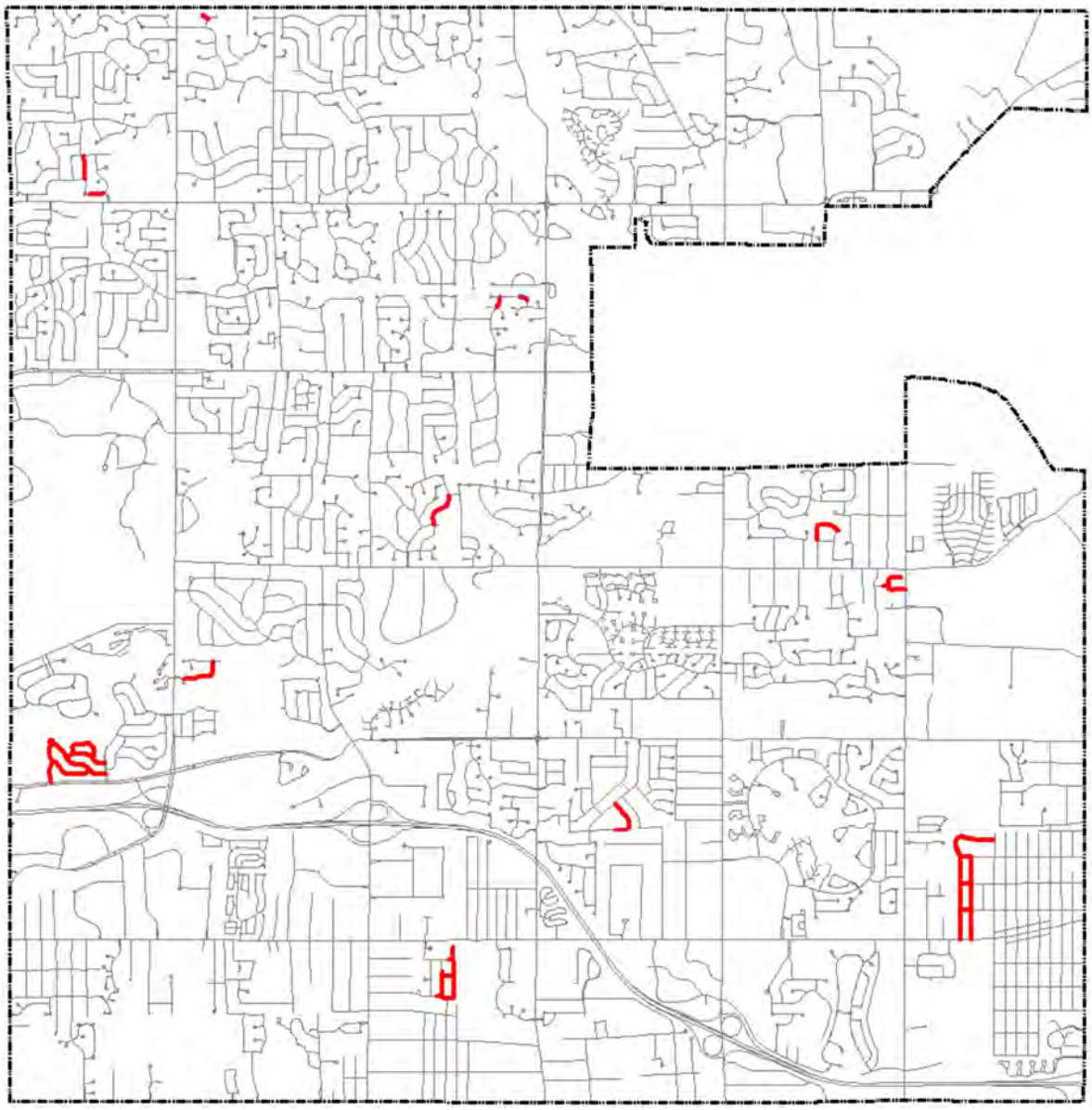


Figure 30: Map showing paved city minor road projects planned for 2023.

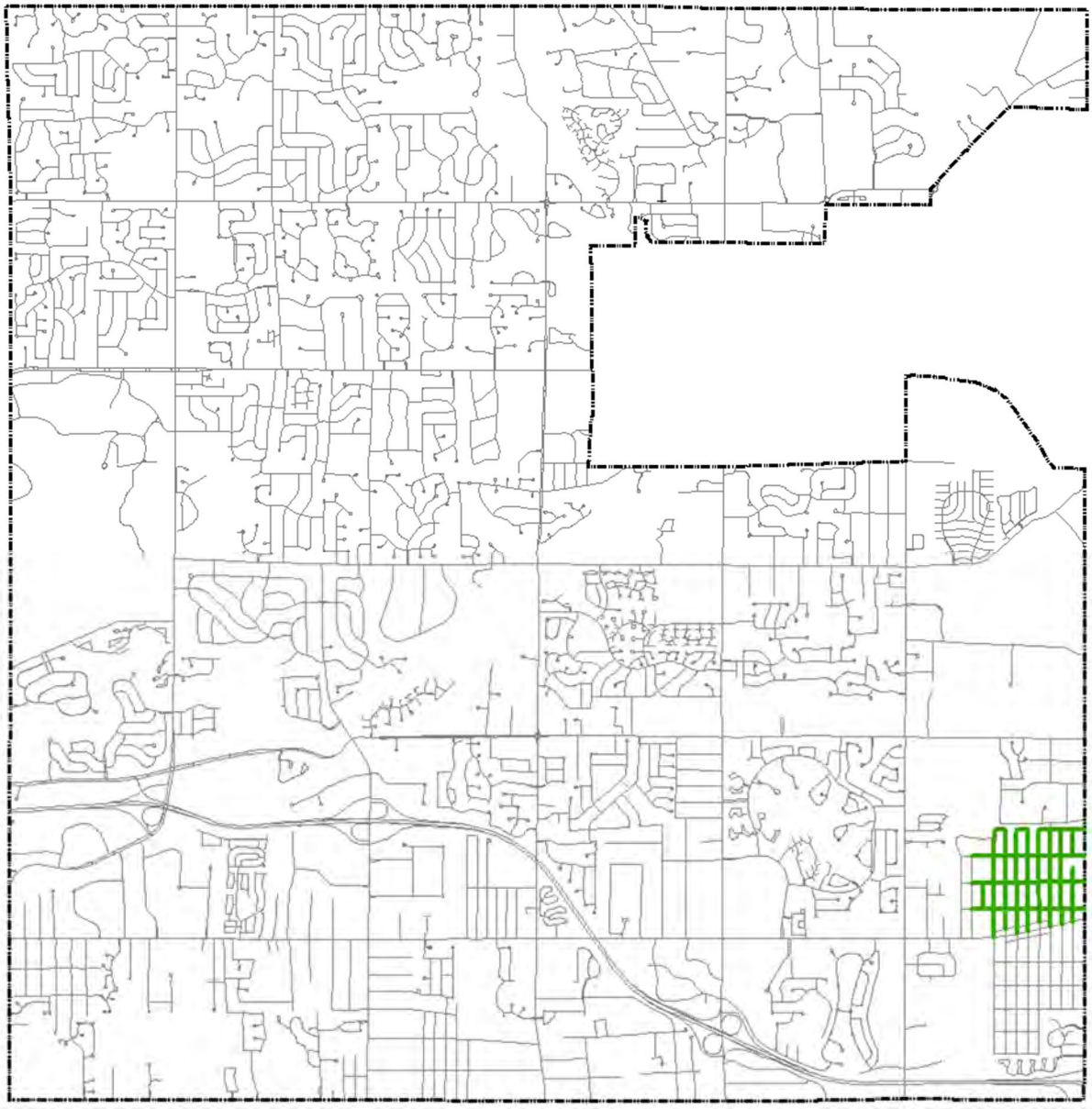


Figure 31: Map showing paved city minor road projects planned for 2024.

Unpaved Road Projects

CoRH currently does not have any planned projects for unpaved roads. Grading, dust control, and ditching are all done on an as-needed basis. The total cost dedicated to maintaining and improving unpaved roads for the next three years is approximately $575,000.

More detailed information on these projects can be found in Appendix A and B.

The current funding levels that CoRH receives are sufficient to meet the goals for the paved city major road network, the paved city minor 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 given the current budget. CoRH believes that the overall condition of this network can be maintained or improved over the next three years with current funding for construction and maintenance.

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. CoRH will overview its general expenditures and financial resources currently devoted to pavement maintenance and construction. This financial information is not intended to be a full financial disclosure or a formal report. Michigan agencies are required to submit an Act 51 Report to the Michigan Department of Transportation each year; this is a full financial report that outlines revenues and expenditures. This report can be obtained on our website at www.rochesterhills.org/fiscal or by request submitted to our agency contact (listed in this plan).

CoRH has a total annual budget for pavement asset management of $12,800,000.

City Major Network

CoRH has historically spent $7,800,000 annually on pavement-related projects. Over the next three years, CoRH plans to spend $5,500,000 annually on city major-network projects consisting of, but not limited to, reconstruction, overlay, culvert replacement, and preventive maintenance. Spending on projects depends on revenue from Michigan Transportation Fund (MTF), city contributions, and federal/state programs.

City Minor Network

CoRH has historically spent $5,900,000 annually on pavement-related projects. Over the next three years, CoRH plans to spend $5,100,000 annually on city minor-network projects consisting of, but not limited

to, reconstruction, overlay, culvert replacement, and preventive maintenance. Spending on projects depends on revenue from millages and city contributions.

3. RISK OF FAILURE ANALYSIS

Transportation infrastructure is designed to be resilient. The system of interconnecting roads and bridges maintained by CoRH 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. Figure 32 illustrates the key transportation links in CoRH's road network, including those that meet the following types of situations:

- **Geographic divides:** Areas where a geographic feature (river, lake, mountain or limited access road) limits crossing points of the feature
- **Emergency alternate routes for high-volume roads:** Roads which are routinely used as alternate routes for high volume roads or roads that are included in an emergency response plan
- **Limited access areas:** Roads that serve remote or limited access areas that result in long detours if closed
- **Main access to key commercial districts:** Areas where large number or large size business will be significantly impacted if a road is unavailable.

Our road network includes the following critical assets: Butler bridge over Galloway Creek, Kings Cove bridge over Paint Creek, Rochdale bridge over Sargent Creek, and Shagbark bridge over Sargent Creek. Overall, all four bridges are in good condition with a rating of eight (8) but did receive a scour critical rating of three (3) during the last inspection which took place in 2020. Inspections take place on "even years" and repairs on "odd years". Necessary repairs as identified in the 2020 inspection report will take place in 2021.

CoRH's road network includes the following critical assets: Hamlin Road, E. Auburn Road (Rochester Rd to Dequindre), John R Road, Barclay Circle, Hampton Circle, Butler Road, Old Perch Road, Brewster

Road, and Tienken Road (Adams west to city limits). Roads within the city not under city jurisdiction but are critical to road users and considered critical assets are: Livernois Road, Tienken Road, Walton Boulevard, Dequindre Road, South Boulevard, Adams Road, Crooks Road, and Avon Road, all owned and maintained by Road Commission for Oakland County (RCOC), and M-59, Auburn Road, and Rochester Road, owned and maintained by Michigan Department of Transportation (MDOT).

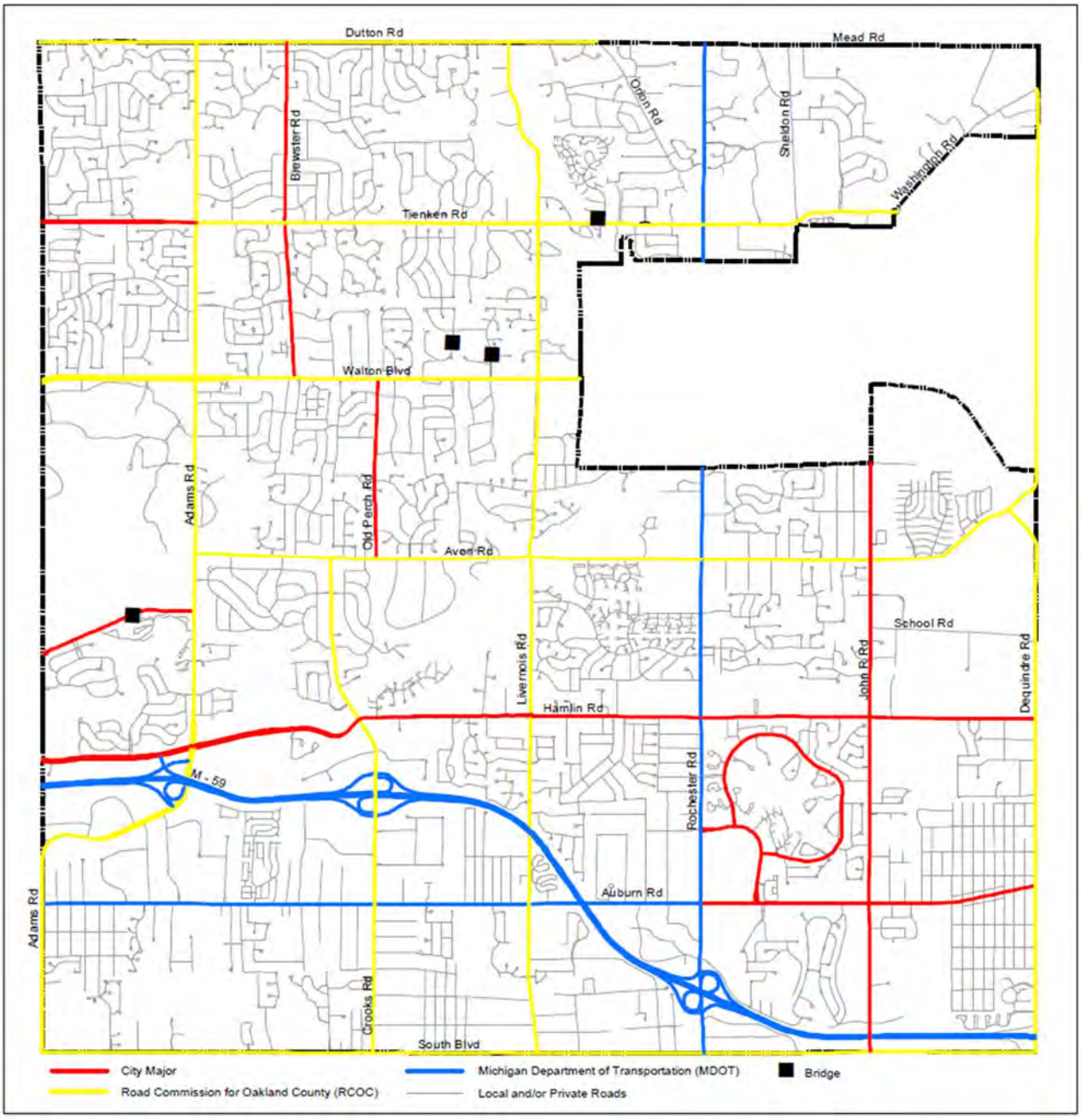


Figure 32: Key transportation links in CoRH's road network

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. CoRH communicates with both public and private infrastructure owners to coordinate work in the following ways:

INTERNAL COORDINATED PLANNING

CoRH maintains drinking water, sanitary and storm sewer assets in addition to transportation assets. CoRH 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 CoRH owns are listed in the city's Capital Improvement Plan (CIP). The three sub-surface utility projects are coordinated with the transportation infrastructure plans to maximize value and minimize service disruptions and cost to the public.

CoRH 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 will consider methods that do not require pavement cuts.

COORDINATON WITH OUTSIDE AGENCIES

CoRH meets with multiple outside agencies to share upcoming planned projects. CoRH attends a biannual coordination meeting hosted by MDOT to coordinate and mitigate disruption to transportation services. Mitigation measures could include rescheduling and coordinating projects to maximize value and minimize disruptions and cost to the public. This meeting is also attended by RCOC and various other agencies.

The CoRH also attends quarterly Oakland County Water Resource Commission meetings where projects are discussed.

Coordination with private utility companies is becoming more prevalent but does not happen on an annual basis. There are multiple private utility companies within the city with various priorities and it can be difficult to plan projects accordingly. However, the CoRH maintains communication with private utility companies and coordinates projects when feasible.

APPENDIX A: 2022-2024 PAVED CITY MAJOR ROAD PLANNED PROJECTS

2022

Asphalt Mill and Overlay

1. Old Perch: Avon Road to Walton Blvd (1.1 miles)
2. E. Auburn Road: S. Rochester Road to Culbertson Ave. (1.5 miles)

Asphalt Reconstruction

1. Waterview Drive: W. Auburn Road to Leach Road (0.6 miles)

2023

Asphalt Mill and Overlay

1. Barclay Circle: S. Rochester Road to E. Auburn Road (0.8 miles)
2. Avon Industrial Road: Crooks Road to End (0.48 miles)
3. Star Court: Avon Industrial to End (0.07 miles)

2024

Asphalt Mill and Overlay

1. Drexelgate Parkway: Livernois Rd to end of asphalt (0.65 miles)

Concrete Reconstruction

1. Drexelgate Parkway: Start of concrete to S. Rochester Road (full-depth slab replacement) (0.47 miles)
2. Eddington Blvd: Start of concrete to Windrift Lane (0.174 miles)

APPENDIX B: 2022 – 2024 PAVED CITY MINOR ROAD PLANNED PROJECTS

2022

Asphalt Mill and Overlay

3. Biggers: from Fieldstone to Bridgestone
4. Biggers Court
5. Bridgestone Drive
6. Cobblestone Drive
7. Fieldstone Drive
8. Ironstone Drive
9. Millstone Drive
10. Millstone Court
11. Oakstone Drive
12. Sandstone Drive
13. Shagbark

Concrete Reconstruction (road segments)

2. Hillcrest Drive
3. Devonwood Drive
4. Cobridge Drive
5. Cobridge Court
6. Olympia Court
7. Dunedin Road
8. Ivy Wood Court
9. Whitney Drive
10. Berry Nook Lane
11. Tanglewood Drive
12. Highsplit Drive
13. Harlan Court

2023

Asphalt Mill and Overlay

1. Blue Heron Lane
2. Cinnabar Drive
3. Fantail Court
4. Fantail Drive
5. Gilsam Avenue
6. Heron Ridge Drive
7. Nesting Ridge
8. Newstead Lane
9. Pine Trail
10. Preswick
11. Rookery
12. Sleepy Fox
13. Wren Lane
14. Frankson
15. Weaverton

Concrete Reconstruction (road segments)

1. Chelsea Court
2. Chaffer Drive
3. Rochdale Drive
4. Greenleaf Drive
5. Misty Brook Lane
6. Spartan Drive
7. Pheasant Ring Drive
8. Kentucky Drive

APPENDIX B CONT'D

2024

Asphalt Mill and Overlay

1. Bridget
2. Cal Ave
3. Clovelly
4. Culbertson (N. of Auburn)
5. Dawes
6. Eastern (N. of Auburn)
7. Emmons (N. of Auburn)
8. Gerald (N. of Auburn)
9. Harrison (N. of Auburn)
10. Hessel (N. of Auburn)
11. Longview (N. of Auburn)
12. Melvin (N. of Auburn)
13. Morley

APPENDIX C: ROADSOFT NETWORK-LEVEL MODEL INPUTS AND OUTPUTS

Strategy Comprehensive Report

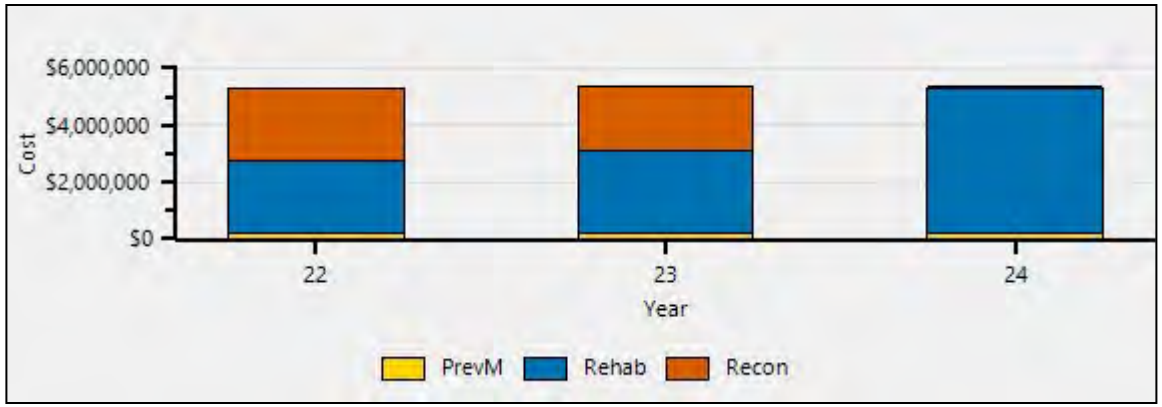
City Local Maintained - Paved

Base Year	2022
Percent Inflation	0
Number of Years	3
Optimized	No
Current Filter	City Maintained - Paved

Subtype	Treatment	Trigger	Reset	Cost/Ln Mile	Budget	Lane Miles	Year
Asphalt-Standard	RC (SI) Recon. 6" HMA, 4" 21AA	1 - 4	10	$348,480.00			
					$0	0.000	2022
	RC (SI) Reconstruction (R$Model)	1 - 3	10	$748,586.67			
					$0	0.000	2022
					$0	0.000	2023
					$0	0.000	2024
	RH (SI) Rehabilitation (Structural Improvement) (R$Model)	4 - 5	9	$361,386.67			
					$2,506,578	6.936	2022
					$2,854,955	7.900	2023
					$5,095,552	14.100	2024
	PM (CPM) Light Capital Preventative Maintenance (R$Model)	6 - 7	7	$6,388.80			
					$242,774	38.000	2022
					$242,774	38.000	2023
					$242,774	38.000	2024
Concrete-Standard	RC (SI) Reconstruction (Structural Improvement) (R$Model)	1 - 4	10	$990,000.00			
					$2,574,000	2.600	2022
					$2,237,400	2.260	2023
					$0	0.000	2024

Strategy Comprehensive Report

Cost Distribution

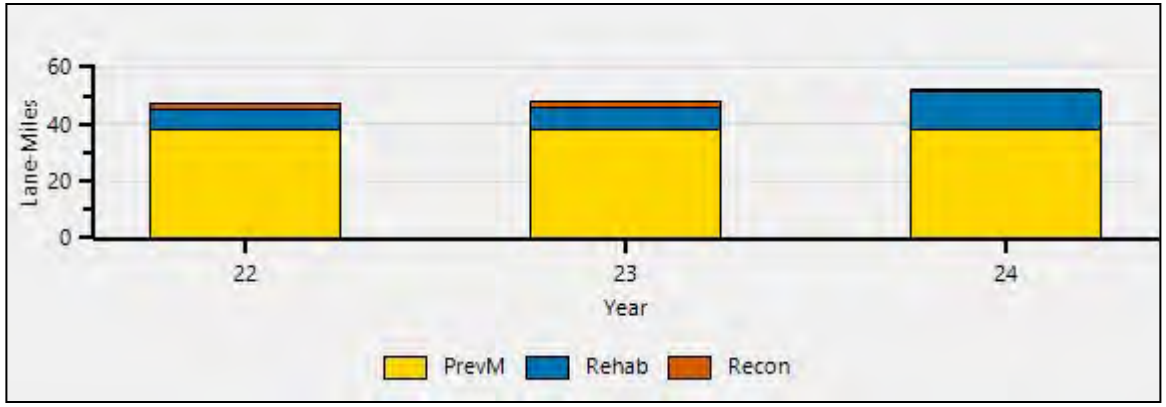


City Local Maintained - Paved

Maintenance Type	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Prev Maint	$242,774	$242,774	$242,774							
Rehab	$2,506,578	$2,854,955	$5,095,552							
Recon	$2,574,000	$2,237,400	$0							
Total	$5,323,352	$5,335,129	$5,338,326							

Strategy Comprehensive Report

Maintenance Performed

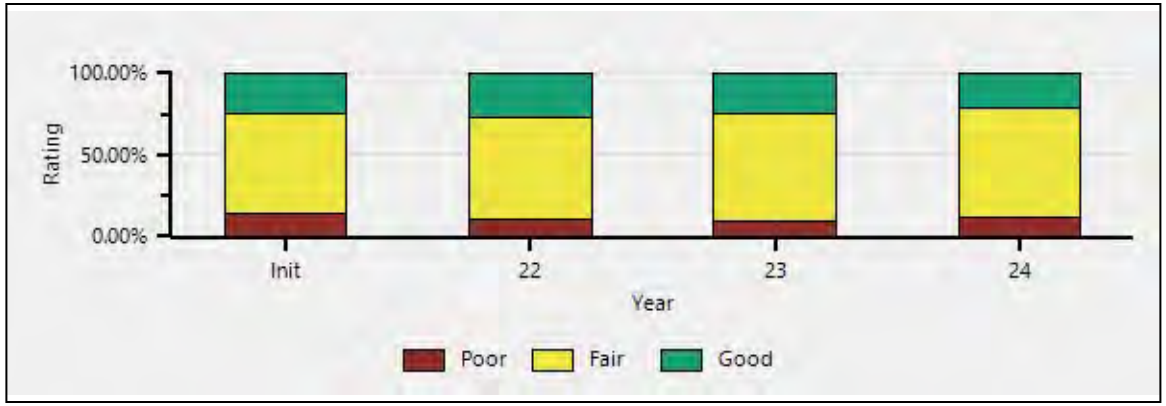


City Local Maintained - Paved

Maintenance Type in Lane Miles	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Prev Maint	38.000	38.000	38.000							
Rehab	6.936	7.900	14.100							
Recon	2.600	2.260	0.000							
Total	47.536	48.160	52.100							

Strategy Comprehensive Report

Rating Distribution



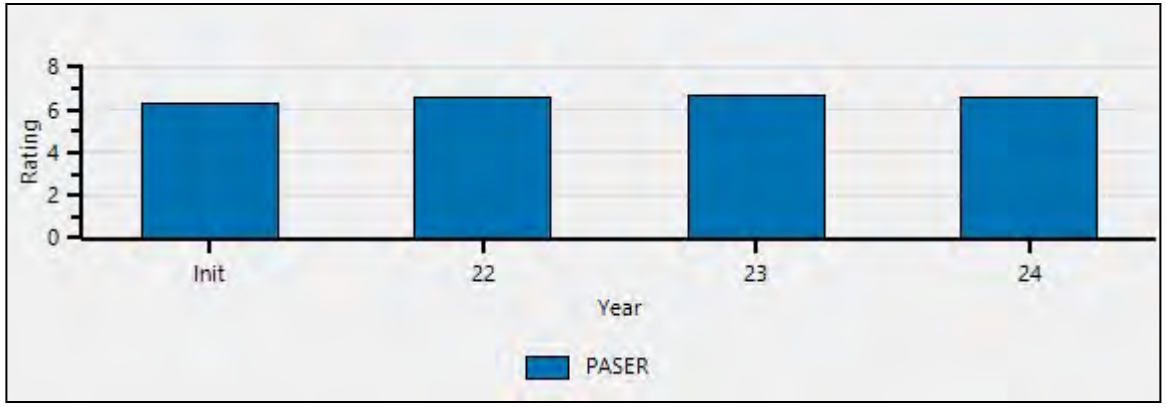
City Local Maintained - Paved

Initial Values

Lane Miles	%	Rating	2022		2023		2024		2025	2026	2027	2028	2029	2030	2031
87.571	24.6	Good	97.107	27.2	86.263	24.2	74.526	20.9							
219.656	61.6	Fair	219.656	61.6	234.746	65.9	240.447	67.5							
49.233	13.8	Poor	39.697	11.1	35.451	10.0	41.487	11.6							
356.460	100.0	Total													

Strategy Comprehensive Report

PASER Distribution



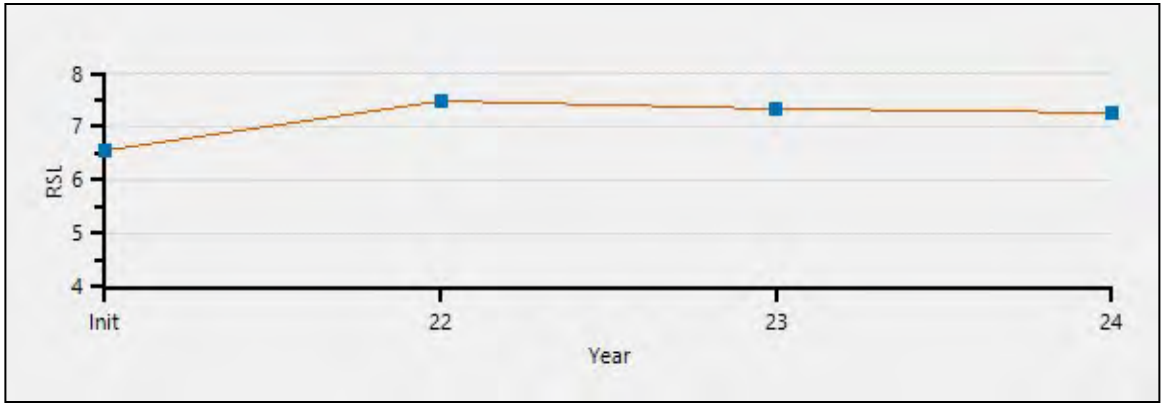
City Local Maintained - Paved

Initial Value

Lane Miles	PASER	2022	2023	2024
5.006	10	7.606	8.560	7.345
32.430	9	39.366	28.324	20.131
50.135	8	50.135	49.379	47.050
64.380	7	102.380	141.296	154.592
105.032	6	67.032	49.118	46.189
50.244	5	50.244	44.332	39.666
38.679	4	31.743	28.251	33.879
10.280	3	7.954	7.200	6.778
0.274	2	0.000	0.000	0.830
0.000	1	0.000	0.000	0.000
6.343	Average	6.599	6.664	6.582

Strategy Comprehensive Report

RSL Distribution



City Local Maintained - Paved

Initial Value

Lane Miles	RSL	2022	2023	2024
4.350	**23**	5.000	0.565	0.000
0.000	**22**	0.650	5.565	0.565
0.000	**21**	0.650	1.215	5.565
0.000	**20**	0.650	1.215	1.215
4.166	**19**	4.166	0.650	1.215
14.952	**18**	14.952	4.166	0.650
0.000	**17**	0.000	14.952	4.166
0.000	**16**	0.000	0.000	14.952
2.282	**15**	2.282	0.000	0.000
17.586	**14**	17.586	2.282	0.000
13.370	**13**	20.306	25.486	16.382
1.036	**12**	1.036	20.306	25.486
8.955	**11**	8.955	1.036	20.306
45.531	**10**	45.531	8.955	1.036
0.490	**9**	9.990	55.031	18.455
22.127	**8**	31.627	19.490	64.531
22.426	**7**	31.926	41.127	28.990
10.588	**6**	20.088	41.426	50.627
54.827	**5**	52.484	20.088	36.636
27.636	**4**	22.754	14.484	0.002
30.855	**3**	0.080	22.754	1.360
20.136	**2**	20.136	0.080	22.754
5.914	**1**	5.914	20.136	0.080
36.223	**0**	29.499	5.474	9.668
0.330	**-1**	0.330	22.039	1.842

Strategy Comprehensive Report

0.620	**-2**	0.408	0.330	22.039
1.506	**-3**	1.506	0.408	0.330
10.110	**-4**	7.954	1.506	0.408
0.000	**-5**	0.000	5.694	1.506
0.000	**-6**	0.000	0.000	5.694
6.574	Average	7.474	7.324	7.245

Strategy Comprehensive Report

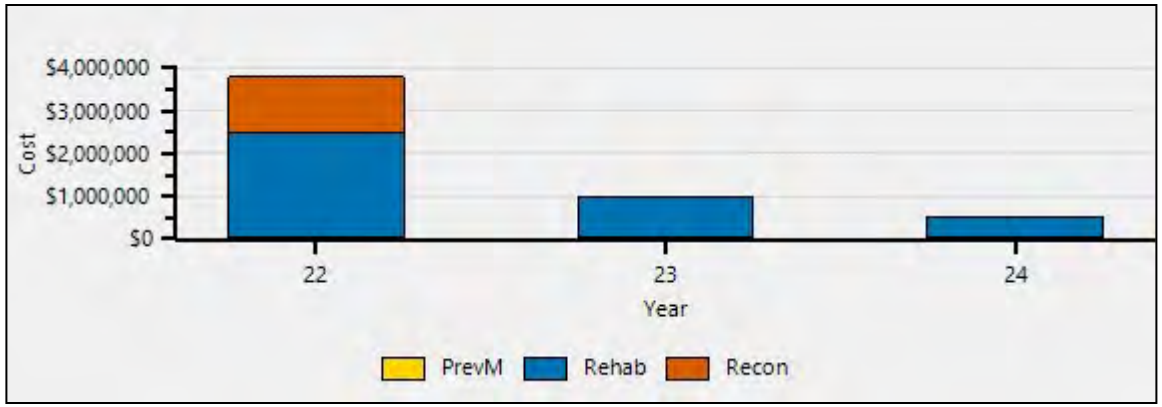
City Major - Paved

Base Year	2022
Percent Inflation	1
Number of Years	3
Optimized	No
Current Filter	City Major - Paved

Subtype	Treatment	Trigger	Reset	Cost/Ln Mile	Budget	Lane Miles	Year
Asphalt-Standard	RC (SI) Reconstruction (R$Model)	1 - 3	10	$748,586.67			
					$931,242	1.244	2022
	RH (SI) Rehabilitation (R$Model)	4 - 5	9	$361,386.67			
					$2,471,523	6.839	2022
					$964,331	2.642	2023
					$479,246	1.300	2024
	PM (CPM) Light CPM (R$Model)	6 - 7	7	$6,388.80			
					$41,527	6.500	2022
					$41,942	6.500	2023
					$42,362	6.500	2024
Concrete-Standard	RC (SI) Reconstruction (R$Model)	1 - 4	10	$990,000.00			
					$344,520	0.348	2022
	RH (SI) Full Depth / Slab Replacement	3 - 3	9	$107,453.25			
					$118,199	1.100	2024

Strategy Comprehensive Report

Cost Distribution

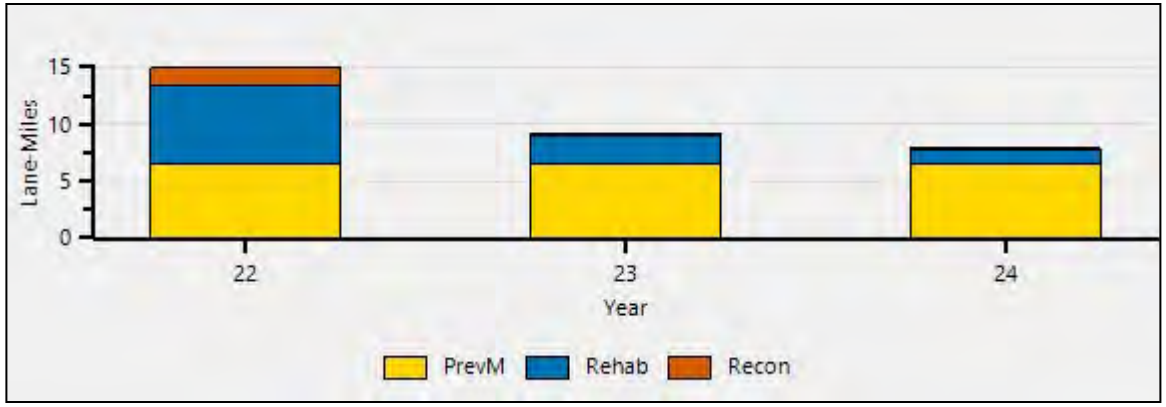


City Major - Paved

Maintenance Type	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Prev Maint	$41,527	$41,942	$42,362							
Rehab	$2,471,523	$964,331	$487,412							
Recon	$1,275,762	$0	$0							
Total	$3,788,812	$1,006,273	$529,774							

Strategy Comprehensive Report

Maintenance Performed

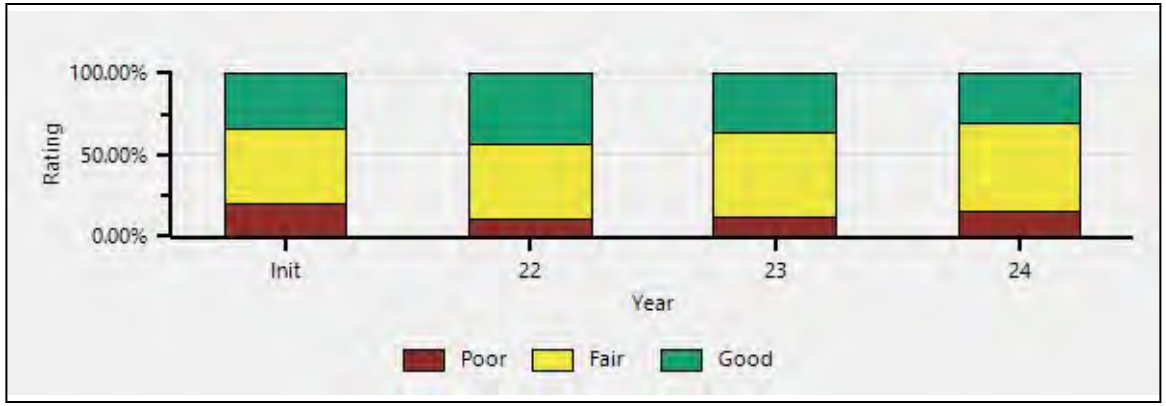


City Major - Paved

Maintenance Type in Lane Miles	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Prev Maint	6.500	6.500	6.500							
Rehab	6.839	2.642	1.376							
Recon	1.592	0.000	0.000							
Total	14.931	9.142	7.876							

Strategy Comprehensive Report

Rating Distribution



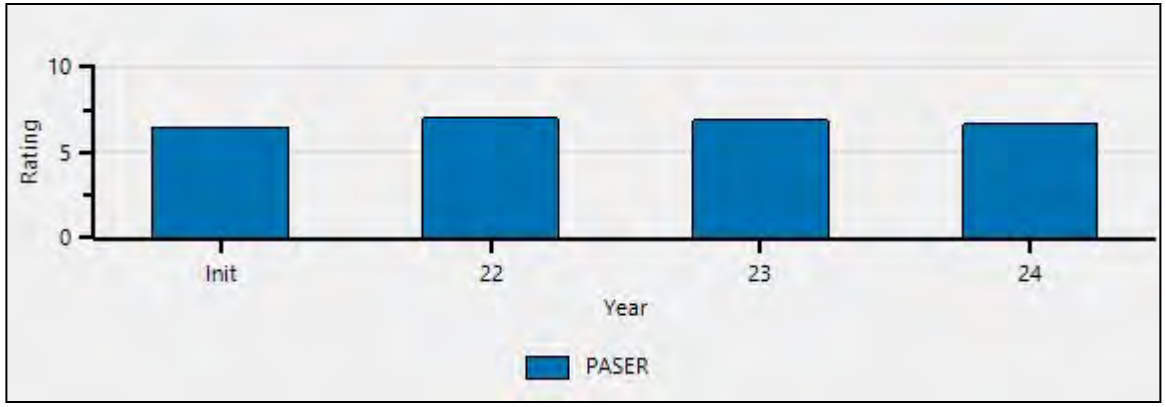
City Major - Paved

Initial Values

Lane Miles	%	Rating	2022		2023		2024		2025	2026	2027	2028	2029	2030	2031
34.811	34.6	Good	43.242	43.0	37.281	37.1	30.481	30.3							
46.137	45.9	Fair	46.137	45.9	51.555	51.3	54.203	53.9							
19.652	19.5	Poor	11.221	11.2	11.764	11.7	15.915	15.8							
100.600	100.0	Total													

Strategy Comprehensive Report

PASER Distribution



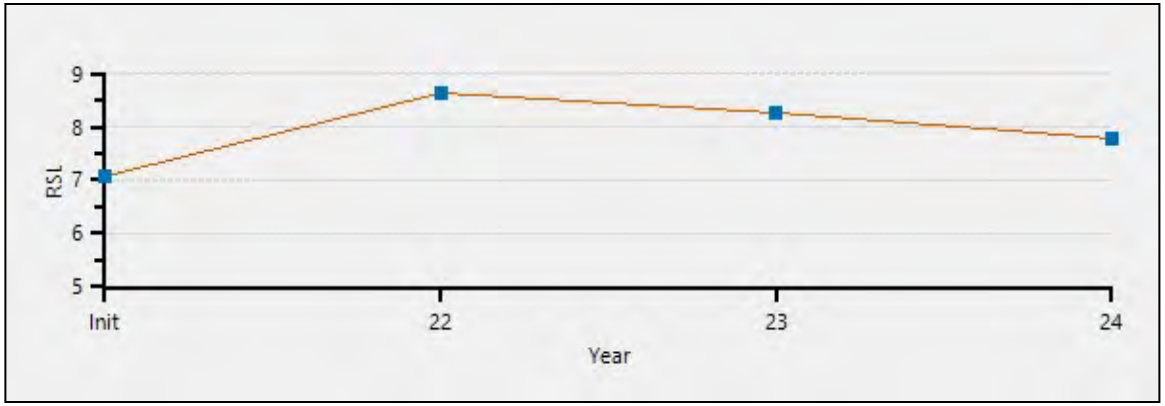
City Major - Paved

Initial Value

Lane Miles	PASER	2022	2023	2024
6.504	10	8.096	3.827	3.740
11.359	9	18.198	11.799	1.549
16.948	8	16.948	21.655	25.192
10.142	7	16.642	29.380	35.293
24.411	6	17.911	13.265	11.749
11.584	5	11.584	8.910	7.161
17.694	4	10.855	11.398	15.625
1.958	3	0.366	0.366	0.000
0.000	2	0.000	0.000	0.290
0.000	1	0.000	0.000	0.000
6.510	Average	7.025	6.901	6.653

Strategy Comprehensive Report

RSL Distribution



City Major - Paved

Initial Value

Lane Miles	RSL	2022	2023	2024
3.566	**23**	3.653	0.000	0.000
0.000	**22**	0.087	3.653	0.000
0.000	**21**	0.087	0.087	3.653
0.000	**20**	0.087	0.087	0.087
0.000	**19**	0.000	0.087	0.112
4.888	**18**	4.888	0.000	0.112
0.000	**17**	0.000	4.888	0.025
0.000	**16**	0.000	0.000	4.888
0.170	**15**	0.170	0.000	0.000
11.098	**14**	12.342	0.170	0.000
6.489	**13**	13.328	14.984	1.470
0.172	**12**	0.172	13.328	14.984
0.173	**11**	0.173	0.172	13.328
13.725	**10**	13.725	0.173	0.172
0.008	**9**	1.633	15.350	1.798
3.552	**8**	5.177	3.258	16.975
4.150	**7**	5.775	6.802	4.883
0.740	**6**	2.365	7.400	8.427
10.574	**5**	10.574	2.365	7.400
5.920	**4**	5.920	7.122	2.365
7.011	**3**	0.511	2.872	0.622
5.527	**2**	5.527	0.511	2.872
3.185	**1**	3.185	5.527	0.511
12.538	**0**	10.855	3.185	5.527
3.315	**-1**	0.000	8.213	3.185

Strategy Comprehensive Report

1.841	**-2**	0.000	0.000	6.913
0.000	**-3**	0.000	0.000	0.000
1.958	**-4**	0.366	0.000	0.000
0.000	**-5**	0.000	0.366	0.000
0.000	**-6**	0.000	0.000	0.290
7.082	Average	8.637	8.261	7.764

APPENDIX D: MEETING MINUTES VERIFYING PLAN ACCEPTANCE BY GOVERNING BODY

B. BRIDGE ASSET MANAGEMENT PLAN

An attached bridge asset management plan follows.

City of Rochester Hills
2021 Bridge
Asset Management Plan

A plan describing the City of Rochester Hills's bridge assets and conditions

Adopted [CC Adopted Date]

Prepared by:
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DPS Technician – Right of Way/Survey
248-841-2494
mcguckinj@rochesterhills.org

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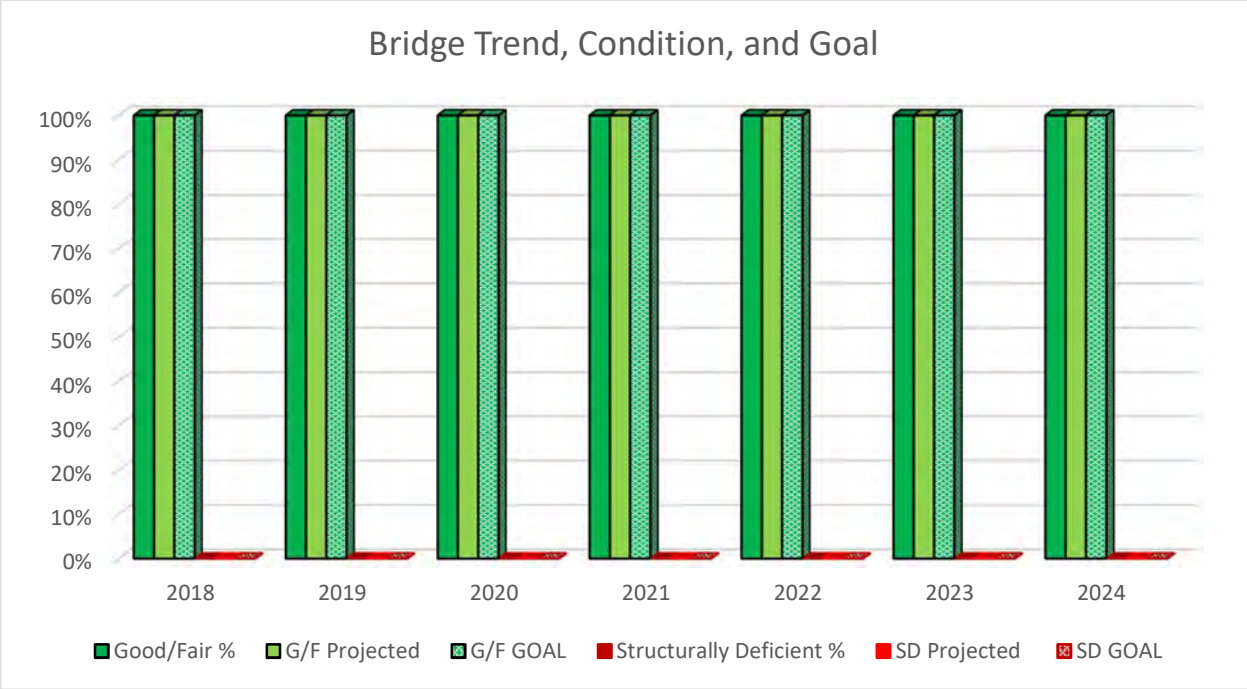
EXECUTIVE SUMMARY

As conduits for commerce and connections to vital services, bridges are among the most important assets in any community. Along with other assets like roads, culverts, traffic signs, traffic signals, and utilities, bridges support and affect the road network. The City of Rochester Hills's (CoRH) bridges, other road-related assets, and support systems are valuable and extensive public assets, 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. This asset management plan is intended to report on how CoRH is meeting its obligations to maintain the bridges for which it is responsible.

This plan reviews the CoRH's bridge conditions and explains how City of Rochester Hills works to maintain and improve the overall condition of those assets. These explanations can help answer:

- What types of bridge assets CoRH has in its jurisdiction and the different options for maintaining these assets.
- What tools and processes CoRH uses to track and manage bridge assets and funds.
- What condition CoRH'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 CoRH's bridge assets' normal life cycle.
- What condition CoRH can expect of its bridge's 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 CoRH's bridge assets.

CoRH owns and/or manages 4 bridges. A summary of the historical and current bridge asset conditions, projected trends, and goals can be seen in the figure, below.



An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of CoRH's obligations towards meeting these requirements. This asset management plan also helps demonstrate the CoRH'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 CoRH's bridge assets. Further, this plan gives taxpayers information to make informed decisions about investing in 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 Rochester Hills 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 bridges in City of Rochester Hills'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 Rochester Hills (CoRH) 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. CoRH is responsible for maintaining and operating 4 bridges.

This 2021 plan outlines how CoRH 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 (3) years to reflect changes in bridge conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to Allan E. Schneck, P.E, Director of Department of Public Services, at 1000 Rochester Hills Drive, Rochester Hills, MI 48309 or at 248-656-4685 and/or schnecka@rochesterhills.org.

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

Figure 1: Girder bridge

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.)

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 1 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.

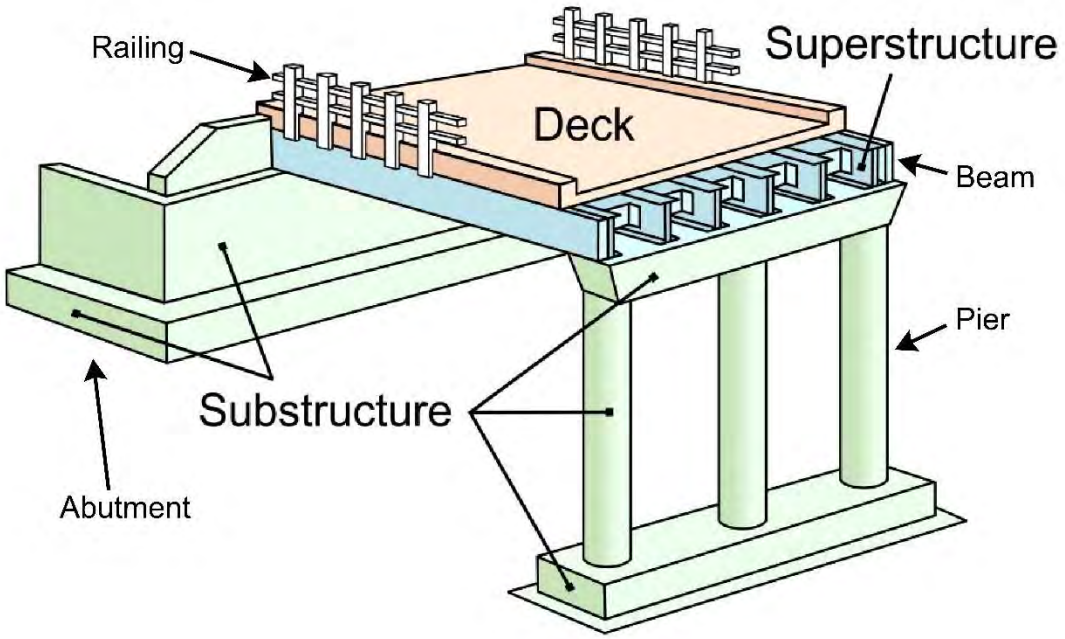


Figure 6: Diagram of basic elements of a bridge

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 Preservation Activities* 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

CoRH implements 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 CoRH'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, CoRH's bridge asset management program aims to preserve and/or improve the condition of its local bridge network within the means of its financial resources.

Nonetheless, CoRH 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, CoRH seeks to identify those bridges that will benefit from a planned maintenance program while addressing those bridges that pose usability and/or safety concerns.

The three-fold goal of CoRH'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, CoRH specifically aims to have 100% of the agency's local bridges in fair to good condition over its three-year plan.

Thus, CoRH'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 selective corrective repairs or rehabilitation for degraded bridge elements order to restore functionality
    - Identify and program those eligible bridges in need of replacement
- To identify available funding sources, such as:

    - Dedicated city resources
    - 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

CoRH is responsible for 4 local bridges. Table 2 summarizes CoRH's bridge assets by type, sizes by bridge type, and condition by bridge type. Additional inventory data, condition ratings, and proposed preventive maintenance actions for each bridge are contained in the tables in Appendixes 3, 4, and 5. The bridge inventory data was obtained from MDOT MiBRIDGE and other sources, and the 2020 condition data and maintenance actions are taken from the inspector's summary report (see Appendix 2).

Types

Of the CoRH's 4 structures, 3 are concrete bridges and 1 is a pre-stressed concrete bridge.

Locations and Sizes

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

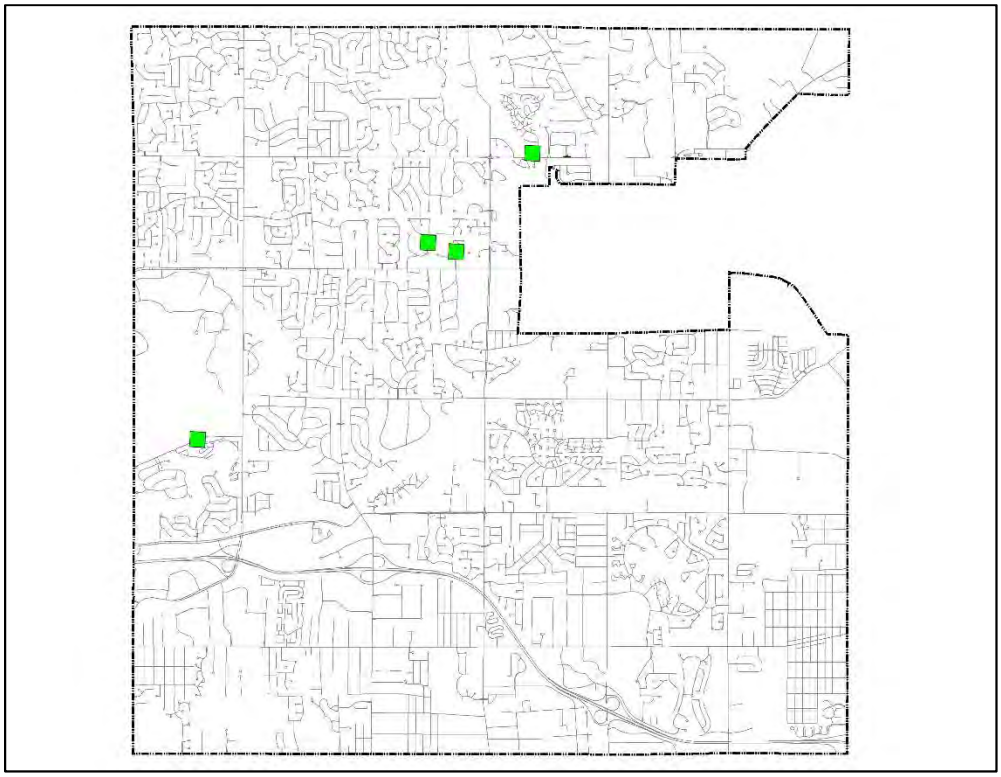


Figure 7: Map illustrating locations of CoRH's bridge assets

Condition

CoRH 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 CoRH's bridge network is 4 (100%) are good, 0 (0%) are fair, and 0 (0%) are poor or lower.

Another layer of classification of CoRH's bridge inventory classifies 0 (0%) bridges as structurally deficient, 0 (0%) bridges as posted, and 0 (0%) bridges as closed. 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. 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. 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.

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	3	3,512	0	0	0	0	0	3
Prestressed concrete – Box beam/girders—multiple	1	2,820	0	0	0	0	0	1
Total SD/Posted/Closed			**0**	**0**	**0**			
Total	**4**	**6,332**				**0**	**0**	**4**
Percentage (%)			**0%**	**0**	**0**	**0**	**0**	**100**

Statewide, MDOT's statistics for local agency bridges show that 11% are poor and 89% are good/fair. Correspondingly, CoRH has 100% of its bridges in fair/good condition versus the statewide average of 89% for local agency bridges. Statewide, 11% of local agency bridge deck area classifies as structurally deficient compared to 0% of CoRH's bridge deck area.

Goals

The goal of CoRH'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.

Specifically, this goal translates into long-range goals of having 100% of its bridges rated fair/good and having less than 0% classify as structurally deficient within three years. These goals are juxtaposed with the historic and current condition and the projected trend in Figure 8.

Several metrics will be used to assess the effectiveness of this asset management program. CoRH will monitor and report the annual change in the number of its bridges rated fair/good (5 or higher) and the annual change in the number of its bridges classified as structurally deficient.

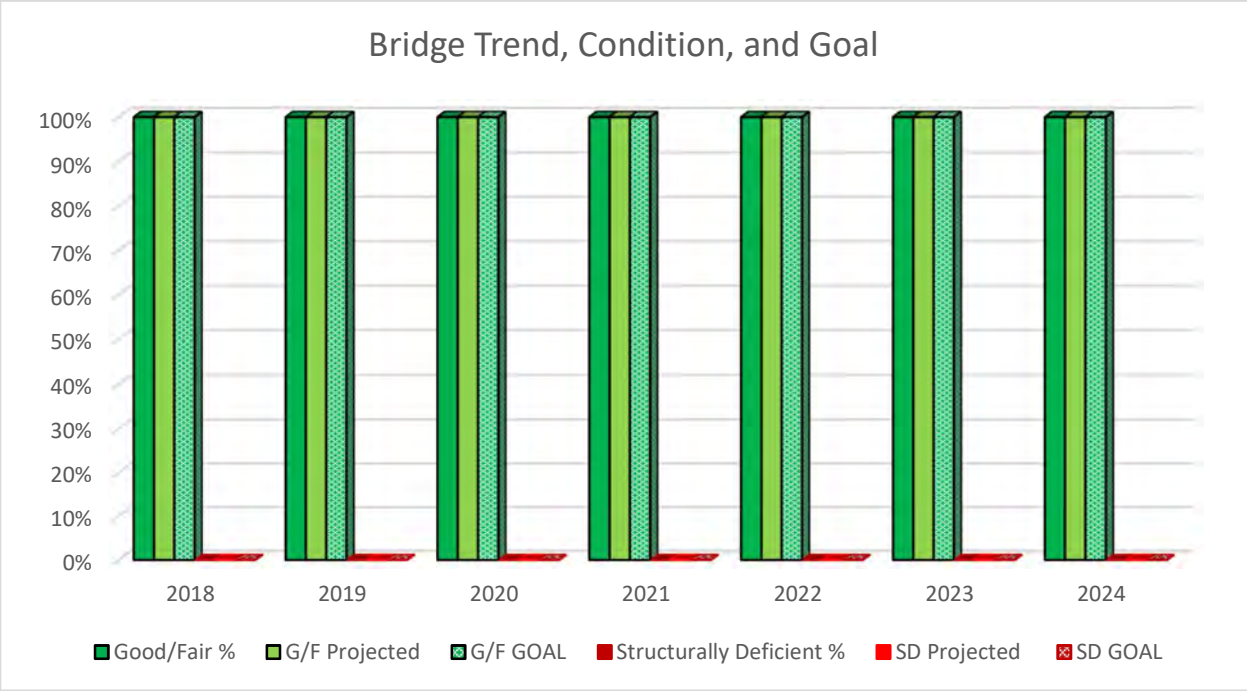


Figure 8: Progress tracking graph indicating CoRH's historic and current bridge conditions, projected trends, and goals.

Based on past inspection records and condition ratings, CoRH will establish a baseline of past performance by determining the average period of time that a bridge remains in good or fair condition. The performance measure will be the increased average amount of time a bridge is in the good or fair condition status after implementation of the asset management strategy when compared to the baseline time before implementation.

Prioritization, Programmed/Funded Projects, and Planned Projects

Prioritization

CoRH'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, CoRH prioritizes bridges for projects by evaluating five factors and weighting them as follows: condition –15%, load capacity –20%, traffic –10%, safety –50%, and detour –5%. 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 projects to establish a priority order.

CoRH annually reviews the current condition of each of the its bridges 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 inspection inventory and condition data are consolidated in spreadsheet format for CoRH's bridges in Appendix 3. CoRH then determines management and preservation needs and corresponding actions for each bridge (Appendix 4) as well as

inspection follow-up actions (Appendix 5). The management and preservation actions are selected in accordance with criteria contained in the *Summary of Preservation Criteria* table (below) and adapted to CoRH'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] • *OR* To correct impact damage that impairs beam strength [1]	40 years [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]	

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
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
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]	

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
	• *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

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
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, CoRH's asset management program uses a "mix of fixes" strategy that is made up of preventive maintenance and scheduled maintenance.

> **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 the agency's in-house maintenance crews while larger, more complex work will be contracted.
>
> CoRH'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 will perform much of this work.

Severely degraded and structurally deficient bridges require replacement or major rehabilitation. Several of the remaining bridges require one-time preventive maintenance actions to repair defects and restore the structure to a higher condition rating. Most bridges are included in a scheduled maintenance plan with appropriate maintenance actions programmed for groups of bridges of similar material and type, bundled by location.

The replacement, rehabilitation, and preventive maintenance projects are generally eligible for funding under the local bridge program.

To achieve its goals, a primary objective of CoRH's asset management program is improvement of bridges rated poor (4 or lower) to a rating of fair (5) or higher and/or preservation of bridges currently rated fair (5) or higher in their current condition within a three-year time period through management and/or preservation activities. A bridge-by-bridge preservation—or maintenance—plan is presented in the Appendix 4.

Programmed/Funded Projects

CoRH received $104,463 in total funding per year for the years 2019-2020. To achieve its goals, CoRH plans to spend an average of $29,000 per year on preventive maintenance of bridges. CoRH does not plan

to replace any bridges in the next three years. By performing the aforementioned preventive maintenance of bridge structures, CoRH will meet its overall bridge network condition goals.

CoRH computes the estimated cost of each typical management and/or preservation action using unit prices in the latest *Bridge Repair Cost Estimate* spreadsheet contained in MDOT's *Local Bridge Program Call for Projects*. The cost of items of varying complexity, such as maintenance of traffic, staged construction, scour counter-measures, and so forth, are computed on a bridge-by-bridge basis. The cost estimates are reviewed and updated annually.

Planned Projects

CoRH does not have any planned projects for the next three years beyond routine maintenance as identified by its biennial inspections. Bridge projects, including routine maintenance, are funded through the city's Capital Improvement Project (CIP) as part of its annual budget process.

Gap Analysis

CoRH believes it should be able to achieve all of its asset management goals for the period of this plan. CoRH does not anticipate replacement or rehabilitation of its bridges over the next three years. If a project is necessary as determined through the biennial inspection, CoRH will continue to monitor those bridge assets and take any necessary steps within its budget to prevent or mitigate a condition decline or a need to post or close the structure.

2. FINANCIAL RESOURCES

Anticipated Revenues

Any projects submitted to the local aid program that are not selected for funding will be added to the agency's program.

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 and funded through the agency's annual operating budget.

3. RISK MANAGEMENT

CoRH 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.

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

CoRH administers the biennial inspection of its bridges in accordance with NBIS and MDOT requirements. The inspection reports document the condition of CoRH's bridges and evaluates them in order to identify new defects and monitor advancing deterioration. The summary inspection report in Appendix 1 identifies additional items needing follow-up, special inspection actions, and recommended bridge-by-bridge maintenance activities.

Bridges that are considered "scour critical" pose a risk to CoRH'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. CoRH has scour critical bridges, which are listed in Table 4.

Table 4: Bridges that are Considered Scour Critical

Scour Critical Bridges	
Bridge Structure Number	**Scour Critical Rating**
8277	3
8279	3
8280	3
13163	3

CoRH does not have posted or closed bridges that are critical to accessing entire areas or individual properties within its jurisdiction.

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 1

City of Rochester Hills 2020 Bridge Inspection Report Summary of Additional Inspection Recommendations

No outstanding additional inspection recommendations at this time.

Appendix 2

City of Rochester Hills 2020 Bridge Inspection Report Executive Summary

General Recommendations

- Remove channel debris and downstream fallen trees restricting stream flow.
- Clean out debris from catch basins, as necessary.
- Maintain hot-poured sealant repairs.

Specific Recommendations

8280 Shagbark Road over Sargent Creek

Constructed: 1965 **Reconstructed:** 2002 **General Condition:** Good (8)

Description: Concrete - culvert

Recommendations: Remove debris in channel. Maintain hot-poured sealant joint between sidewalk and bridge deck, as necessary. Monitor hairline flexural cracks on underside of precast culvert.

13163 Butler Road over Galloway Creek

Constructed: 2001 **Reconstructed:** N/A **General Condition:** Good (8)

Description: Concrete - culvert

Recommendations: Clean out debris from catch basins. Monitor soil erosion at guardrail posts southwest quadrant.

8279 Rochdale Road over Sargent Creek

Constructed: 1965 **Reconstructed:** 2002 **General Condition:** Good (8)

Description: Concrete - culvert

Recommendations: Repair loose guardrail in southwest quadrant. Monitor hairline flexural cracking at midspan of Conspan sections. Remove channel debris.

8277 Kings Cove over Paint Creek

Constructed: 1965 **Reconstructed:** 1998 **General Condition:** Good (8)

Description: Prestressed Concrete – box beam/girders - multiple

Recommendations: Remove downstream and under bridge fallen trees restricting the stream flow. Maintain hot-pour seal repairs at longitudinal deck cracks and apply hot-pour seal to transverse bridge deck cracks.

APPENDIX 3: Inspection Inventory and Condition Data

					Inventory Data									Inspection Findings										
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Primary or Secondary Route	Structure Type Main Span (Item 43A -	Structure Type Main Span (Item 43B)	Num ber	Total Str Length	Year Built (Item 27)	Year Recon.	ADT	Year of ADT	Inspection Date	Operational Status (Item 41)	Deck Rating (Item 58)	Deck Bottom Rating (Item XX)	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 (Item XX)	Other Joints
Prestressed concrete – Box beam/girders—multiple	8277	63457 8500 015B0 1	KINGSCOVE ROAD	PAINT CREEK	Primary	5	5	1	60	1965	1998	1662	2008	11/23/2020	A	8	8	8	8	8	N	7	N	8	7
Concrete – Culvert	8279	63557 8509 912B0 1	ROCHDALE ROAD	SARGENT CREEK	Secondary	1	19	1	30	1965	2002	1589	2008	11/23/2020	A	N		N	N	8	8				
Concrete – Culvert	8280	63557 8594 101B0 1	SHAGBARK ROAD	SARGENT CREEK	Secondary	1	19	1	26.7	1965	2002	809	2008	11/23/2020	A	N		N	N	8	8				
Concrete – Culvert	13163	63557 8502 031C0 1	BUTLER RD	GALLOWAY CREEK	Secondary	1	19	1	25.7	2001		887	2008	11/23/2020	A	N		N	N	8	8				

					Appraisal				
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Structure Evaluation	Structurally Deficient	Sufficiency Rating	Section Loss	Scour Critical (Item 113)
Prestressed concrete – Box beam/girders—multiple	8277	63457 8500 015B0 1	KINGSCOVE ROAD	PAINT CREEK	G			N	3
Concrete – Culvert	8279	63557 8509 912B0 1	ROCHDALE ROAD	SARGENT CREEK	G				3
Concrete – Culvert	8280	63557 8594 101B0 1	SHAGBARK ROAD	SARGENT CREEK	G				3
Concrete – Culvert	13163	63557 8502 031C0 1	BUTLER RD	GALLOWAY CREEK	G				3

APPENDIX 4: Preservation and/or Maintenance Plan per Bridge

					Inventory Data					
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)
Prestressed concrete – Box beam/girders—multiple	8277	63457850001580 1	KINGSCOVE ROAD	PAINT CREEK	5	5	1	60	47	2820
Concrete – Culvert	8279	63557850991280 1	ROCHDALE ROAD	SARGENT CREEK	1	19	1	30	40	1200
Concrete – Culvert	8280	63557850410180 1	SHAGBARK ROAD	SARGENT CREEK	1	19	1	26.7	40.3	1076
Concrete – Culvert	13163	63557850203100 1	BUTLER RD	GALLOWAY CREEK	1	19	1	25.7	48.1	1236

					Replacement				Rehabilitation										
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Total	Super- structure	Deck	Sub- structure	Deep Overlay	Shallow Overlay	HMA Overlay w/ Membrane	HMA Cap	Replace/Re et rofit Railing	Steel Beam Repairs	P/S Conc Beam Repairs	Repair/Repl ace Culvert	Repair/Repl ace Retaining Wall	Geometric Upgrades	Patch Substruct Concrete
Prestressed concrete – Box beam/girders—multiple	8277	63457850001580 1	KINGSCOVE ROAD	PAINT CREEK															
Concrete – Culvert	8279	63557850991280 1	ROCHDALE ROAD	SARGENT CREEK															
Concrete – Culvert	8280	63557850410180 1	SHAGBARK ROAD	SARGENT CREEK															
Concrete – Culvert	13163	63557850203100 1	BUTLER RD	GALLOWAY CREEK															

					Proposed Preventive Maintenance								
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Repair/Repl ace Deck	Repair/Repl ace Steel Bearings	Complete Painting	Zone Painting	Epoxy Overlays	HMA Cap w/o Membrane	Concrete Deck Patching	Channel Improvemen ts	Scour Counter Measures
Prestressed concrete – Box beam/girders—multiple	8277	63457850001580 1	KINGSCOVE ROAD	PAINT CREEK									
Concrete – Culvert	8279	63557850991280 1	ROCHDALE ROAD	SARGENT CREEK									
Concrete – Culvert	8280	63557850410180 1	SHAGBARK ROAD	SARGENT CREEK									
Concrete – Culvert	13163	63557850203100 1	BUTLER RD	GALLOWAY CREEK									

					Proposed Scheduled Maintenance													
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Superstruc Washing	Concrete Surface Washing	Vegetation Control	Debris Removal	Clean Drainage System	Spot Painting	Repair/Rep l ace HMA Surface	Seal HMA Cracks/Joint s	Seal Concrete Cracks/ Joint s	Minor Concrete Patching	Timber Repairs	Repair/ Repl ace Guardrails	Repave Approaches	Repair Slopes	Install RipRap
Prestressed concrete – Box beam/girders—multiple	8277	63457850001580 1	KINGSCOVE ROAD	PAINT CREEK				X											
Concrete – Culvert	8279	63557850991280 1	ROCHDALE ROAD	SARGENT CREEK				X								X			
Concrete – Culvert	8280	63557850410180 1	SHAGBARK ROAD	SARGENT CREEK				X	X										
Concrete – Culvert	13163	63557850203100 1	BUTLER RD	GALLOWAY CREEK					X										

APPENDIX 5: Inspection Follow-up Actions

					Inventory Data					
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)
Prestressed concrete – Box beam/girders—multiple	8277	63457850 0015B01	KINGSCOVE ROAD	PAINT CREEK	5	5	1	60	47	2820
Concrete – Culvert	8279	63557850 9912B01	ROCHDALE ROAD	SARGENT CREEK	1	19	1	30	40	1200
Concrete – Culvert	8280	63557859 4101B01	SHAGBARK ROAD	SARGENT CREEK	1	19	1	26.7	40.3	1076
Concrete – Culvert	13163	63557850 2031C01	BUTLER RD	GALLOWAY CREEK	1	19	1	25.7	48.1	1236

					Inspection Items							
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Initial Inspection	In Depth Steel Inspection	Pin and Hanger Inspection	Diving Inspection	Provide Monitoring	Review Scour Criticality	Load Rating	Update SIA
Prestressed concrete – Box beam/girders—multiple	8277	63457850 0015B01	KINGSCOVE ROAD	PAINT CREEK	x	x	x	x	x	x	x	x
Concrete – Culvert	8279	63557850 9912B01	ROCHDALE ROAD	SARGENT CREEK	x	x	x	x	x	x	x	x
Concrete – Culvert	8280	63557859 4101B01	SHAGBARK ROAD	SARGENT CREEK	x	x	x	x	x	x	x	x
Concrete – Culvert	13163	63557850 2031C01	BUTLER RD	GALLOWAY CREEK	x	x	x	x	x	x	x	x

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.

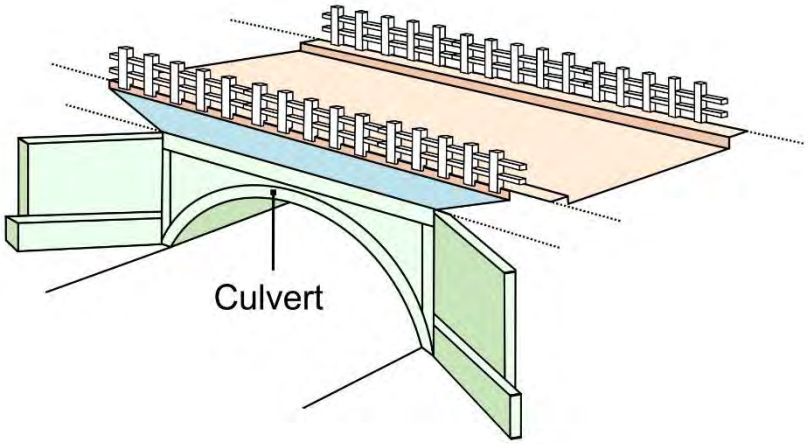


Figure C-1: Diagram of a culvert structure

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.

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.

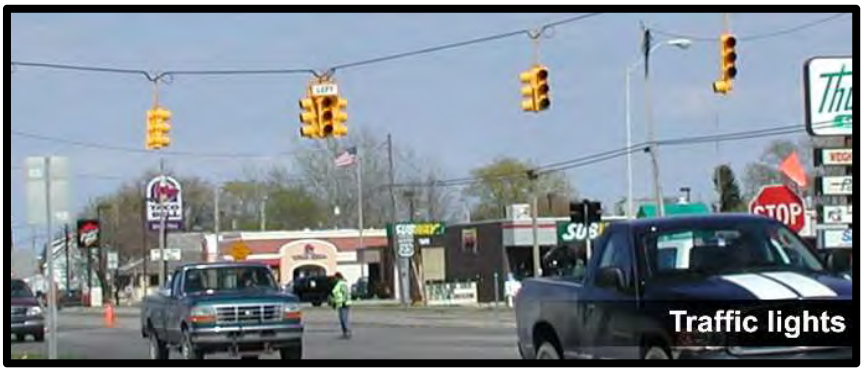


Figure D-1: Example of traffic signals

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.

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