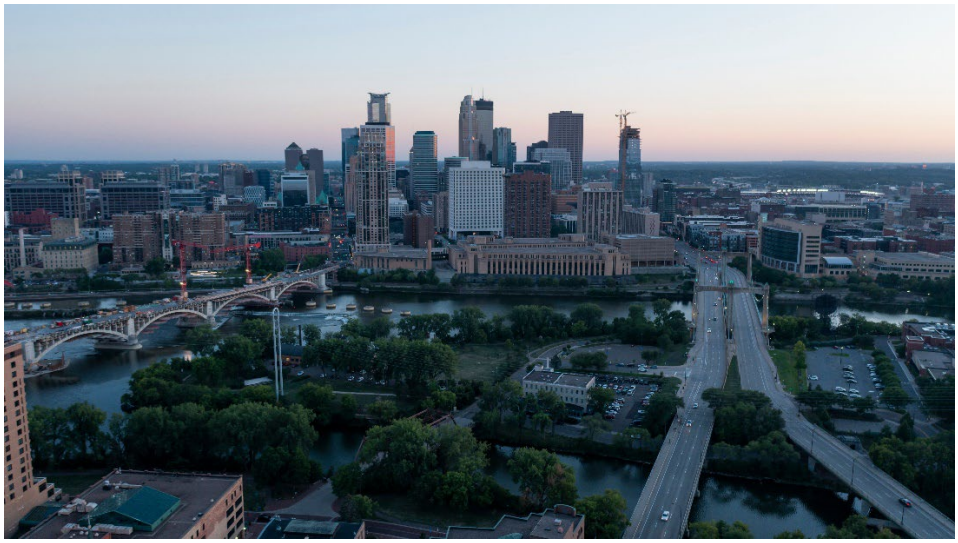
Consideration of Risk in Managing Ancillary Assets

Minnesota Department of Transportation (MnDOT) Case Study



Federal Highway Administration

Office of Infrastructure
1200 New Jersey Avenue, SE
Washington, DC 20590

April 2023

U.S. Department of Transportation
Federal Highway Administration

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation (USDOT) in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

The U.S. Government does not endorse products or manufacturers or outside entities. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

NON-BINDING CONTENTS

The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. However, compliance with applicable statutes or regulations cited in this document is required.

QUALITY ASSURANCE STATEMENT

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

CREDITS

Unless otherwise noted, FHWA is the source for all images in this document.

Cover photo of a view of Minneapolis, MN taken by Christopher Boswell - stock.adobe.com

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-HIF-23-020	None.	None.

4. Title and Subtitle	5. Report Date
Organizational Approach to Implementing Asset Management and Managing Risk: Minnesota Department of Transportation (MnDOT) Case Study	April 25, 2023
	6. Performing Organization Code None.
7. Author(s) Kathryn Zimmerman, Brad W. Allen	**8. Performing Organization Report No.** None.
9. Performing Organization Name and Address Applied Pavement Technology, Inc. 115 West Main Street Suite 400 Urbana, IL 61801	**10. Work Unit No. (TRAIS)** None.
	11. Contract or Grant No. 693JJ319D000023 / 693JJ321F000194
12. Sponsoring Agency Name and Address Federal Highway Administration 1200 New Jersey Ave., SE Washington, DC 20590	**13. Type of Report and Period Covered** Case Study January 2022 – September 2022
	14. Sponsoring Agency Code None.

15. Supplementary Notes

FHWA Lead is Tashia Clemons, tashia.clemons@dot.gov.

16. Abstract

Ancillary assets were a focus during the development of the Asset Management Strategic Implementation Plan (AMSIP) to help ensure that the same performance-based management approach used for pavements and bridges was applied to the other assets Minnesota Department of Transportation (MnDOT) manages. Early on, the Asset Management Program Office (AMPO) recognized that if maintenance and operational expenses could be better considered in asset management trade-off decisions, long-term costs for managing these assets could be reduced. However, the implementation of a performance-based approach for ancillary assets depended heavily on staff in one of the eight regional district areas responsible for the day-to-day operations in the field. Therefore, it was also important to involve district staff in the AMSIP's development and to use these efforts to clarify their asset management roles and responsibilities.

The specific AMSIP development objectives included balancing the resources required to obtain and manage asset data with the associated risks and return on investment, improving the ability to evaluate trade-offs between investment options, and integrating asset management into MnDOT's culture. MnDOT also recognized there were risks if these issues were not addressed. The efforts undertaken to address the stated objectives and the resulting impact on the risks associated with inaction are discussed further in the remainder of the case study.

17. Key Words	18. Distribution Statement
Risk, Finance, Asset Management, TAMP	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.

19. Security Classify. (of this report)	20. Security Classify. (of this page)	21. No of Pages	22. Price
Unclassified.	Unclassified.	20	None.

TABLE OF CONTENTS

MnDOT Case Study
Consideration of Risk in Managing Ancillary Assets
April 2023

LIST OF ABBREVIATIONS

AMPO	Asset Management Program Office
AMSIP	Asset Management Strategic Implementation Plan
BIM	Building Information Modeling
DOT	Department of Transportation
ERS	Earth Retaining System
FHWA	Federal Highway Administration
ITS	Intelligent Transportation Systems
MnDOT	Minnesota Department of Transportation
MnSHIP	Minnesota State Highway Improvement Plan
NCHRP	National Cooperative Highway Research Program
NHS	National Highway System
ROI	Return on Investment
RWIS	Road Weather Information System
TAMP	Transportation Asset Management Plan
TAMS	Transportation Asset Management System

INTRODUCTION

The Minnesota Department of Transportation (MnDOT) owns and operates 14,000 miles of State highway that include various critical assets in its right of way. Most day-to-day operations are managed by one of MnDOT's eight regional districts. Their responsibilities include management of highway construction projects, maintenance, and highway right-of-way issues.

The transportation network serves a vital role in supporting Minnesota's economic competitiveness and quality of life. That has driven MnDOT to maintain a high level of asset performance based on sound investment strategies.

MnDOT has a long history of using asset management to guide its plans, projects, and investment strategies. MnDOT's asset management journey predates Federal regulations requiring State Departments of Transportation (State DOTs) to develop risk-based transportation asset management plans (TAMPs) for pavements and bridges on the National Highway System (NHS) (23 USC 119(e)(1); 23 CFR part 515). This early commitment to asset management led MnDOT to go beyond the minimum requirements for its initial TAMP to include both NHS and non-NHS pavements and bridges, as well as additional asset classes. Its first TAMP, developed in 2014 through a pilot study conducted by the Federal Highway Administration (FHWA), included six asset classes (MnDOT 2014). Its 2022 TAMP included 12 asset classes, as shown in the call-out box (MnDOT 2022).

MnDOT's 2022 TAMP includes the 12 asset classes listed below. (MnDOT 2022)

- **Pavements**
- **Bridges**
- **Culverts**
- **Deep Stormwater Tunnels**
- **Overhead Sign Structures**
- **High-Mast Light Tower Structures**
- **Noise Walls**
- **Signals**
- **Lighting**
- **Pedestrian Infrastructure**
- **Buildings** (including rest areas, weigh stations/scales, truck stations, salt sheds, storage sheds, office buildings, and other buildings)
- **Intelligent Transportation Systems** (including fiber network shelters, traffic management system cabinets, dynamic message signs, traffic monitoring cameras, traffic detector stations/site-loops and radar, various communication equipment, MnPASS toll readers, reversible road gates, ramp meters, rural intersection conflict warning systems, road weather information systems [RWIS] sites, automatic traffic recorders, weigh-in-motion system sites, and road closure systems)

The decision to include so many asset classes is reflected in the objectives MnDOT established in its 2022 TAMP submittal, which include:

- Improving the consideration of maintenance costs in capital investment decisions.
- Reducing business and asset-specific risks.
- Building on existing plans, information, and processes.
- Improving data management.

At the same time, MnDOT is beginning to see benefits from its efforts to implement enterprise asset management software, which MnDOT refers to as its Transportation Asset Management System (TAMS). This provides MnDOT with a framework to better manage roadside infrastructure data including locations, work activity history, and needs for equipment, materials, and staffing. TAMS represents a significant effort by district personnel to build asset inventories and track work activities. Their efforts have yielded several benefits. For instance, the TAMS implementation has increased access to decision-making information. This has enabled MnDOT to better integrate capital and maintenance planning using spatially located information.

MnDOT also integrates its TAMP into existing planning processes, including its 20-Year State Highway Investment Plan (MnSHIP) (MnDOT 2017). MnSHIP is a performance-based plan that documents proposed investment strategies and expected outcomes for all capital investment categories, including asset management. It connects the agency's policy direction (laid out in the 10-year Statewide Vision "Minnesota GO Vision") to improvements made on the State highway system. The TAMP informs MnDOT's capital and operations planning efforts through its life-cycle planning and risk management analyses, performance targets, and investment strategies. The connections among MnDOT's planning documents, including the TAMP, are reflected in figure 1.

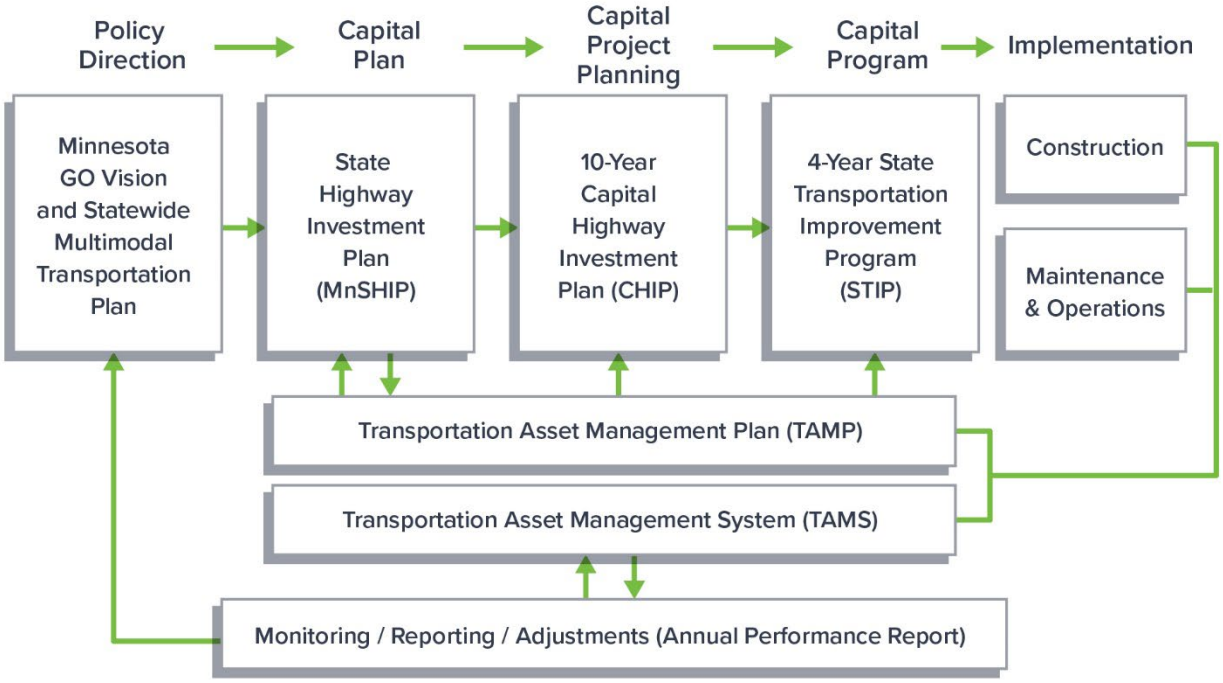


Figure 1. MnDOT's coordinated planning efforts (Minnesota DOT 2022).

To guide implementation of asset management over a 5-year period, MnDOT developed an Asset Management Strategic Implementation Plan (AMSIP) (MnDOT 2021). As part of the AMSIP's development, MnDOT established the following vision for its asset management program: "[t]o effectively manage transportation assets by mitigating risk, optimizing return on investment, and using the best available information and tools (MnDOT 2021)." This case study describes steps taken during the development of the AMSIP to reduce the risks associated with managing ancillary assets through MnDOT's increased focus on life-cycle planning using the tools and information available through TAMS.

CASE STUDY FOCUS

Ancillary assets were a focus during AMSIP development to help ensure the same performance-based management approach used for pavements and bridges was applied to the other assets MnDOT manages. Early on, the Asset Management Program Office (AMPO) recognized that if maintenance and operational expenses could be better considered in asset management trade-off decisions, the long-term costs of managing assets could be reduced. However, implementation of a performance-based approach for ancillary assets depends on district staff. Thus, it was important to involve district staff in the AMSIP's development and to clarify their asset management roles and responsibilities.

The specific AMSIP development objectives included:

1. Balancing the resources required to obtain and manage asset data with their associated risks and return on investment. In turn, data can be used to reduce life-cycle costs and risks for the most critical assets. This involved:
    - Developing a prioritized list of data needs for the assets MnDOT manages.
    - Recommending data collection procedures with roles and responsibilities for acquiring the information, keeping in mind available resources, risks, and return on investment.
    - Addressing State requirements for managing geotechnical assets (Minn. Stat. 174.03, Subd. 12)[1].
    - Identifying strategies to ensure an adequate level of preventive treatments are being used to lower life-cycle cost where appropriate.
2. Improving the ability to evaluate trade-offs between investment options in a consistent and transparent way that maximizes system performance. This involved:
    - Integrating operational and capital considerations to improve efficiency.
    - Evaluating trade-offs between asset classes and programs, recognizing that what is best for an individual asset may not be best for the system.
3. Integrating asset management into MnDOT's culture through effective communication and a workforce with the skills needed to fulfill the agency's asset management duties and responsibilities. This involved:
    - Advancing the understanding of asset management at MnDOT.
    - Defining asset management roles and responsibilities.
    - Building individual and agency capabilities.
    - Establishing succession plans for key positions.

[1] https://www.revisor.mn.gov/statutes/2019/cite/174.03/subd/174.03.12#stat.174.03.12

MnDOT also recognized there were risks if these issues were not addressed, including those listed below:

- Assets may not be managed to the lowest life cycle, possibly resulting in higher long-term costs and lower levels of service.
- Unpredicted failures may occur if MnDOT does not have a good understanding of its asset inventory and conditions.
- Preservation treatments key to implementing the desired life-cycle strategy may not be implemented as planned, which will increase the long-term cost of system preservation.
- Roles and responsibilities for implementing life-cycle strategies may not be known, which could lead to inefficiencies in system preservation.
- Inconsistencies could exist between the planned investment strategies and those implemented, which could impact future programs.
- Maintenance and operational needs could be underestimated, which could impact future levels of service and negatively impact the agency's credibility with stakeholders.

The efforts undertaken to address the stated objectives and the resulting impact on the risks associated with inaction are discussed in the remainder of the case study.

APPROACH TO REDUCING RISKS ASSOCIATED WITH MANAGING ANCILLARY ASSETS

The AMSIP's development benefitted from a collaborative approach that involved individuals from both the Central Office and districts. Senior leadership was involved in early efforts to identify the vision for asset management within the agency and the specific objectives to be achieved (as presented in the previous section).

The next step involved the formation of five working groups charged with developing a plan to address identified process gaps. Representatives from all levels within the Central Office and districts were selected to serve on the working groups, which met weekly or bi-weekly over a three-month period. The expectations for the five working groups were:

- Working Group 1: Matrix Development – Establish a prioritized approach to manage assets that consider the different ways assets are maintained, their importance to the agency, and the risks associated with their failure.
- Working Group 2: Geotechnical Assets – Evaluate options to manage geotechnical assets in compliance with a 2019 Minnesota Statute (Minn. Stat. 174.03, Subd. 12)[2].
- Working Group 3: Pavement Preservation – Establish a plan to increase the consistent use of preventive maintenance treatments that preserve asset conditions and reduce their life-cycle costs.
- Working Group 4: Communication – Suggest ways to build support for MnDOT's asset management program through outreach activities that improve familiarity with asset management, develop internal competencies, and promote the use of asset management practices.
- Working Group 5: TAMP Implementation – Provide recommendations for TAMP changes that improve consideration of life-cycle management techniques in MnDOT's plans and programs, enhance the TAMP's usefulness internally, and strengthen relationships and dependencies with MnSHIP.

Of particular interest to this case study was the effort associated with Working Group 1: Matrix Development. This group first identified 72 infrastructure assets that MnDOT manages and then analyzed gaps between the desired way to manage each asset and the current approach being used for maintenance. These gaps helped identify ways to reduce risk, such as collecting data critical to managing the highest-priority assets. The group's approach was modeled after practices documented in the FHWA's Report No. FHWA-HIF-19-068, *Handbook for Including Ancillary Assets in Transportation Asset Management Program* (FHWA 2019). The approach was customized to MnDOT's resources and unique circumstances.

The Process of Categorizing Ancillary Assets and Determining Data Needs

To categorize the maintenance approach for each of the 72 assets, the working group defined the six maintenance approaches described in figure 2. Each of these approaches influences the type

[2] https://www.revisor.mn.gov/statutes/2019/cite/174.03/subd/174.03.12#stat.174.03.12

of information needed to support the maintenance approach. For instance, condition-based approaches demand that asset inventories are inspected regularly for proactively scheduling work activities to address needs. Condition-based approaches are appropriate for long-lived assets that benefit from various types of treatments at different condition levels. Bridges and pavements are examples of assets that benefit from a condition-based approach, but other assets, such as earth retaining systems (ERS) and bike paths, also fall into this category.

Cyclic approaches are maintained in accordance with a presumed schedule, or the work is done as part of an asset inspection. As a result, condition data is not required to forecast future needs. Examples of assets managed with a cyclic approach include pavement markings, sign structures, culverts, and storm sewers.

As the name implies, reactive maintenance is work done when damage is reported. Rumble strips and guardrails are examples of assets that may be maintained reactively. For some assets, an inventory may not be necessary because the asset is a low priority and does not impact public safety. Fences and roadway ditches may be examples of reactively maintained assets that typically are not inventoried.

Approach	Definition
Condition-Driven Plus (Optimal)	The condition of the asset is routinely monitored and modeled. Actions are taken proactively and reactively to **optimize the asset life cycle** through minimum life-cycle cost, maximum benefit, maximum life-cycle length, or similar.
Condition-Driven	The condition of the asset is routinely monitored, and **actions are taken to manage the long-term performance** of the asset or asset's impact on system performance.
Cyclical-Driven Plus	The asset is inspected and **maintained on a cyclical basis,** where the inspection and maintenance activities are performed simultaneously or in concert and condition data is collected and maintained for analysis that could lead to additional condition-based decisions. **Condition data required.**
Cyclical-Driven	The asset is maintained on a cyclical basis. Condition data may be collected on these assets to meet other business needs, but the inspection cycle is managed separately from the maintenance cycle. **Condition data not required.**
Reactive	**Inventory is maintained,** but there is **no regular condition data** collection, and **no maintenance performed to slow or address damage** or deterioration until an asset is reported as having an unacceptable defect. Annual work is planned at the aggregate level, without concern for the specific locations of potential future defects.
Minimal Maintenance	**No inventory or condition data** is collected or maintained. Maintenance is performed when assets are identified as having an unacceptable defect.

Figure 2. Maintenance approaches used to categorize ancillary assets (Source: Minnesota DOT).

Work group members identified the data needs for each maintenance approach. The questions shown in figure 3 were also addressed. As the results show, the condition-based approaches require more information than both the cyclic and reactive maintenance approaches.

Question	Minimal Maintenance	Reactive	Cycle-Driven	Cycle-Driven Plus	Condition-Driven	Condition-Driven Plus
Does it require an asset inventory?	-	X	X	X	X	X
Does it require an asset maintenance cycle?	-	-	X	X	X	X
Does it require asset condition data?	-	-	-	X	X	X
Does it require long-term performance management?	-	-	-	-	X	X
Are there strategies to optimize its life cycle?	-	-	-	-	-	X

Figure 3. Questions used to determine data needs for each maintenance approach (Source: Minnesota DOT).

In addition to assigning each of the 72 assets with a maintenance approach, they were prioritized using a four-tiered structure. A key contact was also assigned as the lead for each asset class. The tiers reflected asset importance by considering Federal or State regulations, customer needs, asset value, cost recovery/restitution, and budget allocations. The benefits were also qualitatively assessed, recognizing each asset contributed to compliance issues, safety, risk reduction, the number of data consumers using the asset, or new technology. Each tier is described below:

- Tier 1 represents the most important assets. These assets are critical to public safety, mobility, and the economy, so they are maintained at the highest practical level of service. The failure of a tier 1 asset could lead to an immediate safety risk or impact the transportation network for an entire region. Tier 1 assets receive the highest level of scrutiny and resources to support inventory and condition data collection, investment decision-making, maintenance, and capital improvements. Bridges, pavements, rest areas, radio towers, intelligent transportation systems (ITS), and signal systems are all examples of assets included in tier 1.
- Tier 2 assets are not valued as highly as tier 1, but still represent assets with a significant impact on public safety. For this reason, MnDOT dedicates resources to proactively monitoring these assets and scheduling interventions to prevent failures or other forms of

unacceptable performance. Inventory and condition data are used to identify, prioritize, and deliver cost-effective maintenance and repair actions. Examples include ERS, culverts, high-mast tower lights, and frontage roads.

- Tier 3 assets support safety and system performance at their specific locations, so failures have more of a local impact than a systemwide impact. These assets are typically addressed through routine or cyclic replacements to optimize the replacement cycle. Some of these assets may have Federal or State reporting requirements that drive the need for condition data. Tier 3 assets include deep stormwater tunnels, weigh stations, pavement markings, and roadway lighting.
- Tier 4 includes assets that represent limited risk to the transportation network. To mitigate these risks, MnDOT has guidelines regarding maintenance response times. These response times dictate the timeframe between notification of unacceptable condition and repair. MnDOT collects and updates inventory information on these assets but does not collect condition data. Examples of tier 4 assets include concrete noise walls, snow fences, trees, and storage sheds.

Using this framework, the matrix working group assessed gaps between the desired and existing maintenance approaches. Additionally, the group considered data, system, and resource gaps that would have to be addressed to shift to the desired maintenance approach. Data elements identified were classified as being either essential to investment decisions or desirable but not essential. This enabled the working group to prioritize data elements when considering data-collection strategies. The group considered six data collection approaches, including manual visual inspections, manual device inspections, pavement-van camera or sensor collection, satellite or aerial imagery, drone inspections, or mobile lidar. The results were compiled in a comprehensive matrix that included a data collection strategy, as discussed in the next section.

Recommendations to Address Risks

The working group's efforts culminated in the development of a comprehensive ancillary asset matrix. This matrix detailed the suggested and current maintenance approaches for any given asset, the inputs to determining its suggested tier, and the identified data gaps. The matrix is maintained on a shared internal website maintained by AMPO. The matrix is updated regularly as data availability or other factors that impact the asset's priority change.

Once the matrix was compiled, a significant effort went into developing a data collection strategy. The strategy defined ways to collect the data needed to determine the best maintenance approach for each asset. The four data collection recommendations listed below were generated from this activity. In addition, two other recommendations were included. One addressed an update to Section 174.03 of the Minnesota Statute concerning the enhancement of project selection approaches[3]. The second suggested that the working group's recommendations be reviewed annually to reflect changes that might influence the results:

- Recommendation 1: Do not invest resources in data collection activities for certain assets. The group determined that any assets not included in tiers 1 through 4 did not require

[3] https://www.revisor.mn.gov/statutes/cite/174.03/version/2021-10-26%2009:52:25+00:00

inventory or condition information. Assets that fell into this category included mowing, embankments, curb and gutter, gravel shoulders, billboards, and roadway ditches.

- Recommendation 2: Continue the current data collection processes for certain assets where the current maintenance strategy matched the desired approach. Assets that fell into this category included pavements and bridges, highway culverts and stormwater tunnels, weigh stations, and freeway management systems.
- Recommendation 3: Reduce the risks associated with managing assets effectively due to data gaps. Under this recommendation, specific steps were recommended to establish necessary inventories for assets, such as signs and mainline culverts. The steps also addressed collecting post-construction information to update the inventory under a lidar data collection or consultant contract. The as-built information was considered critical to maintaining the asset inventories over time.
- Recommendation 4: Address other identified data-related needs to support asset management as resources allow. In addition to the inventory and condition needs identified by the working group, forty-two other recommendations were offered to improve MnDOT's asset management practices. These recommendations included items like sharing data, reporting on performance measures, and exploring the use of innovative technology and tools to replace existing practices. These additional recommendations will be considered as resources allow. They were considered important enough to capture in the AMSIP since they emerged from the working group's efforts.

Specific recommendations and costs were detailed for each asset identified under recommendation 3. For example, there was a suggestion to hire a consultant to perform a one-time base inventory update of construction project changes since 2018 for several assets, while other inspections and inventories will be performed by districts over a specified timeframe. The total implementation costs were estimated and presented to senior leadership in terms of one-time costs (e.g., building the baseline inventories and building initial inspections) and on-going costs. If district labor was expected to complete an activity, the projected number of hours was estimated and vetted with district personnel.

For culverts, a return on investment (ROI) analysis was conducted using the nonbinding framework and tools from the National Cooperative Highway Research Program (NCHRP) Report 866, *Return on Investment in Transportation Asset Management*. The analysis found that the data collection recommendations for culverts yielded a net present value of $23,000 with a 7-year payback period. The ROI was heavily influenced by the time savings realized by staff since the availability of data for planning, scoping, and design would reduce required field visits. The analysis also found that environmental risks associated with flooding could be reduced by better managing the culverts. A separate analysis for establishing the baseline sign inventory resulted in a similar ROI due to improved efficiencies.

The working group's recommendations were incorporated into the AMSIP and presented to senior leadership in September 2021 and subsequently approved for funding. The recommendations were also presented to district staff to build buy-in for the additional efforts. A key component to the presentations was communicating the benefits MnDOT realized, or expected to realize, from the additional information. The meetings were well received, and the implementation is underway.

HOW RESULTS ARE BEING USED

The work on developing the asset matrix has inspired other initiatives to further enhance the maintenance and management of ancillary assets. A few examples of these efforts are detailed below.

Asset Attribution Value Exercise

Starting with signals, lighting, and ITS assets, an asset attribution value exercise was conducted with district traffic staff to help determine which data attributes most impact the way the assets are managed. The evaluation was based on input received from asset stakeholders during a series of meetings. For each selected asset, the use of each individual inventory and condition data elements populated in TAMS was assessed. This involved describing each specific asset attribute in plain language and then asking districts whether the element should be kept and why. The exercise proved to be easy to facilitate because district personnel had been using TAMS since 2016 and were aware of how time consuming it was to maintain asset inventories. The results helped identify those attributes that are regularly used and those that are less valuable and not worth the extra time to compile. The data elements considered less valuable were not removed from TAMS but instead hidden from the user interface so the districts no longer see them. These elements were retained so that when new technology becomes available (e.g., Building Information Modeling [BIM]), their future attribution and use could be simplified. A similar approach will be used for culverts next.

Communicating Asset Management Roles and Responsibilities

AMPO representatives then conducted a series of meetings with district engineers and their staff to build buy-in for carrying out asset management roles and responsibilities. These meetings established a framework for completing the work necessary, with discussions revolving around innovative ways to collect data and strategies for meeting expectations. For example, the district hydraulics engineer and staff discussed strategies for completing the culvert inventory within the 5-year timeframe established in the AMSIP. Higher-level district managers discussed the potential risks to the agency if the work was not done, and the reception to these discussions among district staff was positive. The AMPO staff found that involving the districts in developing the recommendations made a difference in the level of buy-in and acceptance for the planned implementation.

Improved Project Scoping and Work Planning

The improvements in the TAMS data resulting from these efforts have significantly improved the efficiency and efficacy of project scoping activities. Improved access to images, condition information, and checklists reduces the amount of time district staff require in the field to conduct scoping activities. One district noted that its Hydraulic Infrastructure (HydInfra) data is now so reliable and accessible that the data are being used to:

- Estimate repair costs for projects outside the Statewide Transportation Improvement Program (STIP). The ability to develop reasonable HydInfra cost estimates 6 to 8 years before an official scoping effort have improved project programming because they can better estimate expected HydInfra needs.

- Identify high-priority repairs. Using the TAMS database, district personnel can sort the data based on certain criteria (e.g., Very Poor rating and void under the road) to find assets in need of more urgent repair. These projects can then be matched to upcoming construction projects, assigned to maintenance, or contracted out.

In addition, there have been improvements to work planning activities because of the accessibility to spatial information. One example of an improvement in work planning is shown in figure 4. This figure illustrates how MnDOT tracks the number and location of culverts to be inspected in each fiscal year. The accessibility of this type of information enables district staff to better plan their work activities. It also allows staff to take advantage of opportunities to coordinate inspections with other activities in the same geographic area.

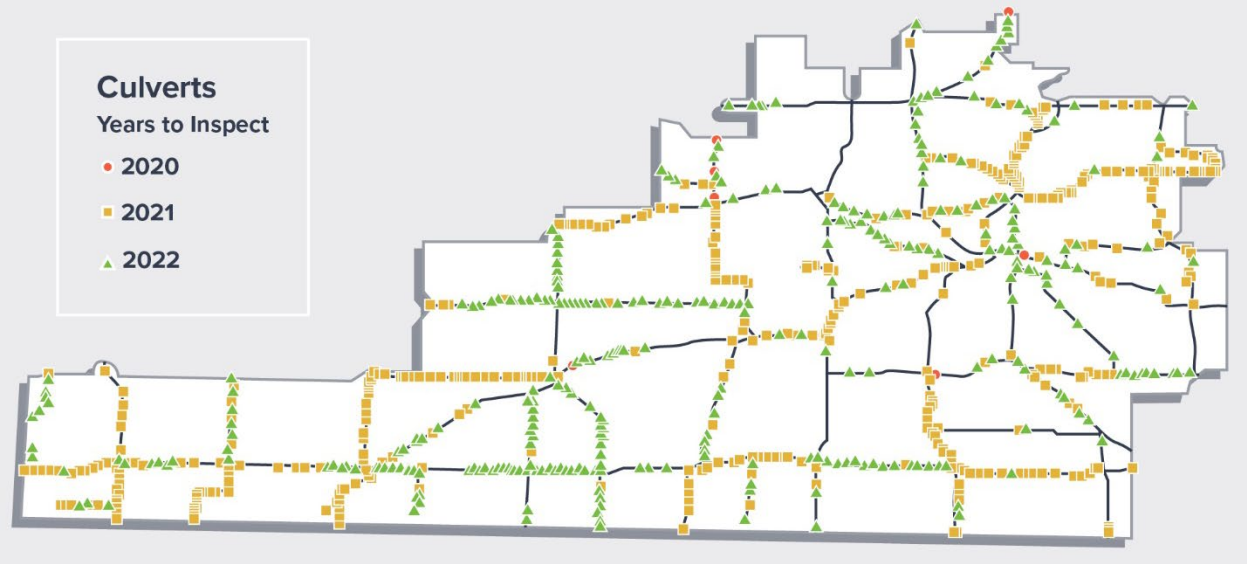


Figure 4. Culvert inspection plan (Source: Minnesota DOT).

Performance Monitoring

The availability of data in TAMS simplifies performance monitoring and helps promote accountability. For example, one district established performance measures for the percent of completed inspections and presented the results on a dashboard. Dashboards are also used to monitor the use of preservation treatments. For example, MnDOT maintains a dashboard to track statewide and district accomplishments for crack filling applied to projects overlaid 5 years prior. The real time updating of relevant work progress has proven to be an advantage to MnDOT.

Damage Restitution Revenue

Improvements in tracking maintenance activities have also increased revenue generated from damage restitution claims. Improved tracking has reduced demands on the resources and redundancies needed to generate work orders for damage restitution while increasing transparency and accuracy. MnDOT reported that the agency received approximately $4 million in revenue from restitutions in one fiscal year. However, due to improved efficiencies, MnDOT received damage restitution revenue of approximately $6 million in the first quarter of the subsequent fiscal year.

Research and Technology Initiatives

The discussions with district staff have led to several research and development initiatives to explore innovative ways to reduce the demands associated with data collection activities. For example, innovative technology such as lidar and BIM are being explored to determine their potential for supporting the development and maintenance of asset inventories. Approximately $3 million has already been allocated for lidar data collection efforts over a multi-year period to test the capabilities of this technology.

The use of 360-degree cameras for inspecting storm sewer structures and the use of remote sensing techniques for building inventories (e.g., pond delineation) are additional examples of the types of technology being considered. Initiatives have also included improvements to data collection forms, so they better match the TAMS database.

HOW THESE EFFORTS HAVE REDUCED RISKS AT MNDOT

The AMSIP's development and the success of its implementation has had a significant role in advancing the agency's efforts to manage ancillary assets from a life-cycle perspective. The participation of district personnel in the AMSIP work groups combined with AMPO's outreach efforts has highlighted the role and responsibility of districts in the asset management process. Even district personnel once slow to use TAMS for managing assets are now recognizing the importance of updating the database and completing scheduled inspections. Overall, there has been a cultural shift in how asset management is viewed and its importance to the agency has increased.

The improvements in ancillary asset management have had a significant impact on reducing what were previously considered under-managed risks in MnDOT's TAMPs. The following examples illustrate how these efforts have reduced risks associated with managing ancillary assets:

- MnDOT has a clear statewide plan for collecting and managing asset data to reduce inefficiencies. Since this information is being updated more regularly, it can be used more reliably for planning purposes. MnDOT can now be more proactive in scheduling maintenance activities, estimating funding needs, and coordinating work with capital improvements. This reduced the risks associated with inefficiencies and uncertainties in planning.
- MnDOT estimated funding needs for all 12 of its high-priority assets on a statewide basis during the development of its 2022 TAMP. Using sophisticated spreadsheet tools, MnDOT estimated the investment requirements for both its current and desired maintenance strategy for each asset class. This provided MnDOT a better understanding of its operational needs for use in long-term planning, reducing the previous uncertainty.
- MnDOT has established its culvert inventory, that according to MNDOT, complies with State law[4]. Development of the program was accomplished through a 5-year implementation plan. This has essentially eliminated the risk of legislated action associated with MnDOT's failure to comply.
- MnDOT developed risk mitigation strategies for all assets in tiers 1-3. This effort identifies risks, ideal mitigation strategy, risk management priority, and potential risk reduction for each asset class. The risk management priority allows MnDOT to classify risk types. This makes it easier for the agency to determine which risks are addressed through efforts to improve data management or quality and which are related to resilience, aging infrastructure, funding, or some other factor. MnDOT now has a better understanding of asset risks and what is needed to mitigate these risks.
- Preventive maintenance treatments are being applied more consistently and performance measures are being implemented. This has lowered life-cycle costs and reduced the risk that more substantial and costly repairs will be needed before they were anticipated.

[4] https://www.revisor.mn.gov/statutes/2019/cite/174.03/subd/174.03.12#stat.174.03.12

- MnDOT has undergone a cultural shift and has placed more emphasis on roles and responsibilities involved in asset management. This has resulted in improved efficiencies and reduced the risks associated with inconsistencies in planned and actual investments. MnDOT's outreach efforts have included the following activities:
  - Information is regularly communicated to MnDOT senior leadership. Individuals at the senior leadership level and district engineers have been very supportive of asset management initiatives.
  - AMPO staff keep the assistant area engineers informed so they can share information with district staff. This involvement made a difference in fostering a team approach.
  - MnDOT developed materials to communicate the benefits of data to those responsible for collecting it. This has been well received.
- Information is shown to improve decision-making and accountability, which also contributed to reducing uncertainty in managing ancillary assets. For example:
  - TAMS HydInfra data from one district is 99 percent digitized with specific information, including flow direction:
    - This information has proven to be extremely beneficial to aid in quickly tracing if there is a spill.
    - The inspection information can be quickly accessed if a citizen or MnDOT Maintenance has concerns about drainage. Information on pipe locations, condition ratings, and contours are readily available.
    - The data is also used for generating approximate repair cost estimates for projects outside the STIP, as a base for scoping efforts, and to identify high-priority repairs.
  - TAMS inspections annual recap lets districts know how they are doing on the required inspection performance measures and provides an overall sense of asset conditions.

NEXT STEPS

The AMSIP's development and the subsequent efforts that have taken place provide the foundation for MnDOT's asset management implementation. However, MnDOT recognizes and accepts its ongoing responsibility to continue adapting to changes and advancements that impact the way the organization operates. With respect to continued efforts to reduce risks associated with managing ancillary assets, MnDOT recognizes the importance of the following ongoing activities:

- Continue outreach activities to build interest and engagement in asset management at all levels of the organization. As part of this effort, MnDOT will expand the use of its Communications Portal, promote its use among district planners, and add content that documents the benefits realized through asset management activities.
- Monitor the status of the AMSIP recommendations at least annually. If changes in technology or agency practices trigger changes to the recommendations, a cross-functional working group will be formed to suggest adaptations needed to the original recommendations.
- Use the priorities established in the asset matrix to consider advancing the use of life-cycle principles by adding additional ancillary assets to the TAMP.
- Continue to advance the use of data to achieve MnDOT's vision for effectively managing ancillary assets. The following are examples of the types of initiatives that would help achieve MnDOT's vision:
  - Demonstrate the applicability of Metro District's Action Plan in other districts to focus on specific actions each district can take to fully implement the recommendations in the AMSIP.
  - Initiate and monitor results from a consultant project for managing electrical services (e.g., ITS, signs, lighting) to generate information on when preventive maintenance should be done, how much is being spent on maintenance, and how the data can be used to improve decisions.
  - Develop additional screening information with district assistance, such as a Resiliency Improvement Priority, to help address emerging asset management needs.

REFERENCES

23 USC §119(e)(1). *National Highway Performance Program. State Performance Management*.

Federal Highway Administration (FHWA). 2019. *Handbook for Including Ancillary Assets in Transportation Asset Management Programs*. FHWA. Washington, DC.

Minnesota Department of Transportation (MnDOT). 2014. Transportation Asset Management Plan. Minnesota Department of Transportation, St. Paul, MN.

Minnesota Department of Transportation (MnDOT). 2017. *20-Year State Highway Investment Plan (MnSHIP)* 2018-2037. Minnesota Department of Transportation, St. Paul, MN.

Minnesota Department of Transportation (MnDOT). 2022. *2022 Minnesota Transportation Asset Management Plan*. Minnesota Department of Transportation, St. Paul, MN.

Minnesota Department of Transportation (MnDOT). 2011. *Minnesota Go. Planning Minnesota's Transportation Future*. Minnesota Department of Transportation, St. Paul, MN.

Minnesota Department of Transportation (MnDOT). 2021. *MnDOT's Asset Management Strategic Implementation Plan.* Minnesota Department of Transportation, St. Paul, MN.

National Oceanic and Atmospheric Administration (NOAA). 2022. *What is lidar?* NOAA. https://oceanservice.noaa.gov/facts/lidar.html. (accessed October 25, 2022).