Asset Management Guide for Local Agency Bridges in Michigan

A guide for asset management of Michigan's local agency bridges

Sponsored by:
Michigan Transportation Asset Management Council

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Contents

Cover Photos

Far Left – Thornapple River Drive over Thornapple River, Ada Township, Kent County
Left – East Delhi Road over Huron River, Washtenaw County
Right – Lincoln Avenue over Cheboygan River, City of Cheboygan
Far Right – CR 510 over Dead River, Marquette County

1.0 Introduction

1.1 Purpose

Maintaining bridges in good condition has proven to extend service life and to be more cost effective than allowing deterioration to progress, resulting in the need for more extensive and costly rehabilitation or replacement projects. By developing and implementing a comprehensive bridge preservation plan, a local agency can better identify its needs, prioritize its actions, and allocate available funds appropriately.

This *Asset Management Guide for Local Agency Bridges in Michigan* is intended to provide:

- Assistance in understanding bridge management and bridge preservation;
- Guidance to decision makers and county bridge or highway engineers in the planning, developing, programming, and implementing of effective and efficient capital programs and maintenance actions to preserve the bridges under their jurisdiction;
- Information to assist local agencies (1) in understanding their bridge network, (2) in the preparation and implementation of a bridge preservation plan, and (3) to support applications for funding under Michigan's Local Bridge Program.

Resources
Michigan Public Act 51 of 1951
http://www.legislature.mi.gov/(S(0ncjvxlcys20keep3vr5ucef))/mileg.aspx?page=mcl-Act-51-of-1951

Michigan Public Act 498 of 2002
https://www.legislature.mi.gov/(S(btz2nlmsr3cieubpzwguezkf))/mileg.aspx?page=2002-PA-0498

Michigan Public Act 499 of 2002
https://www.legislature.mi.gov/(S(btz2nlmsr3cieubpzwguezkf))/mileg.aspx?page=2002-PA-0499

MDOT, Local Agency Program Bridge Program
https://www.michigan.gov/mdot/business/local-government/local-agency-program (select *Bridge Program* tab in the body of the page and refer to *Call for Projects* section)

1.2 Using this Guide

This guide provides specific information related to the management of bridge assets. Michigan has substantial resources to assist local agencies in guiding their asset management practices. This guide provides useful links to that information and to resource material available from transportation agencies such as the U.S. Department of Transportation Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and others. Users of this guide are encouraged to consult these resources in the development of their bridge asset management plans.

1.3 Definitions/Acronyms

This guide employs a number of terms commonly used in the inspection, evaluation, and maintenance of bridges; asset management plans; capital programming and funding; resource management; and the administration of Michigan's Local Bridge Program. Links to references containing definitions of these terms and the common acronyms used in the guide are provided in the endnotes for this section. The user is encouraged to review the cited references in order to get a better understanding and to implement the principles and procedures described in the guide.

In May 2006, AASHTO initiated the Transportation System Preservation Technical Services Program (TSP·2). The program, dedicated to the preservation of infrastructure investment was initiated as a clearinghouse to disseminate information on enhancing the performance and extending the useful life of the highway infrastructure, both pavements and bridges, through efficient and effective preservation measures. The TSP·2 website contains the working definition of bridge preservation.

Bridge preservation starts with obtaining timely information on bridge conditions; then, developing and implementing a planned strategy to maintain and extend the useful life of the bridge network. A preservation strategy is composed of various preventive maintenance activities and treatments. Applied at the proper time, preventive maintenance activities extend the service life of a bridge in a cost-effective manner. The definition of critical terms used in the management of bridge assets are discussed in Section 2.2.

Definitions
FHWA, *Asset Management* (web page) (2022)
https://www.fhwa.dot.gov/asset/

Asset Management Overview (archived content containing useful definitions) (2008) – Direct link:
http://www.fhwa.dot.gov/asset/if08008/amo_09.cfm

Transportation System Preservation Technical Services Program (TSP·2)
http://www.tsp2.org

Acronyms
AASHTO – American Association of State Highway and Transportation Officials
ADT – average daily traffic
ADTT - average daily truck traffic
BIR – Bridge Inspection Report
BMS – Bridge Management System
BSIR – Bridge Safety Inspection Report
CRA – County Road Association (of Michigan)
CPM – capital preventive maintenance
FHWA – U.S. Department of Transportation Federal Highway Administration
LBAB – Local Bridge Advisory Board
LBF – Local Bridge Fund
LBP – Local Bridge Program
LTAP – (Michigan) Local Technical Assistance Program
LCCA – life cycle cost analysis
MDOT – Michigan Department of Transportation
MML – Michigan Municipal League
MTF – Michigan Transportation Fund
MPO – metropolitan planning organization
NBI – National Bridge Inventory
NBIS – National Bridge Inspection Standards
NCHRP - National Cooperative Highway Research Program
RBC – regional bridge council
RSL – remaining service life
SAFETEA-LU – Safe, Accountable, Flexible, and Efficient Transportation Equity Act Legacy for Users
SI – structural improvement
SIA – structure inventory and appraisal
STIP – Statewide Transportation Improvement Program
TAMC – Michigan Transportation Asset Management Council
TEDF – Transportation Economic Development Fund
TIP – Transportation Improvement Program
TMS – transportation management system

1.4 Asset Management in Michigan

In Michigan, asset management is defined as “an ongoing process of maintaining, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment” per Act 499 of the Michigan Public Acts of 2002, Section 9(a)(1)(a).

Act 499 encourages all agencies that spend state transportation funds on roads and bridges to implement an asset management approach under the leadership and oversight of the TAMC.

Resources
Michigan Public Act 499 of 2002
https://www.legislature.mi.gov/(S(btz2nlmsr3cieubpzwguezkf))/mileg.aspx?page=2002-PA-0499

1.5 Role of the Michigan Transportation Asset Management Council (TAMC)

Created by Act 499 of the Michigan Public Acts of 2002, the TAMC's stated mission is to advise the State Transportation Commission on a statewide asset management strategy and the necessary procedures and analytical tools to implement such a strategy on Michigan's highway system in a cost-effective, efficient manner.

In order to apply the principles of asset management to the process of allocating transportation resources, the TAMC developed the following high-level strategic process that could be applied to a variety of infrastructure types in order to:

- Assess current condition
- Create a "mix of fixes", estimate costs and funding levels
- Predict future condition, develop performance measures and targets
- Conduct tradeoff analysis, identify candidate projects
- Set priorities, develop a multi-year program
- Report results

This guide is intended to assist local agencies in applying this process to the development of a preservation plan for bridges under their jurisdiction and to provide background material on bridge preservation.

Resources
Michigan Transportation Asset Management Council (TAMC)
https://www.michigan.gov/mic/tamc

2.0 Bridge Asset Management in Michigan

2.1 Bridge Management System

A bridge management system is defined as a collection of interacting processes designed to assist decision makers in the selection of cost-effective bridge preservation, rehabilitation, and improvement strategies and actions to improve the efficiency and safety of the bridge network and to protect the investment in a network of bridges (23 CFR 500.107) Code of Federal Regulations.

Michigan has a system-wide process for transportation asset management of highway bridges. For local agencies, this process is administered through Michigan's Local Bridge Program by the Local Bridge Advisory Board and seven regional councils. The TAMC supports the state's bridge asset management program by providing technical assistance and guidance, publishing annual asset management reports, communicating infrastructure needs, and implementing asset management principles.

Resources

FHWA, *Bridge Management* (web page) (2022)
http://www.fhwa.dot.gov/bridge/management/index.cfm

AASHTO, *AASHTO Transportation Asset Management Guide* (2022)
https://www.transit.dot.gov/regulations-and-programs/asset-management/aashto-transportation-asset-management-guide
Direct link: https://www.transit.dot.gov/sites/fta.dot.gov/files/2022-03/AASHTO-Transportation-Asset-Management-Guide.pdf

MDOT, *MDOT Regions* (web page) (2022)
https://www.michigan.gov/mdot/about/regions

2.2 Bridge Preservation through Preventive Maintenance

The Federal-aid to Highways Program allows states to use Highway Bridge Program (HBP) funds to improve the condition of highway bridges through replacement, rehabilitation, and preservation activities identified using an approved systematic process. Bridge preservation and preventive maintenance are terms that are used interchangeably.

Bridge preservation is defined by FHWA as “actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements; restore the function of existing bridges; keep bridges in good condition; and extend their useful life”.

Preservation actions may be preventive or condition-driven.

Preventive maintenance is recognized as a cost-effective way to preserve the investment in and service life of bridges.

AASHTO defines preventive maintenance as “a planned strategy of cost-effective treatment to an existing roadway system and its appurtenances that preserves the system, retards future deterioration and maintains or improves the functional condition of the system without increasing structural capacity”.

An effective bridge preservation program 1) employs long-term network strategies and practices that are aimed to preserve the condition of bridges and extends their useful life, 2) has sustained and adequate funding sources, and 3) ensures that the appropriate treatments are applied at the appropriate time.

Some agencies employ a program of scheduled maintenance performed by in-house forces.

2.3 Michigan’s Systematic Plan to Preserve Bridges

The FHWA defines a systematic process as “a documented methodology regularly applied to repeatedly achieve a desired outcome or goal”. The plan must define a specific outcome or goal for the preventive maintenance program and describe a systematic process to achieve that goal.

Resources

FHWA, *Bridge Management* (web page –guidance for approval of a bridge management system and/or a systematic process)
http://www.fhwa.dot.gov/bridge/management/index.cfm

Midwest Regional University Transportation Center, “*A systematic process for using federal aid to support bridge preventive maintenance”.* Project Report 07-14 (2008)
https://minds.wisconsin.edu/handle/1793/54140
Direct link: https://minds.wisconsin.edu/bitstream/handle/1793/54140/07-14_FR.pdf

MDOT, *MI Transportation Plan Moving Michigan Forward—2005-2030 State Long-Range Transportation Plan* (2007)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Planning/SLRP/2005-2030-MI-Transportation-Plan.pdf

MDOT, *Transportation Asset Management Plan* (2022)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Planning/Asset-Management/2022-Transp-Asset-Management-Plan.pdf

2.3.1 Elements of Michigan's Systematic Plan

Michigan's systematic plan for preserving its trunk-line bridges as well as local bridge preservation plans should address the following key elements:

- *Identify the needs:* This first step describes the engineering criteria used to determine the agency's need for funding for bridge preventive maintenance. Michigan's Local Bridge Program identifies statewide and regional needs by monitoring bridge condition by functional classification annually. The TAMC also identifies needs and provides reports to the Michigan Legislature annually. Bridge owners must also identify needs in order to schedule and perform routine maintenance and to submit projects for capital preventive maintenance, rehabilitation, and replacement projects.

- The state of Michigan uses two types of inspections for NBI structures: routine inspection and Michigan element-level bridge inspection. Element-level bridge inspection data is extremely useful when determining a preservation plan for bridges. Local agencies are encouraged to incorporate element-level bridge inspection and reporting into their local bridge inspection program.

- *Prioritize the needs:* The state of Michigan has a prescriptive procedure that evaluates bridge condition using bridge inspection records and inventory data in MiBRIDGE. This information is made available to the Local Bridge Advisory Board, regional councils, and local agency bridge owners to be used to prioritize bridge replacement, rehabilitation, and preventive maintenance projects. Bridge owners are encouraged to use the concepts of asset management and MiBRIDGE tools to develop bridge preventive maintenance programs. Maintaining bridges so that they remain in good or fair condition consistently proves to be a cost-effective way to manage a bridge population and minimize costly major rehabilitations. For TAMC purposes and for other forecasted reporting needs, MDOT uses a spreadsheet known as the Bridge Condition Forecasting System (BCFS) to predict future condition.

- *Define the goal:* Bridge condition goals and objectives are an important part of a preservation plan as they provide targets by which strategies, and corresponding metrics to evaluate those strategies, can be set and performance monitored. The TAMC encourages local agencies to establish goals that will improve and preserve their bridge network, such as opening closed bridges, reducing the number of structurally deficient and functionally obsolete bridges (n.b., bridges are no longer classified as "structurally deficient" or "functionally obsolete" by the NBIS; however, these terms may still used for the purposes of asset management decision making), and maintaining more of their bridges in good or fair condition.

- *Demonstrate cost-effectiveness:* Cost effectiveness of bridge preservation projects is best accomplished by monitoring bridge deterioration rates. MDOT has been doing preservation projects for many years and has accumulated data showing the effectiveness of many bridge preservation projects and activities for their highway bridges. MDOT's Bridge Deck Preservation Matrix provides repair options for bridge decks in various condition states and estimates of fix life for the repair options.
- *Identify and dedicate resources:* The Local Bridge Advisory Board dedicates funds to each of the seven regional councils for replacement, rehabilitation, and preventive maintenance projects. Local agency bridge owners should estimate the resource requirements over time to preserve their bridges.
- Using the NBI condition ratings, bridge deterioration rate, project cost, expected inflation, and fix strategies, MDOT and the TAMC generate estimates of the future condition of a bridge network. These estimates can be used to develop a mix of fixes by modeling different percentages of preventive maintenance, rehabilitation, and replacement projects.
- *Annual reporting:* The TAMC annually tracks bridge condition and provides reports to the State Transportation Commission and Michigan Legislature.
- To monitor bridge condition and needs over time, bridge owners are encouraged to use MiBRIDGE for entering/storing data on bridge and culvert assets, viewing that data, and retrieving standardized reports. Annual reports showing bridge condition trends and needs are an important part of a local bridge preservation plan and are helpful in justifying funds to local agencies.

Resources

Michigan TAMC, *Dashboards – Bridge* (website – data dashboard of bridge assets and condition) (n.d.)
https://www.mcgi.state.mi.us/mitrp/tamcDashboards/reports/bridge

MDOT, *GIS Open Data* (website – data dashboard that includes bridge assets and condition) (n.d.)
https://gis-mdot.opendata.arcgis.com/

MDOT, *MDOT NBI Rating Guidelines* (2017)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Inspections/MDOT-NBI-Rating-Guidelines.pdf

MDOT, Bridge Deck Preservation Matrices
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select *Manuals and Guides* tab in the body of the page)

Bridge Paint Matrix – Steel (n.d.) – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Bridge-Paint-Matrix-Steel.pdf

Bridge Deck Preservation Matrix – Decks with Uncoated "Black" Rebar (2021) – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Bridge-Deck-Preservation-Matrix-Decks-Uncoated-Black-Rebar.pdf

Bridge Deck Preservation Matrix – Decks with Epoxy Coated Rebar (2021) – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Bridge-Deck-Preservation-Matrix-Decks-Epoxy-Coated-Rebar.pdf

Michigan TAMC, Annual Reports
https://www.michigan.gov/mic/tamc/annual-reports

MDOT, *MiBRIDGE* (web page)
https://www.michigan.gov/mdot/programs/bridges-and-structures/mibridge

2.4 Funding Bridge Preservation

Under the Safe, Accountable, Flexible, and Efficient Transportation Equity Act Legacy for Users (SAFETEA-LU), Michigan is eligible to use federal funds to support bridge preventive maintenance. MDOT has an FHWA-approved systematic plan for the preventive maintenance program that ensures the activities are cost effective in extending the service life of bridges.

Through legislation enacted on October 1, 2004, Michigan created a Local Bridge Fund to be administered by the newly-formed Local Bridge Advisory Board and seven regional bridge councils, giving control of the funding allocations to the local agencies. An application process was instituted for local agency funding at that time.

Michigan uses a combination of federal HBP funds, Michigan Transportation Fund (MTF) funds, and local bridge funds to implement the approved preservation plan.

Resources

Michigan Public Act 51 of 1951
http://www.legislature.mi.gov/(S(0ncjvxlcys20keep3vr5ucef))/mileg.aspx?page=mcl-Act-51-of-1951
Direct link: http://www.legislature.mi.gov/(S(mvvti5ad0wcygoz05ppbieut))/documents/mcl/pdf/mcl-Act-51-of-1951.pdf

MDOT, Act 51 Primer
https://www.michigan.gov/mdot/business/local-government/act-51 (select *ADARS - Act 51* tab in the body of the page)
Direct link: https://www.house.mi.gov/hfa/Archives/PDF/act51.pdf

FHWA, "Guidance on Highway Preservation and Maintenance" (memorandum) (2016)
https://www.fhwa.dot.gov/preservation/memos/160225.cfm

FHWA, *Bridge Programs* (web page – Bridge & Structures Management/Preservation Funding Programs) (2022)
https://www.fhwa.dot.gov/bridge/bripro.cfm

FHWA, *Highway Bridge Replacement & Rehabilitation Program (HBRRP)* (web page) (2017)
http://www.fhwa.dot.gov/bridge/hbrrp.htm

FHWA, *Funding Tables – Highway Funding under Extensions of SAFETEA-LU* (web page) (n.d.)
http://www.fhwa.dot.gov/safetealu/fundtables.htm

MDOT, *Five-Year Transportation Program* (web page – outlines state funding for bridge projects)
https://www.michigan.gov/mdot/programs/planning/five-year-transportation-program

MDOT, *Overview of Local Bridge Program* (2006)
https://www.michigan.gov/mdot/business/local-government/local-agency-program/local-bridge-program-information (refer to *Overview* section "Local Bridge Program Overview")
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Overview-Local-Bridge-Program.pdf

MDOT, Michigan Transportation Fund (MTF) (web page resources list)
https://www.michigan.gov/mdot/business/local-government/act-51 (select *Michigan Transportation Fund (MTF)* tab in the body of the page)

MDOT, *Transportation Economic Development Fund* (web page) (2022)
https://www.michigan.gov/mdot/Programs/grant-programs/Transportation-Economic-Development-Fund

MDOT, Local Agency Programs Local Bridge Program Funds (web page resources list)
https://www.michigan.gov/mdot/business/local-government/local-agency-program (select *Bridge Program* tab in the body of the page and refer to *Call for Projects* section)

MDOT, Local Agency Programs Safety Funds (web page resources list)
https://www.michigan.gov/mdot/business/local-government/local-agency-program (select *Safety Program* tab in the body of the page and refer to *Application Process* section)

County Road Association of Michigan Township Relations Committee, *A Quick Guide to Road & Road Funding in Michigan* (local funds) (2009)
http://www.micountyroads.org/PDF/Twp_funding.pdf

Muskegon County Road Commission, *Taxes on Gasoline* (Funding 101 Flyer) (n.d.)
http://www.muskegoncountyroads.org/DocumentCenter/View/315/Funding101Flyer_544367_7.PDF

3.0 MDOT Local Agency Program

3.1 Overview

By legislation in October, 2004, Michigan established a Local Bridge Program that includes a Local Bridge Fund to be administered by a local bridge advisory board and seven regional bridge councils, giving control of the funding allocations to the local agencies. Funding from the Local Bridge Fund is allocated to each region based on available funds and weighted ratios provided in the legislation.

MDOT provides administrative support, technical assistance, and bridge inventory data. MDOT reviews submitted applications, performs project field inspections, determines the computer-generated rating points, checks the plans and specifications for conformance to AASHTO guidelines, schedules and participates in all required meetings, and advertises and awards contracts for the bridge projects. MDOT representatives are non-voting members of both the Local Bridge Advisory Board and the regional bridge councils.

Resources

MDOT, *Local Bridge Program* (web page)
https://www.michigan.gov/mdot/business/local-government/local-agency-program/local-bridge-program-information

Guidelines of Local Bridge Program (n.d.) – Direct link:
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Guidelines-of-Local-Bridge-Program.pdf

Overview of Local Bridge Program (2006) – Direct link:
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Overview-Local-Bridge-Program.pdf

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3.2 Local Bridge Advisory Board

The Local Bridge Advisory Board (LBAB) is the state-level committee that oversees the Local Bridge Program operations. The LBAB is responsible for, at a minimum, managing the “large” bridge program, addressing emergency situations involving local bridges, allocating percentages of funding to each region, and ensuring the regional bridge councils are following established guidelines.

The LBAB allocates funding to each region by formula. The three elements in the formula are number of bridges, bridge deck area, and deficient bridge deck area.

Resources

MDOT, *Local Bridge Advisory Board Procedures* (n.d.)
https://www.michigan.gov/mdot/business/local-government/local-agency-program/local-bridge-program-information (see *Overview* section)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Local-Bridge-Advisory-Board-Procedures.pdf

MDOT, *Flow Chart of Local Bridge Process Steps* (2022)
https://www.michigan.gov/mdot/business/local-government/local-agency-program/local-bridge-program-information (see *Overview* section)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Local-Bridge-Process-Flow-Chart.pdf

3.3 Regional Bridge Council

A regional bridge council (RBC) is a regional committee that is charged with the responsibility of determining a three-year bridge program that replaces, rehabilitates, and maintains the bridge inventory of their respective region. Each region's RBC evaluates and rates applications submitted by local agencies using the RBC *Discretionary Rating Guide* and determines which bridge projects are to be funded each year based on the dollars allocated by the LBAB.

Projects are selected and programmed on a rolling three-year basis; for example, projects that are selected based on the 2023 applications will be funded in 2026 as the 2023 through 2025 programs have already been established in 2022. Each RBC's three-year program is reviewed annually by the LBAB for concurrence.

Resources

MDOT, *Regional Bridge Councils Contact Information* (web page) (2022)
https://www.michigan.gov/mdot/business/local-government/local-agency-program/regional-bridge-councils-contact-information

MDOT, *Regional Bridge Council Procedures* (n.d.)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Regional-Bridge-Council-Procedures.pdf

MDOT, Local Bridge Program Bridge Selection Process – *Calculated Rating Point Guidance* (2017)

https://www.michigan.gov/mdot/business/local-government/local-agency-program/local-bridge-program-information (see *Bridge Selection Process* section)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Calculated-Rating-Point-Guidance-May-2017.pdf

MDOT, Local Bridge Program Bridge Selection Process – *Voted Rating Point Guidance* (2017)
https://www.michigan.gov/mdot/business/local-government/local-agency-program/local-bridge-program-information (see *Bridge Selection Process* section)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Voted-Rating-Point-Guidance-May-2017.pdf

MDOT, Local Agency Program Selected Projects – Bridges
https://www.michigan.gov/mdot/business/local-government/local-agency-program (see *Call for Projects* section: FY… Selected Projects for FY…)

3.4 Michigan's Local Bridge Program Strategy

The local bridge preservation strategy is established by the RBCs based on both the funding and the applications that they receive. The RBCs determine how they want to optimize or prioritize each region's mix of fixes. Certain funding is reserved for "large" bridges and local bridge emergencies. The LBAB reviews and approves the RBCs' strategy at its annual meeting and then allocates funds to the regions in the major work categories of replacement, rehabilitation, and preventive maintenance. The RBCs, in turn, distribute the funds to the local agencies.

Resources
MDOT, Local Bridge Program Call for Applications (web page resources list)
https://www.michigan.gov/mdot/business/local-government/local-agency-program (select *Bridge Program* tab in the body of the page and refer to the *Call for Projects* section)

3.5 Call for Applications

A copy of the application documents for the current year can be found on the Local Bridge Program website.

Resources
MDOT, Local Bridge Program Call for Applications (web page resources list)
https://www.michigan.gov/mdot/business/local-government/local-agency-program (select *Bridge Program* tab in the body of the page and refer to the *Call for Projects* section)

3.6 Application Process

A copy of a flow chart describing the application process is contained in Appendix A.

Resources

MDOT Local Agency Programs, *Instructions for Preparing to Bid Federal Aid Projects through MDOT* (2007)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Urban/Preparing-Federal-Aid-Projects.pdf

4.0 Bridge Condition Assessment

The National Bridge Inspection Standards (NBIS) sets the national standards for the proper safety inspection and evaluation of all highway bridges. The NBIS apply to all publicly-owned highway bridges (i.e., structures longer than 20 feet) located on public roads. These same standards are applied to Michigan's local bridges.

As the inspection results are the foundation of bridge preservation planning, it is critical that each agency obtain complete and accurate data on the current condition of each bridge in its network. Inspection reporting includes the inspector's "work recommendations", which should initiate preventive maintenance actions.

Resources

FHWA, *National Bridge Inspection Standards* (web page) (2022)
http://www.fhwa.dot.gov/bridge/nbis.htm

Virginia DOT, Bridge Inspection Definitions
https://www.virginiadot.org/info/resources/bridge_defs.pdf

MDOT, *Bridges & Structures – Safety Inspection* (web page – compliance, manuals, guides, forms, and resources) (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/inspection

4.1 National Bridge Inventory

The National Bridge Inventory (NBI) is a database covering about 600,000 of the nation's bridges located on public roads, including interstate highways, U.S. highways, state and county roads, and publicly-accessible bridges on federal lands. It presents a state-by-state summary of the number, location, and general condition of the highway bridges within each state.

The collection of NBI data is authorized by federal statute and implemented by regulation. The FHWA established NBIS for the safety inspection and evaluation of highway bridges. Each state is required to conduct periodic inspections of all bridges subject to the NBIS, prepare and maintain a current inventory of these structures, and report the data to the FHWA using the procedures and format outlined in the *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*.

The FHWA uses NBI data to satisfy requirements for the FHWA under law, which mandates for all highway bridges on public roads the inventory of classification of those bridges, cost estimates for replacement or rehabilitation, and assignment of replacement or rehabilitation priorities.

Resources
FHWA, *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (Report No. FHWA-PD-96-001) (1995)
https://www.fhwa.dot.gov/bridge/bripub.cfm
Direct link: https://www.fhwa.dot.gov/bridge/mtguide.pdf

MDOT, *MDOT NBI Rating Guidelines* (2017)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Inspections/MDOT-NBI-Rating-Guidelines.pdf

4.2 Bridge Safety Inspections

The FHWA bridge inspection program regulations were developed as a result of the Federal-Aid Highway Act of 1968 that required the secretary of transportation to establish the national bridge inspection standards. Therefore, the primary purpose of the NBIS is to locate and evaluate existing bridge deficiencies to ensure the safety of the traveling public.

The Federal-Aid Highway Act of 1968 directed the states to maintain an inventory of federal-aid highway system bridges. The Federal-Aid Highway Act of 1970 limited the NBIS to bridges on the federal-aid highway system. After the Surface Transportation Assistance Act (STAA) of 1978 was passed, the NBIS requirements were extended to bridges greater than 20 feet on all public roads. The Surface Transportation and Uniform Relocation Assistance Act (STURRA) of 1987 expanded bridge inspection programs to include special inspection procedures for fracture critical members and underwater inspection.

There are more than 11,200 highway bridges in Michigan. MDOT is directly responsible for approximately 4,500 of them and administers a biennial inspection program in compliance with NBIS requirements, collecting both routine and element-level inspection data. The remaining 6,700 bridges are the responsibility of local agencies; these local agencies are required to perform biennial inspections of their bridges in accordance with NBIS. While it is not required that local agencies collect element-level inspection data, local agencies are encouraged to do so as this data is extremely useful when determining a preservation plan for bridges.

Resources
AASHTO, *Manual for Bridge Evaluation* (2020)
https://store.transportation.org/Item/CollectionDetail?ID=216

FHWA, *Guidelines for Installation, Maintenance, and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals* (2005)
https://trid.trb.org/view.aspx?id=1083961 – Summary: http://www.fhwa.dot.gov/BRIDGE/signinspection.cfm
Direct link: https://www.fhwa.dot.gov/bridge/signinspection.pdf

FHWA, *Stream Stability at Highway Structures* – Fourth (Hydraulic Engineering Circular - 20) (2012)
https://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=19&id=152

FHWA, Scour Resources
https://www.fhwa.dot.gov/engineering/hydraulics/scourtech/

4.3 Bridge Condition and Appraisal

Bridge inspectors carefully inspect and evaluate the entire structure and assign a numerical rating to each component of the bridge. There are two categories of ratings—condition ratings and appraisals.

Together, these ratings define the current condition of the bridge, the extent and severity of deterioration, and the bridge's compliance with current standards. Deteriorated and/or substandard bridges can be further classified as "structurally deficient" or "functionally obsolete".

Resources
MDOT, Michigan *Bridge Element Inspection Manual* (2015)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/inspection (select *Manuals* tab in the body of the page)
Direct link: https://www.michigan.gov/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/BOBS/2/MiBEIM-20150305-Final.pdf

MDOT, *Michigan Structure Inventory and Appraisal Coding Guide* (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/load-rating (select *Guides and Manuals* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Inspections/Michigan-Structure-Inventory-Appraisal-Bridges.pdf

4.3.1 Condition Ratings

Condition ratings are used to describe the existing condition of in-place bridge components compared to their original as-built condition. Evaluation is done for the deck, substructure, and superstructure components of a bridge. The evaluation also includes the channels and channel protection and culverts. Condition ratings range from 0 to 9 as follows:

Code Description

N NOT APPLICABLE

9 EXCELLENT CONDITION

8 VERY GOOD CONDITION - no problems noted

7 GOOD CONDITION - some minor problems

6 SATISFACTORY CONDITION – structural elements show some minor deterioration

5 FAIR CONDITION - all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour

4 POOR CONDITION - advanced section loss, deterioration, spalling, or scour

3 SERIOUS CONDITION - loss of section, deterioration, spalling, or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.

2 CRITICAL CONDITION - advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, closing the bridge may be necessary until corrective action is taken.

1 "IMMINENT" FAILURE CONDITION - major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may allow for light service.

0 FAILED CONDITION - out of service and beyond corrective action.

4.3.2 Appraisals

Appraisals rate components of a bridge in comparison to current standards. The items are used to evaluate a bridge in relation to the level of service that the bridge provides on the highway system of which it is a part. The structure is compared to a new structure built to current standards for that particular type of road. Appraisals range from 0 to 9 as follows:

Code Description

N Not applicable

9 Superior to present desirable criteria

8 Equal to present desirable criteria

7 Better than present minimum criteria

6 Equal to present minimum criteria

5 Somewhat better than minimum adequacy to tolerate being left in place as is

4 Meets minimum tolerable limits to be left in place as is

3 Basically intolerable requiring high priority of corrective action

2 Basically intolerable requiring high priority of replacement

1 *(This value of rating code not used)*

0 Bridge closed

Resources
MDOT, *Michigan Structure Inventory and Appraisal Coding Guide* (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/load-rating (select *Guides and Manuals* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Inspections/Michigan-Structure-Inventory-Appraisal-Bridges.pdf

4.3.3 MDOT Inspection Data Collection

The proper assessment of the condition of bridge elements is the cornerstone of sound bridge management. Element-level inspection methods have been adopted by MDOT, and these detailed condition assessments provide the raw inspection information used in MiBRIDGE.

MDOT collects bridge condition data for all NBI structures using the Michigan Bridge Element Inspection Manual (MiBEIM). MDOT also stresses that the inspectors provide detailed comments describing the bridge condition.

Resources
MDOT, Michigan *Bridge Element Inspection Manual* (2015)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/inspection (select *Manuals* tab in the body of the page)
Direct link: https://www.michigan.gov/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/BOBS/2/MiBEIM-20150305-Final.pdf

4.3.4 Structurally Deficient Bridges

Bridges are no longer defined as “structurally deficient” by the NBIS; however, for the purposes of asset management decision making, bridges are considered to be “structurally deficient” if the physical condition of any of the major structural components—deck, substructure, and superstructure—are rated as “poor” or below (rating of 4 or less) or if the appraisals rate the structure or waterway adequacy as requiring a high priority for replacement (rating of 2 or less). A culvert is considered

structurally deficient if the overall culvert rating is “poor” or below (rating of 4 or less).

Resources

Michigan TAMC, *Dashboards – Bridge Conditions – Structurally Deficient Deck Area State of Michigan* (website – data dashboards) (n.d.)
https://www.mcgi.state.mi.us/mitrp/tamcDashboards/reports/bridge/conditions?year=2021&areaType=State&area=State%20of%20Michigan&jurisdictionType=All%20Bridges&reportType=sdArea

4.3.5 Functionally Obsolete Bridges

Bridges are no longer defined as “functionally obsolete” by the NBIS; however, for the purposes of asset management decision making, a bridge is considered “functionally obsolete” if the structural evaluation, deck geometry, under-clearances, approach roadway alignment, or waterway adequacy is rated as “intolerable requiring high priority of corrective action” (rating of 3 or less). A functionally-obsolete bridge may or may not be able to carry all legal loads, but its configuration impairs its ability to carry traffic safely or pass high water.

Information on functionally-obsolete bridges can be obtained through MDOT’s MiBRIDGE application (see section 4.4).

4.3.6 Closed Bridges

At any given time, a number of local agency bridges around the state of Michigan are closed pending funding for major rehabilitation or replacement. These closed crossings can cause considerable inconvenience to the travelling public by extending travel times, creating troublesome detours, and increasing traffic volumes on available routes.

Some local bridges remain closed for years. While closed, the bridge remains on the NBI and remains eligible for federal funding. Bridges that have been closed for over five years will be removed from the inventory unless the agency provides documentation of progress being made for the replacement or rehabilitation of the bridge.

One of the goals of a local agency bridge asset management plan is to program preventive maintenance and repairs to avoid the progressive deterioration of bridges to the point where an expensive rehabilitation or replacement project is necessary. In this way, potential problems can be addressed before a critical condition develops that may require closing a bridge.

Information on closed bridges can be obtained through MDOT’s MiBRIDGE application (see section 4.4).

Resources
MDOT, Michigan Bridge Conditions dashboard (select *Posted and Closed Bridges (NBI)* tab in the header of the page)
https://mdot.maps.arcgis.com/apps/MapSeries/index.html?appid=fb70725b2be04dc7b01703d0b6c91bb6

4.4 MiBRIDGE Application

MiBRIDGE is the bridge management and inspection system for the state of Michigan. MiBRIDGE allows bridge owners, engineers, inspectors, consultants, and managers to view and enter information for bridge assets. MiBRIDGE includes data on the more than 11,200 bridges in Michigan, provides complete coverage of all bridges in Michigan, not just those for which MDOT has responsibility, and supports the regional and local agencies bridge asset management efforts. MiBRIDGE can retrieve information and standardized reports ranging from entire bridge networks to individual bridge inspection reports.

Resources
MDOT, *MiBRIDGE* (web page)
https://www.michigan.gov/mdot/programs/bridges-and-structures/mibridge

4.5 Reporting Condition Data

MDOT's MiBRIDGE produces various reports to assure a proper level of decision support to the user:

- National Bridge Inventory Bridge Inspection – information on bridge conditions
- Element-level Bridge Inspection – information on extent and severity of bridge element deterioration
- Structure Inventory & Appraisal – information on location, dimensions, material, design, capacity, condition, etc.
- Load Ratings – information on the load rating analysis and controlling vehicles.

The first two reports describe the condition of the bridge at the time of the inspection. The NBI report uses the condition ratings and appraisals (described in sections 4.3.1. and 4.3.2), and these findings are presented in the MDOT Bridge Safety Inspection Report (BSIR). The element-level report describes the extent and severity of the deterioration for individual bridge elements.

This condition data is the basis for determining a preservation program for each bridge and for prioritizing actions within a bridge asset management plan. The importance of starting with complete and accurate inspection data and “work recommendations” cannot be overemphasized.

Resources
MDOT, Michigan *Bridge Element Inspection Manual* (2015)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/inspection (select *Manuals* tab in the body of the page)
Direct link: https://www.michigan.gov/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/BOBS/2/MiBEIM-20150305-Final.pdf

MDOT, *Bridge Safety Inspection Report* (n.d.)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/inspection (select *Forms* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Inspections/Bridge-Safety-Inspection-Report.pdf

4.6 Inspector Work Recommendations

Bridge inspectors are expected to assess and evaluate the condition of the bridge elements and recommend appropriate corrective action based on their judgment of the condition. These “Work Recommendations” are presented on the Bridge Inspection Report (BIR) Form.

In Michigan, bridge inspectors using NBI terminology provide work recommendations at three levels of priority, categorized as high, medium, or low priority. The bridge owner takes action based on the inspector’s recommendations.

MDOT’s *Project Scoping Manual* for state trunk-line bridges is a valuable resource for local agencies in understanding and implementing work recommendations.

The proper interpretation of the inspection condition data by the bridge-owning agency is the foundation for making informed maintenance, repair, and/or replacement decisions in order to develop an optimum strategy for bridge preservation. The local agency should establish a set of metrics as a basis for prioritizing its actions with structural and safety issues taking precedence.

Resources
MDOT, *MDOT NBI Rating Guidelines* (2017)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/inspection (select *Guides* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Inspections/MDOT-NBI-Rating-Guidelines.pdf

MDOT, *Project Scoping Manual* (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select *Manuals and Guides* tab in the body of the page)
Direct link: https://mdotcf.state.mi.us/public/docs/design/files/scopingmanual/Scoping_Manual.pdf

4.7 Structure Evaluation

The Michigan Structure Inventory & Appraisal (SI&A) sheet calculates a structure evaluation (Item 67), which is an overall assessment of the bridge. The appraisal takes into account the major structural deficiencies and evaluates a bridge in relation to the level of service it provides in comparison to a new bridge built to current standards. Important factors considered in this appraisal are the bridge load rating and the condition ratings of the substructure and superstructure.

Condition ratings and appraisals are described in sections 4.3.1. and 4.3.2 of this guide. The bridge load rating (in tons) denotes the safe sustained-load capacity of a structure, determined in accordance with the MDOT *Bridge Analysis Guide,* the AASHTO *Manual for Bridge Evaluation,* and federal regulations.

In terms of NBI condition ratings, bridge elements having an NBI condition rating of 4 or less exhibit advanced deterioration. These structures are considered to be in poor condition and in need of repair or rehabilitation. If action is deferred and the deterioration is left to progress, the bridge elements will degrade to serious or critical condition.

Bridge elements having an NBI condition rating of 5 or 6 exhibit minor to moderate deterioration. These structures are considered to be sound and in fair condition but need maintenance or minor repair; they are often good candidates for preventive maintenance.

Bridge elements having an NBI condition rating of 7 or more exhibit only minor deterioration. These structures are considered to be in good condition and need only scheduled maintenance.

Resources

MDOT, *Bridge Analysis Guide* (2009)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/load-rating (select *Guides and Manuals* tab in the body of the page)

Part 1 – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Load-Rating/2009-Interim-MDOT-Bridge-Analysis-Guide-Part1.pdf

Part 2 – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Load-Rating/2009-Interim-MDOT-Bridge-Analysis-Guide-Part2.pdf

AASHTO, *Manual for Bridge Evaluation* (2020)
https://store.transportation.org/Item/CollectionDetail?ID=216

FHWA, *Bridge Load Rating for National Bridge Inventory* (memorandum) (2006)
http://www.fhwa.dot.gov/bridge/nbis/103006.cfm

AASHTO, *AASHTOWare Bridge Rating*™ (brochure) (2022)
https://www.aashtowarebridge.com/wp-content/uploads/2021/06/Bridge-Rating-Product-Brochure-FY-2022.pdf

CTT (sponsored by MDOT), *Bridge Load Rating* (website)
https://loadrating.michiganltap.org/

MDOT, Bridge Analysis Spreadsheets
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/load-rating/bridge-analysis-spreadsheets

Gusset Plate LFR Analysis – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Load-Rating/Gusset-Plate-LFR-Analysis.xls
Gusset Plate LFR Documentation – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Load-Rating/Gusset-Plate-LFR-Documentation.pdf

4.8 Relating Bridge Condition and Performance to Maintenance

Proper condition evaluation is an essential component of an asset management plan for bridge preservation. For the overall health of the local bridge network, it is important to take the appropriate response in addressing recorded condition deficiencies in bridge elements and preventive measures to retard potential future degradation. A goal of preservation is to employ preventive and responsive maintenance to sustain the network in good condition longer and to extend the service life of bridges.

An effective way to achieve this goal is to develop a local bridge preservation plan. A local agency goal may be to maintain its bridges at an NBI condition rating of 5 or better and a load capacity that meets the demands of the traffic using the route. It is suggested that the preservation plan improves poor bridges, provides a capital preventive maintenance program to maintain fair bridges in the same condition or better, and addresses its good bridges through a capital scheduled maintenance program. The combination of potential actions into an appropriate “mix of fixes” enables the local agency to develop an optimum bridge preservation strategy.

5.0 Developing an Optimum Bridge Preservation Strategy

A local agency is encouraged to prepare a bridge preservation plan that includes a capital maintenance program designed to maximize the service life of bridges and to achieve optimal use of funding. The capital program may include structural improvements as well as preventive maintenance.

MDOT, through the RBCs and the statewide LBAB, annually reviews applications for bridge replacements, rehabilitation projects, and preventive maintenance projects and evaluates the needs based on the applications submitted by local agencies.

Once a local agency has assessed the condition of the bridges in its network, it must then determine the available fixes that will best preserve the system using a "mix-of-fixes" approach, or "*the right fix in the right place at the right time*". A properly developed "mix of fixes" usually includes a combination of activities—structural improvements in the form of replacement and/or rehabilitation projects and both scheduled and preventive maintenance programs.

It is advisable to have both short- and long-term objectives. Short- term objectives address facilities that currently are in poor condition while long-term objectives address the need for sustained investment in the bridge network through capital preventive maintenance.

MDOT has developed a project scoping manual for state trunk line bridges for the purpose of more accurately and uniformly scoping projects. It serves as a valuable resource for local agencies in determining required fixes and in preparing their preservation plans.

Resources
MDOT, *Project Scoping Manual* (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select *Manuals and Guides* tab in the body of the page)
Direct link: https://mdotcf.state.mi.us/public/docs/design/files/scopingmanual/Scoping_Manual.pdf

MDOT, *Statewide Scoping Package Master Checklist – Bridge* (2016)
https://mdotjboss.state.mi.us/webforms/GetDocument.htm?fileName=0593.pdf

MDOT, *Statewide Scoping Package Master Checklist – Bridge CSM/CPM* (2015)
https://mdotjboss.state.mi.us/webforms/GetDocument.htm?fileName=0594.pdf

5.1 Types of Potential Fixes

Many types of fixes are available to the local agency. The fixes described in this section are based on actions delineated on MDOT Local Bridge Program lists.

Resources
Juntunen, David A. “Improving the Condition of Bridge Networks—Michigan Crafts a Preservation Program”. TR News, v. 228, pp. 26-30. September-October 2003.
https://trb.org/publications/trnews/trnews228.pdf

Kitalong-Will, Ann. “County Maintenance Crew Replaces a Bridge Using Prefabricated Components”. Michigan LTAP: *The Bridge*, v.21, n.4, May 2008.
http://www.michiganltap.org/sites/michiganltap.org/files/bridge-newsletter/2008_bridge_21_4_0.pdf

5.1.1 Structural Improvement

Structural improvement includes any activity that preserves or improves the structural integrity of a bridge. These activities may be replacement or rehabilitation:

Replacement - Projects involving replacement of the entire bridge—substructure, superstructure, and deck—and associated approach work. This work is intended to improve the condition for the total bridge — deck, substructure, and/or superstructure, elements—from “poor” to “good”.

Rehabilitation - Major work required to restore the structural integrity of a bridge as well as work necessary to correct major safety defects. This work is intended to improve ratings from “poor” or “fair” to “good”. Some typical rehabilitation projects include:

- Full deck replacement (with or without painting of steel beams)
- Bridge barrier replacement
- Extensive substructure repairs
- Superstructure replacement
- Superstructure repairs
- Steel repairs
- Concrete beam end repairs

- Geometric upgrades
- Structure widening
- Demolition of existing bridge

5.1.2 Preventive Maintenance

Preventive maintenance encompasses both routine scheduled maintenance and capital preventive maintenance.

Routine scheduled maintenance is a regularly scheduled activity that maintains serviceability and reduces the rate of deterioration of structural elements. In many instances, local agency forces are able to perform some or all of this work.

Capital preventive maintenance is a scheduled work activity that restores element integrity and supports serviceability. This work is intended to address the needs of elements rated "fair".

Examples of preventive maintenance include:

- HMA overlay (with or without membrane)
- Deep or shallow deck overlay
- Epoxy overlay
- Guardrail beam installation or retrofit
- Approach pavement relief joints
- Pin and hanger replacement
- Scour countermeasures
- Painting only (full, zone, or spot painting)
- Superstructure washing
- Expansion or construction joint repair or replacement
- Concrete sealing
- Minor concrete patching and repair
- Concrete crack sealing
- Temporary supports
- Slope paving repair
- Drainage system repair (bridge deck drains and bridge approach downspouts)
- Drainage system clean-out and repair
- Vegetation control

Resources

MDOT, *Bridge Capital Scheduled Maintenance Manual* (2010)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select *Manuals and Guides* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Bridge-CSM-Manual.pdf

AASHTO Center for Environmental Excellence (Vendor Consulting and Parsons Brinckerhoff), "Environmental Stewardship Practices, Procedures, and Policies for Highway Maintenance and Construction", Chapter7: Bridge Maintenance. NCHRP Report 25-254 (2004)
https://environment.transportation.org/wp-content/uploads/2021/04/25-254_FR.pdf

5.1.3 Bridge Maintenance Technical Guidance

Capital scheduled maintenance (CSM) activities maintain the existing serviceability and reduce deterioration rates on bridges. CSM work activities sustain the current bridge condition longer, whether the current condition is good, fair, or poor. MDOT's *Capital Scheduled Maintenance Manual* provides a thorough description of various preventive maintenance actions.

Resources
MDOT, *Bridge Capital Scheduled Maintenance Manual* (2010)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select Manuals and Guides tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Bridge-CSM-Manual.pdf

5.2 Cost Estimating

MDOT's *Bridge Cost Estimate Worksheet – CPM, Rehab, Replacement* contains unit prices for various preventive maintenance actions. These values can be used to estimate the cost of alternative maintenance or rehabilitation actions and to evaluate relative costs in determining the optimum program in the preparation of a bridge asset management plan.

Resources
MDOT, *Bridge Cost Estimate Worksheet – CPM, Rehab, Replace* (and CSM) (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select *Project Estimating* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Bridge-Scoping-Cost-Estimate-Worksheet.xlsx
Bridge Repair Cost Estimate Worksheet - Key (2022) – Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Bridge-Cost-Estimate-Worksheet.pdf

MDOT, *Life Cycle Cost Analysis Worksheet* (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select *Project Estimating* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Life-Cycle-Cost-Analysis-Worksheet.xlsx

TRB, *Bridge Life Cycle Cost Analysis*. NCHRP Report 483 (2003)
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_483a.pdf

5.2.1 Deterioration Models

The objective of a bridge asset management plan is to determine the optimal

preservation decisions in current and future years based on the consequences of different actions on the future condition of the given bridge network using the data in MDOT's BMS.

Bridge deterioration models are an essential component of the BMS and express a relationship between condition and time by predicting the future condition of the bridge components based on selected actions or inactions.

Bridge deterioration models use condition rating as the measure of bridge performance. Deterioration models predict the deterioration process as a decay of condition ratings over time. These models are built based on expert opinion and inspection history.

5.2.2 Costing Deferred Maintenance

There are two components to consider when evaluating the cost of deferred maintenance. The first is the increased costs due to greater deterioration of the bridge or component and the need to perform more extensive repairs in the future. This must be compared to the benefit of using the available funding for another project within that time period.

Deterioration models can serve as a basis for determining the cost of deferring specific maintenance or repair actions. As the models establish a relationship between condition and time, the user can predict the future condition of a bridge element based on its current condition and, in this way, determine the future increased repair work and associated cost resulting from deferral.

The benefits of a project can include safety, reduced agency or user costs, elimination of traffic congestion, reduction of travel time, better geometrics, improved surface rideability, and operational improvements by addition of traffic control devices.

When prioritizing between two or more projects, deferring work is not a recommended strategy if the cost of deferral exceeds the benefits of the alternative project. This type of comparison and its results are factored into the prioritization decision process through the life cycle cost analysis module of a BMS.

5.2.3 In-house Costs versus Contract Costs

Scheduled maintenance work and preventive maintenance work can be performed by either in-house maintenance crews or by contracted firms. Most local agencies use a combination of the two.

An estimate of the cost of work to be performed by in-house crews should consider supervisory and crew labor expenses, including wages, benefits, and other payroll burdens; materials and supplies; equipment operating costs for owned equipment; equipment rental costs, as needed; and administrative costs. The local agency should

keep a record of all maintenance work performed by in-house crews in the bridge file for future reference.

Work done by contract with private sector firms generally involves projects too large or too specialized to be done by in-house crews. Estimates of work to be performed by contract may be based on the unit price guide contained in MDOT's *Bridge Cost Estimate Workbook*. The local agency's cost of contract administration and project support should be added to the estimated contract cost.

In its analysis, the local agency should consider the potential cost benefits of collaborating with other agencies to combine resources and share the costs of work to be performed in-house or by contract.

The final estimated costs are used for developing the prioritization plan within the bridge asset management plan.

5.2.4 Life Cycle Cost Analysis

The cost of a bridge is not a one-time expense. A bridge represents a long term, multi-year investment. After its initial planning, design, and construction, over its lifetime a bridge requires maintenance, repair, rehabilitation, and, ultimately, replacement.

The time between construction and replacement is the service life of a bridge. The actions and events that influence the condition of the bridge during its service life comprise the life cycle. Bridge owners develop a bridge management strategy by making decisions about bridge materials, design, construction, maintenance, and repairs based on their expectations of costs and results.

Life-cycle cost analysis (LCCA) is a computational process for comparing initial and future costs to arrive at the most economical strategy for ensuring that the bridge will provide its intended service for its expected service life. LCCA is essentially a method for considering the economic efficiency of various alternate expenditures.

Resources

MDOT, *Life Cycle Cost Analysis Worksheet* (2022)
https://www.michigan.gov/mdot/programs/bridges-and-structures/structure-preservation-and-management/bridge-management-and-scoping (select *Project Estimating* tab in the body of the page)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Bridges-and-Structures/Mgmt-and-Scoping/Life-Cycle-Cost-Analysis-Worksheet.xlsx

TRB, *Bridge Life-Cycle Cost Analysis*. NCHRP Report 483 (2003)
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_483a.pdf

5.3 Concept of a Mix of Fixes

In its asset management plan, the TAMC has adopted the philosophy of “the right fix in the right place at the right time”. This philosophy espouses a program of developing a mix of fixes that results in the optimum use of bridge preservation funds.

By comparing maintenance, repair, and rehabilitation needs for each bridge, the cost of implementing various preservation actions or deferring work can be compared with the cost of completely replacing a bridge. Replacement of a bridge may be warranted if replacement is the most cost-effective means to satisfy the existing structural or functional needs. Alternatively, if the physical condition of the bridge has deteriorated to a point where the bridge is considered unsafe, bridge replacement may be determined to be the only feasible alternative.

An example of a bridge preventive maintenance strategy developed by the Greater Buffalo-Niagara Regional Transportation Council for its bridges is accessible through the referenced link.

Resources

MDOT, *MI Transportation Plan Moving Michigan Forward—2005-2030 State Long-Range Transportation Plan* (2007)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Planning/SLRP/2005-2030-MI-Transportation-Plan.pdf

MDOT, *Transportation Asset Management Plan* (2022)
https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Planning/Asset-Management/2022-Transp-Asset-Management-Plan.pdf

Greater Buffalo-Niagara Regional Transportation Council, *Bridge Preventive Maintenance Strategy for Erie-Niagara Local Bridge Owners*. Report (2007)
https://www.gbnrtc.org/reports
Direct link:
https://static1.squarespace.com/static/56ccbbfd3c44d8670dbd1d84/t/56e1c610b09f9598c198710f/1457636906084/Bridge+Preventive+Maintenance+Strategy.pdf

5.4 Developing a Local Bridge Preservation Plan

Developing and implementing a local bridge preservation plan is a means of extending the useful service life of the agency’s bridges and for using available funds more effectively.

The benefits of a bridge preservation plan to a local agency include:

- an identification and understanding of the condition of the bridges in the network;
- a defined program of rehabilitation, replacement, and preventive maintenance designed to restore the functionality of degraded bridge elements;
- a program of regular maintenance to impede deterioration of sound bridges;
- dedicated local resources and an increased opportunity to obtain additional funding;

- optimal use of all available resources.

The bridge preservation plan should address similar items as described for a systematic plan in Section 2.3.1. Some of the items suggested for inclusion in a local agency bridge preservation plan include:

- *Bridge assets*: A summary of the number, type, and condition of the bridges in the network
- *Condition analysis*: An overall assessment of the current state of the bridges in the network
- *Goal*: A statement of the agency's purpose, describing future expected outcomes. Goals provide programmatic direction and focus on ends rather than means.
- *Objectives*: Clear, specific, measurable, and time-limited statements of action which, when completed, will move towards achieving the goal
- *Performance measures*: Metrics by which the agency will evaluate the effectiveness of the plan
- *Prioritization*: Agency's methodology used to rank projects for funding
- *Preservation strategy*: Agency's overall actions to address bridge preservation
- *Implementation*: How the agency will execute the plan
- *Operations and maintenance plan*: Annual activities scheduled in a five-year program
- *Five-year annual cost projection*: A year-by-year, project-by-project schedule of costs
- *Cost estimate*: An annual review and updating of the actions programmed in the plan
- *Funding sources*: An identification of funding sources and allocation of those funds for the time period identified in the plan
- *Risk management*: A recognition of the risks inherent in degraded bridges and how those degraded bridges impact the network itself.

A sample plan for a local bridge owner following this format is discussed in Section 5.4.3. (below).

5.4.1 Prioritization of Repairs

The local bridge owner seeks to optimize the use of available funding in the implementation of a preservation plan, and, therefore, must establish a priority order for the replacement, rehabilitation, and preventive maintenance actions proposed in the plan. Many factors may be used to rank the importance of projects, and the owner

should establish a guideline to accomplish this end. Some of the factors that should be considered in developing a prioritization plan include:

- *Condition*: Consider the NBI condition ratings for the substructure, superstructure, and deck for bridges
- *Load capacity*: Consider whether the load rating is sufficient for the traffic routinely crossing the bridge
- *Traffic*: Consider whether the bridge is on a primary or secondary route and whether it is part of a designated route for essential services, school buses, or emergency evacuation
- *Safety*: Consider the structural adequacy and whether the bridge is classified as "structurally deficient"; and, consider operational characteristics like whether the bridge is classified as "functionally obsolete" and whether any of its inadequacies create a safety hazard
- *Detour*: Evaluate the distance, traffic volume, and delay time of the detour route
- *Cost*: Compare the cost of the preservation action using current pricing with the projected cost of deferred action using deterioration modeling (Sect 5.2.2 and 5.3.3).

Each factor in the prioritization formula should be weighted at the discretion of the bridge owner. For example, in the sample asset management plan discussed in 5.4.3, the road-owning agency uses a prioritization formula that evaluates five factors and weights them as follows: condition – 30%; load capacity – 25%; traffic – 20%; safety – 15%; and detour – 10%. The total score is then compared to other proposed actions to establish a priority order.

5.4.2 Risk Assessment

As the Michigan Local Bridge Program funds are used for bridge preservation activities, a level of assurance is needed to confirm that the funds are being applied in a cost-effective manner to improve and preserve Michigan's bridges. Local agencies should attempt to prioritize their funding needs according to a risk-based methodology.

The potential risks associated with bridges can include personal injury, property damage, limited commercial access to a region, delays, congestion, and inconvenience arising from bridge collapse or element failure, closures, temporary outages, restricted load postings, or a reduced level of serviceability.

The local agency owner should recognize the potential risks related to each degraded bridge and assess the need for improvement based on impacts of action versus deferral of action when prioritizing repairs. Structural and safety issues should be given priority. For example, a beam end needing repair that reduces the load rating for a beam may

need higher consideration than other repairs that have little or no impact on the bridge load carrying capacity.

5.4.3 Sample Local Bridge Preservation Plan

A bridge asset management plan template has been developed in response to Public Act 325 of 2018 for the bridges under a road- and bridge-owning agency's jurisdiction. The TAMC has included a copy of the document in Appendix B as a sample for local agencies.

Appendix A: Application Process Flow Chart

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LBAB: Local Bridge Advisory Board
LAP: MDOT's Local Agency Programs
RBC: Regional bridge council
LA: Local agencies

Revised: January 2022
This flow chart was reproduced from MDOT's *Flow Chart of Local Bridge Process Steps* (2022) with formatting changes for this document.
Original source:
https://www.michigan.gov/mdot/business/local-government/local-agency-program/local-bridge-program-information (see Overview section)
Direct link: https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Business/Local-Government/Local-Agency-Program/Bridge/Local-Bridge-Process-Flow-Chart.pdf

Appendix B: Sample Bridge Asset Management Plan Template for Michigan Local Road- and Bridge-owning Agencies

[Agency Name]
[Year] Bridge
Asset Management Plan

A plan describing the [Agency Name]'s transportation assets and conditions

Prepared by:

Author
Author's title
Contact information

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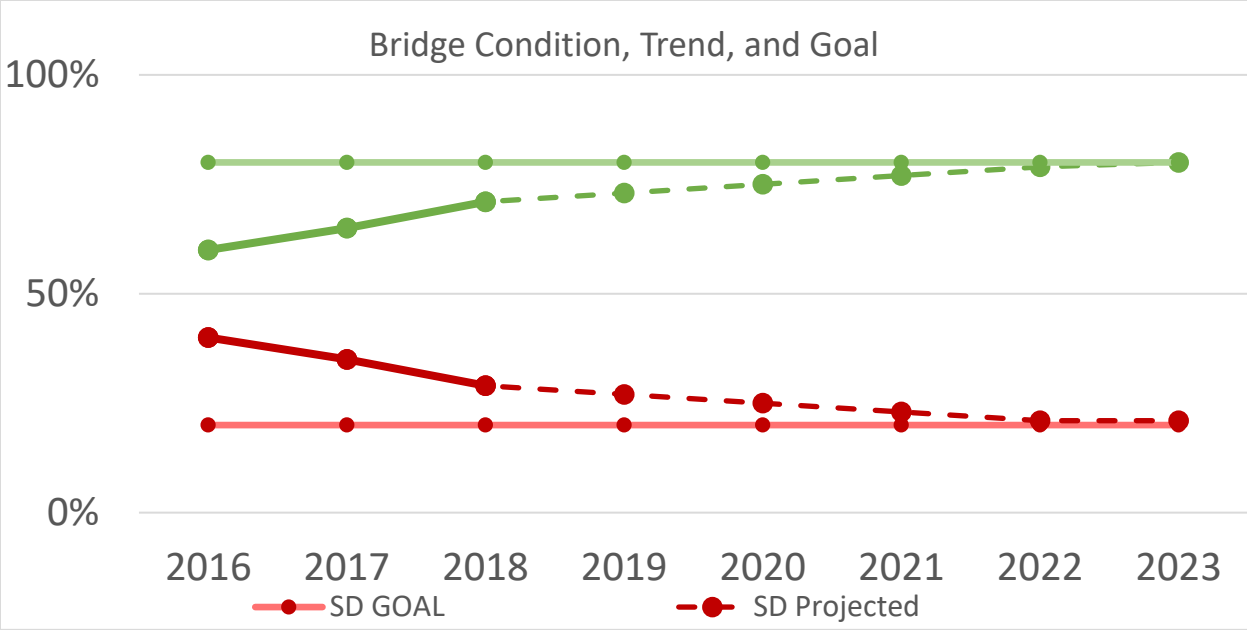
EXECUTIVE SUMMARY

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 that support and affect the road network. The [Agency Name]'s ([AgencyShort]) bridges, other road-related assets, and support systems are some of the most valuable and extensive public assets, all of which are paid for with taxes collected from ordinary 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 [AgencyShort] is meeting its obligations to maintain the bridges for which it is responsible.

This plan overviews [AgencyShort]'s bridge assets and conditions and explains how [Agency Name] works to maintain and improve the overall condition of those assets. These explanations can help answer:

- What kinds of bridge assets [AgencyShort] has in its jurisdiction and the different options for maintaining these assets.
- What tools and processes [AgencyShort] uses to track and manage bridge assets and funds.
- What condition [AgencyShort]'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 [AgencyShort]'s bridge assets' normal life cycle.
- What condition [AgencyShort] can expect of its bridge assets if those assets continue to be funded at the current funding levels
- How changes in funding levels can affect the overall condition of all of [AgencyShort]'s bridge assets.

[AgencyShort] owns and/or manages [##] bridges. A summary of its 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 [AgencyShort]'s obligations towards meeting these requirements. This asset management plan also helps demonstrate [AgencyShort]'s responsible use of public funds by providing elected and appointed officials as well as the general public with inventory and condition information of [AgencyShort]'s bridge assets, and gives taxpayers the information they need 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 [Agency Name] 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 [Agency Name]’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 [Agency Name] ([AgencyShort]) 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. [AgencyShort] is responsible for maintaining and operating [##] bridges.

This [Year] plan outlines how [AgencyShort] 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 [freq of updates] years to reflect changes in bridge conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to [Contact Name][at contact address][or at phone/email]. [A copy of this plan can be accessed on our website at URL.]

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

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

Bridge Primer

Bridge Types

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

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

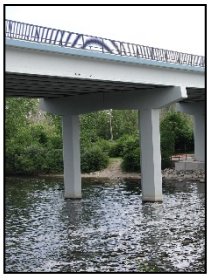


Figure 1: Girder bridge

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

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

Figure 2: Slab bridge

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

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

Figure 3: Truss bridge

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

Michigan is also home to several unique bridge designs.

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

Figure 4: Three-sided box bridge

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

Bridge Condition

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

Table 1: Summary of the NBI Rating Scale

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

Bridge Treatments

Replacement

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

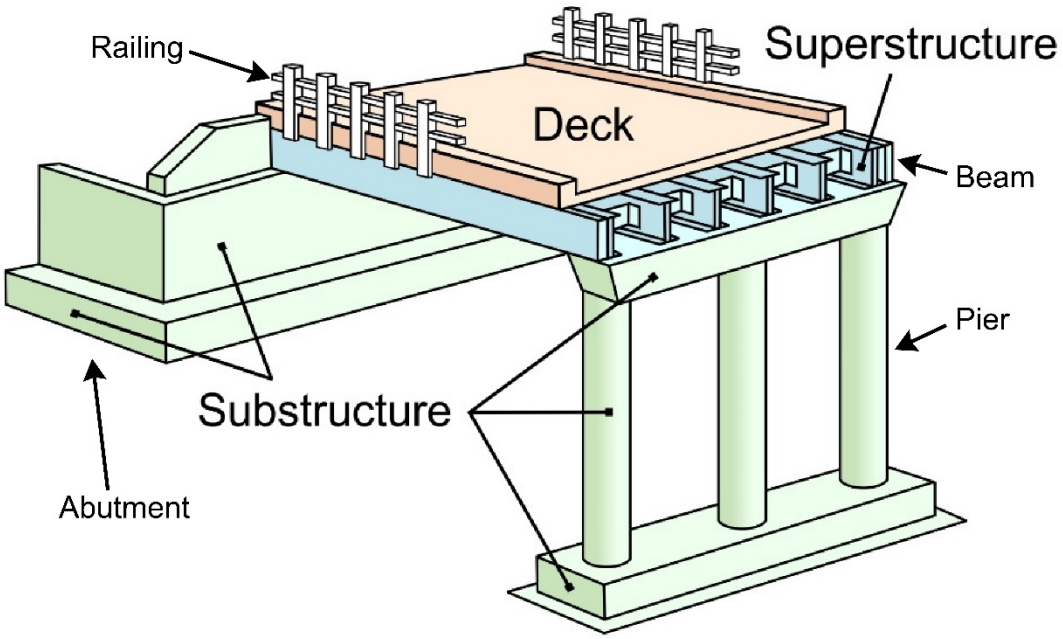


Figure 6: Diagram of basic elements of a bridge

Rehabilitation

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

Railing retrofit/replacement: A railing retrofit or replacement either reinforces the existing railing or replaces it entirely (Figure 6). This rehabilitation is driven by a need for safety improvements on poor-rated railings or barriers (NBI rating less than 5).

Beam repair: Beam repair corrects damage that has reduced beam strength (Figure 6). In the case of steel beams, it is performed if there is 25 percent or more of section loss in an area of the beam that affects load-carrying capacity. In the case of concrete beams, this is performed if there is 50 percent or more spalling (i.e., loss of material) at the ends of beams.

Substructure concrete patching and repair: Patching and repairing the substructure is essential to keep a bridge in service. These rehabilitation efforts are performed when the abutments or piers are fair or poor (NBI rating of 5 or 4), or if spalling and delamination affect less than 30 percent of the bridge surface.

Preventive Maintenance

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

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

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

Deck repairs: Deck repairs include three common techniques: HMA overlay with or without waterproof membranes, concrete patching, deck sealing, crack sealing, and joint repair/replacement. An HMA overlay with an underlying waterproof membrane can be placed on bridge decks with a surface rating of fair or lower (NBI of 5 or less) and with deficiencies that cover between 15 and 30 percent of the deck surface and deck bottom. An HMA overlay without a waterproof membrane should be used on a bridge deck with a deck surface and deck bottom rating of serious condition or lower (NBI rating of 3 or less) and with deficiencies that cover greater than 30 percent of the deck surface and bottom; this is considered a temporary holdover to improve ride quality when a bridge deck is scheduled to undergo major rehabilitation within five years. All HMA overlays need to be accompanied by an updated load rating. Patching of the concrete on a bridge deck is done in response to an inspector's work recommendation or when the deck surface is in good, satisfactory, or fair condition (NBI rating of 7, 6, or 5) with minor delamination and spalling. To preserve a good bridge deck in good condition, a deck sealer can be used.

Deck sealing should only be done when the bridge deck has surface rating of fair or better (NBI of 5 or more). Concrete sealers should only be used when the top and bottom surfaces of the deck are free from major deficiencies, cracks, and spalling. An epoxy overlay may be used when between 2 and 5 percent of the deck surface has delaminations and spalls, but these deficiencies must be repaired prior to the overlay. An epoxy overlay may also be used to repair an existing epoxy overlay. Concrete crack sealing is an option to maintain concrete in otherwise good condition that has visible cracks with the potential of reaching the steel reinforcement. Crack sealing may be performed on concrete with a surface rating of good, satisfactory, or fair (NBIS rating of 7, 6, or 5) with minor surface spalling and delamination; it may also be performed in response to a work recommendation by an inspector who has determined that the frequency and size of the cracks require sealing.

Steel bearing repair/replacement: Rather than sitting directly on the piers, a bridge superstructure is separated from the piers by bearings. Bearings allow for a certain degree of movement due to temperature changes or other forces. Repairing or replacing the bearings is considered preventive maintenance. Girders and a deck in at least fair condition (NBI of 5 or higher) and bearings in poor condition (NBI rating of 4 or less) identifies candidates for this maintenance activity.

Painting: Re-painting a bridge structure can either be done in totality or in part. Total re-painting is done in response to an inspector's work recommendation or when the paint condition is in serious condition (NBI rating of 3 or less). Partial re-painting can either consist of zone re-painting, which is a preventive maintenance technique, or spot re-painting, which is scheduled maintenance (see below). Zone re-painting is done when less than 15 percent of the paint in a smaller area, or zone, has failed while the rest of the bridge is in good or fair condition. It is also done if the paint condition is fair or poor (NBI rating of 5 or 4).

Channel improvements: Occasionally, it is necessary to make improvements to the waterway that flows underneath the bridge. Such channel improvements are driven by an inspector's work recommendation based on a hydraulic analysis or to remove vegetation, debris, or sediment from the channel and banks (Figure 6).

Scour countermeasures: An inspector's work recommendations or a hydraulic analysis may require scour countermeasures (see the *Risk Management* section of this plan for more information on scour). This is done when a structure is categorized as scour critical and is not scheduled for replacement or when NBI comments in abutment and pier ratings indicate the presence of scour holes.

Approach repaving: A bridge's approach is the transition area between the roadway leading up to and away from the bridge and the bridge deck. Repaving the approach areas is performed in response to an inspector's work recommendation, when the pavement surface is in poor condition (NBI rating of 4 or less), or when the bridge deck is replaced or rehabilitated (e.g., concrete overlay).

Guardrail repair/replacement: A guardrail is a safety feature on many roads and bridges that prevents or minimizes the effects of lane departure incidents. Keeping bridge guardrails in good condition is important. Repair or replacement of bridge guardrail should be done when a guardrail is missing or damaged, or when it needs a safety improvement.

Scheduled Maintenance

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

Superstructure washing: Washing the superstructure, or the main structure supporting the bridge, typically occurs in response to an inspector's work recommendation or when salt-contaminated dirt and debris collected on the superstructure is causing corrosion or deterioration by trapping moisture.

Drainage system cleanout/repair: Keeping a bridge's drainage system clean and in good working order allows the bridge to shed water effectively. An inspector's work recommendation may indicate drainage system cleanout/repair. Signs that a drainage system needs cleaning or repair include clogs and broken, deteriorated, or damaged drainage elements.

Spot painting: Spot painting is a form of partial bridge painting. This scheduled maintenance technique involves painting a small portion of a bridge. Generally, this is done in response to an inspector's work recommendation and is used for zinc-based paint systems only.

Slope repair/reinforcement: The terrain on either side of the bridge that slopes down toward the channel is called the slope. At times, it is necessary to repair the slope. Situations that call for slope repair include when the slope is degraded, when the slope has significant areas of distress or failure, when the slope has settled, or if the slope is in fair or poor condition (NBI rating of 5 or less). Other times, it is necessary to reinforce the slope. Reinforcement can be added by installing Riprap, which is a side-slope covering made of stones. Riprap protects the stability of side slopes of channel banks when erosion threatens the surface.

Vegetation control and debris removal: Keeping the area around a bridge structure free of vegetation and debris safeguards the bridge structure from these potentially damaging forces. Removing or restricting vegetation around bridges prevents damage to the structure. Vegetation control is done in response to an inspector's work recommendation or when vegetation traps moisture on structural elements or is growing from joints or cracks. Debris in the water channel or in the bridge can also cause damage to the structure. Removing this debris is typically done in response to an inspector's work recommendation or when vegetation, debris, or sediment accumulates on the structure or channel.

Miscellaneous repairs: These are uncategorized repairs in response to an inspector's work recommendation.

1. BRIDGE ASSETS

[AgencyShort] seeks to implement an asset management program for its bridge structures. This program balances the decision to perform reconstruction, rehabilitation, preventive maintenance, scheduled maintenance, or new construction, with [AgencyShort]'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, [AgencyShort]'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, [AgencyShort] 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, [AgencyShort] 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 [AgencyShort]'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, [AgencyShort] specifically aims to have [to have ##% or more of the agency's local bridges in fair to good condition] and [to have less than ##% classify as structurally deficient] over its [##-year plan].

Thus, [AgencyShort]'s asset management plan objectives are:

- To establish the current condition of the county'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 county resources
    - County funding through Michigan's Local Bridge Program
    - Opportunities to obtain other funding
- To prioritize the programmed actions within available funding limitations
- To [improve the condition of bridges currently rated poor (4 or lower) and/or preserve bridges currently rated fair (5 or higher) in their current condition in order to extend their useful service life].

Inventory

[AgencyShort] is responsible for [## of local bridges]. Table 2 summarizes [AgencyShort]'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 [YYYY] condition data and maintenance actions are taken from the inspector's summary report (see Appendix 2).

Types

Of the [AgencyShort]'s [##] structures, [##] are concrete bridges, [##] are steel bridges, [##] are pre-stressed concrete bridges, and [##] are timber bridges.

Locations and Sizes

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

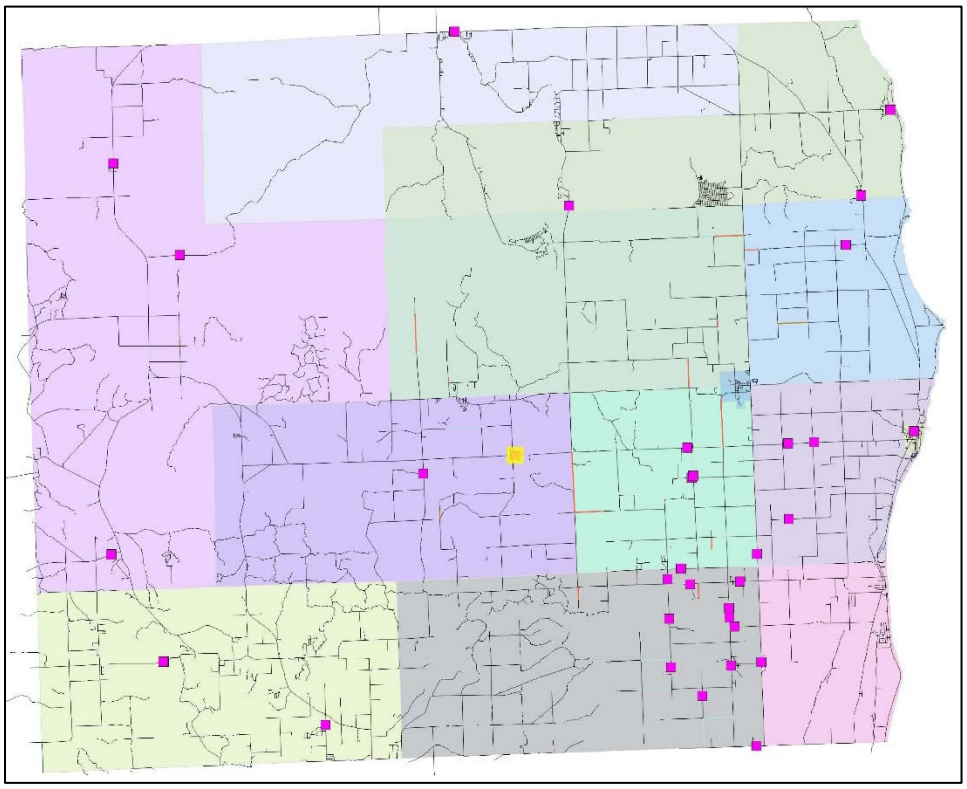


Figure 7: Map illustrating locations [AgencyShort]'s of bridge assets

Condition

[AgencyShort] 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 [AgencyShort]'s bridge network is [##] ([##]%) are good, [##] ([##]%) are fair, and [##] ([##]%) are poor or lower.

Another layer of classification of [AgencyShort]'s bridge inventory classifies [##] ([##%]) bridges as structurally deficient, [##] ([##]) bridges as posted, and [##] ([##]) 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	Total Deck Area	Condition: Structurally Deficient, Posted, Closed			[YYYY] Condition		
Bridge Type	Bridges	(sq ft)	Struct. Defic	Posted	Closed	Poor	Fair	Good
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
[Bridge Type]	[##]	[##]	[##]	[##]	[##]	[##]	[##]	[##]
Total SD/Posted/Closed			**[##]**	**[##]**	**[##]**			
Total	**[##]**	**[##]**				**[##]**	**[##]**	**[##]**
Percentage (%)			**[##%]**	**[##]**	**[##]**	**[##]**	**[##]**	**[##]**

Statewide, MDOT's statistics for local agency bridges show that 14% are poor and 86% are good/fair, indicating that the [AgencyShort] has [a greater/lesser percentage of poor bridges] compared to the statewide average for local agencies. Correspondingly, [AgencyShort] has [##%] of its bridges in fair/good condition versus the statewide average of 86% for local agency bridges. Statewide, 8% of local agency bridge deck area classifies as structurally deficient compared to [##%] of [AgencyShort]'s bridge deck area.

Goals

The goal of [AgencyShort]'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 ##% of its bridges rated fair/good] and [having less than ##% classify as structurally deficient] within [a yet-to-be-determine time frame]. 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. [AgencyShort] 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.

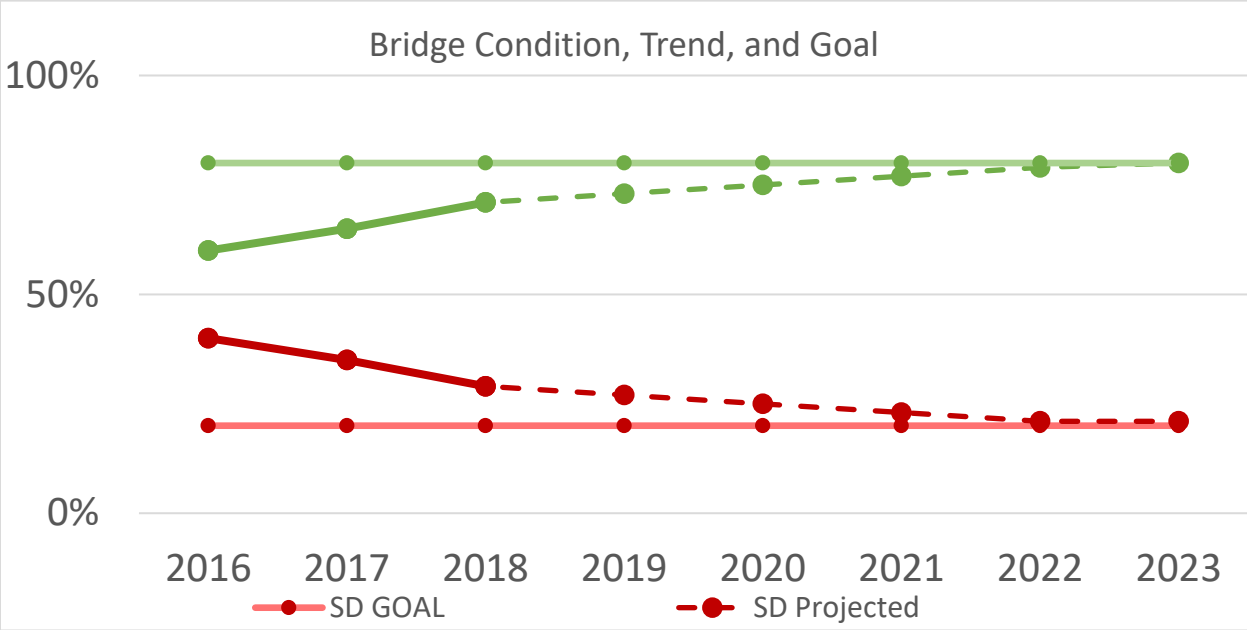


Figure 8: Progress tracking graph indicating [AgencyShort]'s historic and current bridge conditions, projected trends, and goals.

Based on past inspection records and condition ratings, [AgencyShort] 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

[AgencyShort]'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 [strategy, similar to either the 'worst-first' or the 'mix-of-fixes' strategies,]. Therefore, [AgencyShort] prioritizes bridges for projects by evaluating five factors and weighting them as follows: condition –[##]%, load capacity –[##]%, traffic –[##]%, safety –[##]%, and detour –[##]%. There are several components within each factor that are used to arrive at its score. Each project under consideration is scored, and its total score is then compared with other proposed project to establish a priority order.

[AgencyShort] 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 [AgencyShort]'s bridges in Appendix 3. [AgencyShort] 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 [AgencyShort]'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
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]
Rehabilitation		
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] • *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*]

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
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* 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* Safety improvement is needed [1]	
Culvert Repair/Replacement	• NBI rating of 4 or less for culvert or drainage outlet structure • *OR* Has open vertical cracks, signs of deformation, movement, or differential settlement	
Preventive Maintenance		
Shallow Concrete Deck Overlay	• NBI rating is 5 or less for deck surface, and deck surface has more than 15% area with deficiencies [1] [2] • NBI rating of 4 or 5 for deck bottom, and deck bottom has between 5% and 30% area with deficiencies [1] [2] • *OR* In response to inspector's work recommendation [1]	12 years
Deep Concrete Deck Overlay	• NBI rating of 5 or less for deck surface, and deck surface has more than 15% area with deficiencies [1] [2] • NBI deck bottom rating is 5 or 6, and deck bottom has less than 10% area with deficiencies [1] [2] • *OR* In response to inspector's work recommendation [1]	25 years
HMA Overlay with Waterproofing Membrane	• NBI rating of 5 or less for deck surface, and both deck surface and bottom have between 15% and 30% area with deficiencies [1] [2] • *OR* Bridge is in poor condition and will be replaced in the near future and the most cost-effective fix is HMA overlay [1]	
HMA Overlay Cap without Membrane	• Note: All HMA caps should have membranes unless scheduled for replacement within five years. • NBI rating of 3 or less for deck surface and deck bottom, and deck surface and deck bottom have more than 30% area with deficiencies. Temporary holdover to improve ride quality for a bridge in the five-year plan for rehab/replacement. [1] [2]	3 years
Concrete Deck Patching	• NBI rating of 5, 6, or 7 for deck surface, and deck surface has between 2% and 5% area with delamination and spalling [1] [2] • *OR* In response to inspector's work recommendation [1]	5 years
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]	

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
	• *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] • *OR* Presence of excessive section loss, severe pack rust, or out-of-plane distortion [1]	15 years
Zone Repainting	• NBI rating of 5 or 4 for paint condition, and paint has 3% to 15% total area failing [1] [2] • *OR* During routine maintenance on beam ends or pins and hangers [1] • *OR* less than 15% of existing paint area has failed and remainder of paint system is in good or fair condition [1]	10 years
Complete Repainting	• NBI rating of 3 or less for paint condition [1] [2] • *OR* Painted steel beams that have greater than 15% of the existing paint area failing [1]	
Partial Repainting	• See Zone or Spot Painting	
Channel Improvements	• Removal of vegetation, debris, or sediment from channel and banks to improve channel flow • *OR* in response to inspector's work recommendation	
Scour Countermeasures	• 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]	5 years

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
	• *OR* In response to inspector's work recommendation [1]	
Slope Paving Repair	• NBI rating is 5 or less for slope protection [1] [2] • *OR* Slope is degraded or sloughed • *OR* Slope paving has significant areas of distress, failure, or has settled [1]	
Riprap Installation	• To protect surface when erosion threatens the stability of side slopes of channel banks	
Vegetation Control	• When vegetation traps moisture on structural elements [1] • *OR* Vegetation is growing from joints or cracks [1] • *OR* In response to inspector's work recommendation for brush cut [1]	1 year
Debris Removal	• When vegetation, debris, or sediment accumulates on the structure or in the channel • *OR* In response to inspectors work recommendation	1 year
Deck Joint Repair	• Do not repair compression joint seals, assembly joint seals, steel armor expansions joints, and block out expansion joints; these should always be replaced. [1] • NBI rating is 5 for joint [1] [2] • *OR* In response to inspector's work recommendation for repair [1]	
Concrete Sealing	• Top surface of pier or abutments are below deck joints and, when contaminated with salt, salt can collect on the surface [1] • *OR* Surface of the concrete has heavy salt exposure. Horizontal surfaces of substructure elements are directly below expansion joints [1]	
Concrete Crack Sealing	• Concrete is in good or fair condition, and cracks extend to the depth of the steel reinforcement [1] • *OR* NBI rating of 5, 6, or 7 for deck surface, and deck surface has between 2% and 5% area with deficiencies [1] [2] • *OR* Unsealed cracks exist that are narrow and/or less than 1/8" wide and spaced more than 8' apart [1] • *OR* In response to inspector's work recommendation [1]	5 years
Minor Concrete Patching	• Repair minor delaminations and spalling that cover less than 30% of the concrete substructure [1] • *OR* NBI rating of 5 or 4 for abutments or piers, and comments indicate that their surface has less than 30% spalling or delamination [1] [2] • *OR* 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	

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
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. * From source with interpretation added.		

In terms of management and preservation actions, [AgencyShort]’s asset management program uses a [strategy, similar to either the 'worst-first' or the 'mix-of-fixes' strategies,] that is [made up of replacement, rehabilitation, preventive maintenance and/or 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 maintenance will be performed by the agency's in-house maintenance team and/or contracted out.]

[AgencyShort]’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.

Certain of the 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 [will/may or may not be/will not] generally eligible for funding under the local bridge program[, and any requests for funding may or may not be submitted with TCRC's annual applications].

To achieve its goals, [a primary objective of TCRC'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 -year time period through management and/or preservation activities.][The primary work activities that will be used to meet this improvement objective include a combination of reconstruction, replacement, rehabilitation, preventive maintenance, and scheduled maintenance.][The work has been prioritized by considering each individual bridge's needs, its importance, the present costs of improvements, and the impact of deferral (i.e., cost increase due to increased degradation).] [Additionally,][AgencyShort's asset management program incorporates preservation of bridges currently rated fair (5) or higher in their current condition in order to extend their useful service life.][The primary work activities used to meet this preservation objective include some combination of scheduled and preventive maintenance.] A bridge-by-bridge preservation—or maintenance—plan is presented in the Appendix 4.

Programmed/Funded Projects

[AgencyShort] received [$###,###] in total funding per year for the years [##]. To achieve its goals, [AgencyShort] plans to spend [$###,###] per year on preventive maintenance of bridges. [AgencyShort] plans to replace [##] bridges at a cost of [$###,###]. By performing the aforementioned preventive maintenance and replacement of bridge structures, [AgencyShort] [will/may or may not/will not] meet its overall bridge network condition goals.

[AgencyShort] 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. A summary of the programmed/funded projects and investments can be found in Table 4, the Cost Projection table, below.

Planned Projects

[AgencyShort] identifies additional priority projects that remain unfunded. These are identified according to high, medium, and low priority in Table 4.

Table 4: Planned Projects and Gap Analysis

Strategy	2019	2020	2021	2022	2023	GAP
New						
1003	$5,000,000					
1010		$7,000,000				
1005				$124,000		
1005				$4,000,000		
1011					$6,699,000	
1011					$8,000,000	
Subtotal	$5,000,000	$7,000,000	$0	$4,124,000	$14,699,000	$0
Replacement						
1023		$935,000				
1022				$692,000		
1004						$680,000
Subtotal	$0	$935,000	$0	$692,000	$0	$680,000
Rehabilitation						
1016			$181,000			
Subtotal	$0	$0	$181,000	$0	$0	$0
Scheduled Maintenance						
1022	$157,000					
1014			$686,000			
1017				$300,000		
Subtotal	$157,000	$0	$686,000	$300,000	$0	$0
Preventive Maintenance						
1002		$435,000				
1015			$500,000			
1004						$260,000
1009						$20,000
Subtotal	$0	$435,000	$500,000	$0	$0	$280,000
Other						
Subtotal	$0	$0	$0	$0	$0	$0

Gap Analysis

When [AgencyShort] compares its funding and its programmed/funded projects with all of its prioritized projects as shown in Table 4, [AgencyShort] believes it should be able to achieve [a yet-undetermined portion] of its asset management goals for the period of this plan. For projects that it is unable to complete, [AgencyShort] 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

[AgencyShort has programmed projects and/or has been granted funding types for the purpose(s) of various primary work types for selected bridges. This funding is intended for use in the identified years.]

[AgencyShort applied for funding type in the specific funding years for the purpose(s) of various primary work types for selected bridges. This funding would be intended for use in the identified year(s).][AgencyShort also applied for funding type in the specific funding years for the purpose(s) of various primary work types for selected bridges. This funding would be intended for use in the identified year(s).]

[AgencyShort plans to prepare and submit applications for an idenfied funding type for the purpose(s) of various primary work types for identified bridges. This funding would be intended for use in the identified year(s).]

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

[AgencyShort] 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.

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

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

Bridges that are considered "scour critical" pose a risk to [AgencyShort]'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. [AgencyShort] has scour critical bridges, which are listed in Table 6.

Table 5: Scour Critical Bridges	
Bridge Structure Number	**Scour Critical Rating**

[AgencyShort] has posted or closed bridges that are critical to accessing entire areas or individual properties within its jurisdiction. These bridges are listed in Table 7.

Table 6: Posted/Closed Bridges that are Critical Links		
Bridge Structure Number	**P/K**	**Comments**

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: [Agency Name] [YYYY] Bridge Inspection Report Summary of Additional Inspection Recommendations

[#####] [Name of road or drive] over [Name the feature intersected]: [Write a summary of additional inspection recommendations].

Appendix 2: [Agency Name] [YYYY] Bridge Inspection Report Executive Summary

General Recommendations

- [List general recommendations that arise out of the inspection report here.]

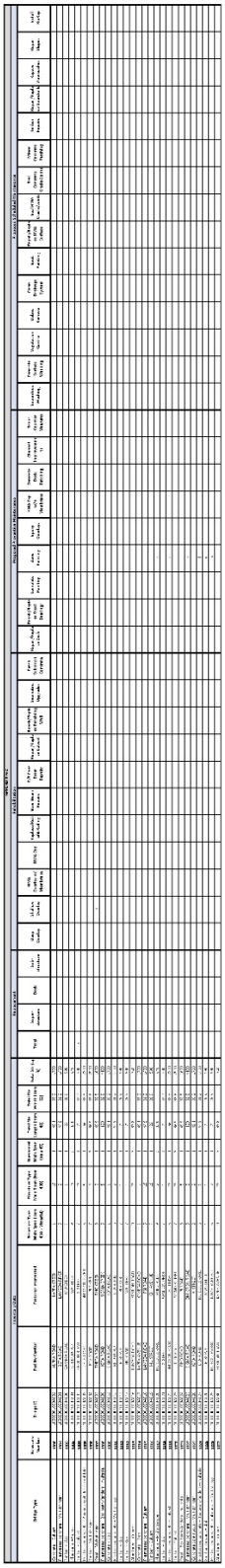
[Township or Other Division]

[#####] [Name of road or drive] over [Name the feature intersected]
Constructed: [YYYY] **Reconstructed:** [YYYY] **General Condition:** [Condition]
Description: [Write a description of the structure].
Recommendations: [Write a description of the recommendations for this structure].

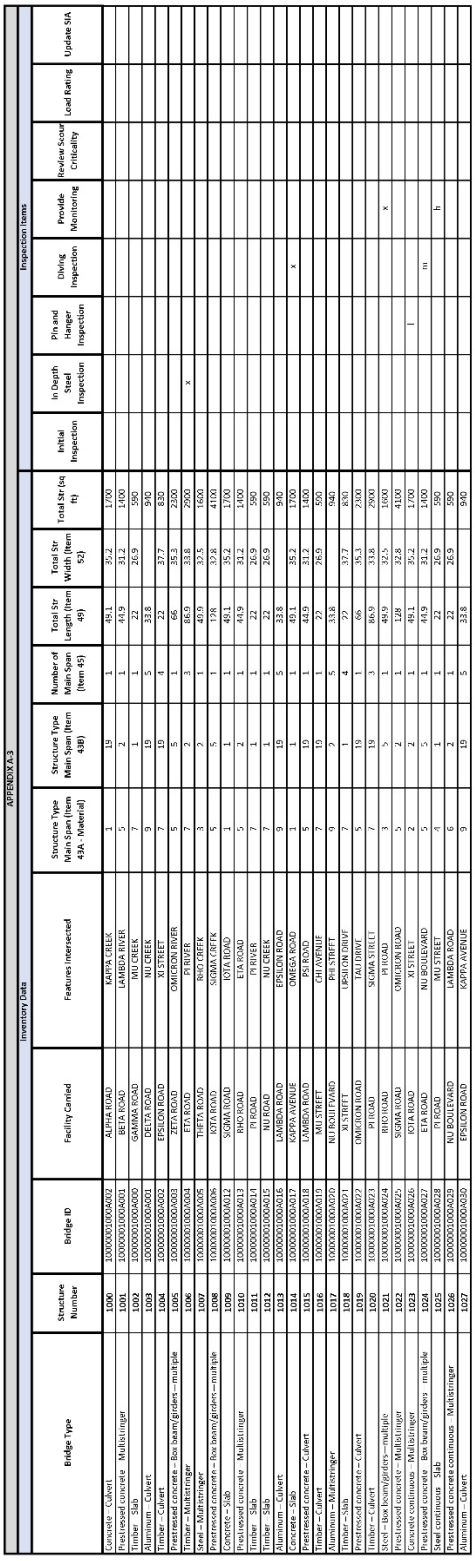
Appendix 3: [Agency Name] [YYYY] Inventory and Inspection Summary

Inventory Data																		Inspection Findings												Appraisal			
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Primary or Secondary Route	Structure Type Main: Type and Material	Structure Type Main: Span (Item 43B)	Number of Spans in Main Unit (Item 45)	Total Bridge Length (Item 49)	Year Built (Item 27)	Year Reconstructed (Item 106)	ADT	Year of ADT	Inspection Date	Inspection Date (Item -1)	Deck Rating (Item 58)	Deck & Railing Ends (Item XX)	Superstructure (Item 59)	Substructure Rating (Item 60)	Channel Rating (Item 61)	Culvert Rating (Item 62)	Railing Rating (Item 36A)	Flood Rtg	Bridge Posting (Item 70)	Other Joints	Structure Evaluation	Structurally Deficient	Sufficiency Rating	Bottom Loss	Scour Critical (Item 113)
Concrete – Culvert	1898	10XXXX0XXXX001	N 25th ROAD	UNTA CREEK	Private	1	20	1	40.0	1925		600	1998	12/5/2025	5	N	?	?	?	N	?	?	N	N	N	5		69.2	N	6
Prestressed concrete – Parallel Stringer	1881	10XXXX0XXXX002	87TH ROAD	cowDOG RIVER	Private	5	2	1	44.9	1976		600	1998	7/29/2025	A	?	?	?	N	?	N	N	N	5		69.2	N	6
Timber – Slab	1882	10XXXX0XXXX003	1500TH ROAD	BIG CREEK	Private	3	35	1	33	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1883	10XXXX0XXXX004	1500TH ROAD	BIG CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1884	10XXXX0XXXX005	87TH ROAD	X CREEK	Private	3	4	1	33	1985		600	1998	7/29/2025	A	N	N	3	?	?	N	?	/	N		F	28% Def	38.9		4
Concrete – T-Beam	1885	10XXXX0XXXX006	87TH ROAD	UNTA CREEK	Private	5	3	1	44.9	1976		600	1998	7/29/2025	A	?	?	6	?	?	N	?	N	N		5		69.2	?	6
Prestressed concrete – Parallel Stringer	1886	10XXXX0XXXX007	87TH ROAD	N FORK	Private	5	3	1	60.0	1976		600	1998	7/29/2025	A	?	?	6	?	?	N	?	N	N		5		69.2	?	6
Steel – Multiple Stringer	1887	10XXXX0XXXX008	87TH ROAD	SNAG CREEK	Private	3	2	1	45.0	1945	2015	1200	2015	8/25/2025	F	?	?	?	N	5	5	N	N	5		39.5	?	5
Steel – Multiple Stringer	1888	10XXXX0XXXX009	87TH ROAD	SNAG CREEK	Private	3	2	1	45.0	1945		1200	2015	8/25/2025	F	?	?	?	N	5	5	N	N	5		39.5	N	5
Concrete – Slab	1889	10XXXX0XXXX010	900TH ROAD	UNTA CREEK	Private	5	3	1	48.1	2015		450	2020	7/29/2025	A	N	?	?	N	?	?	N	N	5		39.9		5
Prestressed concrete – Parallel Stringer	1890	10XXXX0XXXX011	87TH ROAD	UNTA CREEK	Private	5	3	1	44.9	1976		600	1998	7/29/2025	A	?	?	6	?	?	N	?	N	N		5		69.2	?	6
Timber – Culvert	1891	10XXXX0XXXX012	1500TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1892	10XXXX0XXXX013	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Concrete – Culvert	1893	10XXXX0XXXX014	1500TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Prestressed concrete – I or Bulb Tee	1894	10XXXX0XXXX015	87TH ROAD	UNTA CREEK	Private	5	3	1	44.9	1976		600	1998	7/29/2025	A	?	?	6	?	?	N	?	N	N		5		69.2	?	6
Timber – Culvert	1895	10XXXX0XXXX016	1500TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Concrete – Culvert	1896	10XXXX0XXXX017	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Prestressed concrete – I or Bulb Tee	1897	10XXXX0XXXX018	87TH ROAD	UNTA CREEK	Private	5	3	1	44.9	1976		600	1998	7/29/2025	A	?	?	6	?	?	N	?	N	N		5		69.2	?	6
Timber – Slab	1898	10XXXX0XXXX019	87TH ROAD	UNTA CREEK	Private	3	2	1	22	1985		600	1998	7/29/2025	A	?	?	6	?	?	N	?	N	N		5		69.2	?	6
Timber – Culvert	1899	10XXXX0XXXX020	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Concrete – Culvert	1900	10XXXX0XXXX021	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1901	10XXXX0XXXX022	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1902	10XXXX0XXXX023	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1903	10XXXX0XXXX024	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1904	10XXXX0XXXX025	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1905	10XXXX0XXXX026	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1906	10XXXX0XXXX027	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5
Timber – Culvert	1907	10XXXX0XXXX028	87TH ROAD	UNTA CREEK	Private	3	20	1	30.0	1925		850	2020	8/26/2025	F	5	5	4	5	5	N	N	N	5	28% Def	43.2	N	5

Appendix 4: [Agency Name] [YYYY] Maintenance Plan



Appendix 5: [Agency Name] [YYYY] Inspection Follow Up



APPENDIX A-3																				
Inventory Data											Inspection Items									
Bridge Type	Structure Number	Bridge ID	Facility Carried	Features Intersected	Structure Type Main Span (Item 43A - Material)	Structure Type Main Span (Item 43B)	Number of Main Spans (Item 45)	Total Str Length (Item 49)	Total Str Width (Item 52)	Total Str Area (sq ft)	Initial Inspection	In Depth Steel Inspection	Pin and Hanger Inspection	Diving Inspection	Provide Monitoring	Review Scour Criticality	Load Rating	Update SIA
Concrete – Culvert	1000	10000001000A002	ALPHA ROAD	KAPPA CREEK	1	19	1	49.1	35.2	1700								
Prestressed concrete – Multistringer	1001	10000001000A001	BETA ROAD	LAMBDA RIVER	5	2	1	44.9	33.2	1400								
Timber – Slab	1002	10000001000A000	GAMMA ROAD	MU CREEK	7	1	1	22	26.9	590								
Aluminum – Culvert	1003	10000001000A001	DELTA ROAD	NU CREEK	9	19	5	33.8		940								
Timber – Culvert	1004	10000001000A002	EPSILON ROAD	XI STREET	7	19	4	22	37.7	830								
Prestressed concrete – Box beam/girders – multiple	1005	10000001000A003	ZETA ROAD	OMICRON RIVER	5	5	1	66	35.3	2300								
Timber – Multistringer	1006	10000001000A004	ETA ROAD	PI RIVER	7	2	3	816.9	33.8	2900		x						
Steel – Multistringer	1007	10000001000A005	THETA ROAD	RHO CREEK	3	2	1	49.9	32.5	1600								
Prestressed concrete – Box beam/girders – multiple	1008	10000001000A006	IOTA ROAD	SIGMA CREEK	5	5	1	198	33.8	4100								
Concrete – Slab	1009	10000001000A012	SIGMA ROAD	IOTA ROAD	1	1	1	49.1	35.2	1700								
Prestressed concrete – Multistringer	1010	10000001000A013	RHO ROAD	ETA ROAD	5	2	1	44.9	33.2	1400								
Timber – Slab	1011	10000001000A014	PI ROAD	PI RIVER	7	1	1	22	26.9	590								
Timber – Slab	1012	10000001000A015	NU ROAD	NU CREEK	7	1	1	22	26.9	590								
Aluminum – Culvert	1013	10000001000A016	LAMBDA ROAD	EPSILON ROAD	9	19	5	33.8		940								
Concrete – Slab	1014	10000001000A017	KAPPA AVENUE	OMEGA ROAD	1	1	1	49.1	35.2	1700				x				
Prestressed concrete – Culvert	1015	10000001000A018	LAMBDA ROAD	PSI ROAD	5	19	1	44.9	31.2	1400								
Timber – Multistringer	1016	10000001000A020	MU STREET	OMICRON DRIVE	7	19	1	22	26.9	590								
Aluminum – Multistringer	1017	10000001000A021	NU BOULEVARD	PHI STREET	9	2	5	33.8		940								
Timber – Slab	1018	10000001000A021	XI STREET	LEMON DRIVE	7	1	4	22	37.7	830								
Prestressed concrete – Culvert	1019	10000001000A022	OMICRON ROAD	TAU DRIVE	5	19	1	66	35.3	2300								
Timber – Culvert	1020	10000001000A023	PI ROAD	SIGMA STREET	7	19	3	816.9	33.8	2900								
Steel – Box beam/girders – multiple	1021	10000001000A024	RHO ROAD	PI ROAD	3	5	1	49.9	32.5	1600								
Prestressed concrete – Multistringer	1022	10000001000A025	SIGMA ROAD	OMICRON ROAD	5	2	1	128	32.8	4100					x			
Concrete continuous – Multistringer	1023	10000001000A026	IOTA ROAD	XI STREET	2	2	1	49.1	35.2	1700			l					
Prestressed concrete – Box beam/girders – multiple	1024	10000001000A027	ETA ROAD	NU BOULEVARD	5	5	1	44.9	31.2	1400				m				
Steel continuous – Slab	1025	10000001000A028	PI ROAD	MU STREET	4	1	1	22	26.9	590					h			
Prestressed concrete continuous – Multistringer	1026	10000001000A029	NU BOULEVARD	LAMBDA ROAD	6	2	1	22	26.9	590								
Aluminum – Culvert	1027	10000001000A030	EPSILON ROAD	KAPPA AVENUE	9	19	5	33.8		940								