

Chapter 8

FINANCIAL PLAN AND INVESTMENT STRATEGIES: SUPPLEMENTAL INFORMATION

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Overview

This chapter provides a description of the asset management investment strategies developed and how they were incorporated into the TAMP. While specific strategies were laid out for investments in pavement and bridge assets in the Minnesota State Highway Investment Plan (MnSHIP), the investment strategy for other "Roadside Infrastructure" assets (including, but not limited to, highway culverts, deep stormwater tunnels, overhead sign structures and high-mast light tower structures) was generic and focused primarily on maintaining operable conditions at expected funding levels. MnSHIP does not explicitly break out the asset types within the Roadside Infrastructure investment category. Therefore, as a part of the TAMP development process, investment strategies for highway culverts, deep stormwater tunnels, overhead sign structures and high-mast light tower structures were examined more closely and tools were developed to estimate the level of investment needed to maintain these assets over the 10-year period covered in the TAMP.

Process

This chapter includes brief descriptions of the investment strategies developed in MnSHIP and the Highway Systems Operations Plan (HSOP) and how they were incorporated into the TAMP. This is followed by a discussion on the process for developing investment strategies for highway culverts, overhead sign structures, and high-mast light tower structures. Finally, a summary is provided regarding the envisioned process changes for how future TAMPs will inform MnSHIP.

INVESTMENT STRATEGIES

As discussed in Chapter 2 of the TAMP, tradeoffs between investment levels, performance levels, and risks were evaluated as a part of the MnSHIP development process to understand and demonstrate the impact of a holistic investment decision methodology. Three approaches were considered during the MnSHIP scenario planning process:

- **Approach A:** Focus on maintaining existing infrastructure on the entire system, leaving little-to-no ability to invest in local priorities and mobility.
- **Approach B (Adopted):** Maintain an approach similar to MnDOT's current priorities – emphasizing pavements, bridges, and safety – with some improvements in local priorities and mobility.
- **Approach C:** Greater emphasis on mobility for all modes and addressing local concerns at priority locations, which will result in significant declines in infrastructure condition on most state highways.

Considering two primary risks – (a) failure to implement federal policy set in MAP-21 and (b) failure to preserve the state's bond rating by falling below the thresholds set in Government Accounting Standards Board Statement 34 (GASB 34) – the investment strategy adopted for the first 10 years focused on maintaining a diverse mix of improvements to reduce overall life-cycle costs, as well as enhancing mobility and MnDOT's ability to respond to evolving needs. The asset management investment strategy laid out in MnSHIP is summarized in Figure 8-1.

Figure 8-1: MnSHIP Investment Strategies

INVESTMENT CATEGORY		10-YEAR STRATEGY
Asset Management	Pavements	<ul style="list-style-type: none"> • Maintain conditions on NHS pavements. • Allow non-NHS pavements to deteriorate to a slightly lower condition, while maintaining safe conditions for the traveling public. • Use low-cost maintenance and preservation strategies. • Use performance-based design to select projects that address pavement and safety needs. • Alternate bidding and contracting mechanisms to determine the most cost-effective solutions. • Research/evaluate innovative materials and construction techniques.
	Bridges	<ul style="list-style-type: none"> • Maintain condition of NHS bridges. • Allow non-NHS bridges to deteriorate to a slightly lower condition, while keeping them safe and operable to the traveling public. • Invest in state highway bridges at optimum points in their life- cycles to ensure safety and structural health. • Conduct bridge inspections to ensure timely application of maintenance and capital improvements. • Apply appropriate measures to ensure bridges achieve or exceed their intended service lives.
	Roadside Infrastructure	<ul style="list-style-type: none"> • Maintain culverts, signals, sign structures, sign panels, lighting structures, rest areas, barriers, and retaining walls in safe operable conditions with the understanding that their general conditions are expected to deteriorate with current expected funding levels.

In addition to the capital investment strategies outlined in MnSHIP, HSOP provides a framework for managing key operations and maintenance activities throughout Minnesota and complements other strategic planning efforts, such as MnDOT’s District Highway Investment Plans, which focus on capital infrastructure needs. Specific maintenance/operations strategies to address a host of critical issues faced by MnDOT – ranging from aging infrastructure to increased responsibilities (as a result of state and federal mandates) to declining staff levels – are discussed in detail in HSOP (and summarized in Chapter 2 of the TAMP).

The strategies laid out in MnSHIP and HSOP are carried forward in MnDOT’s TAMP. Moving forward, future TAMPs are expected to inform MnSHIP updates and streamline the investment planning process (discussed later).

ASSET INVESTMENT STRATEGIES PRESENTED IN THE TAMP

The specific investment strategies adopted for the asset categories discussed in the TAMP are summarized below.

PAVEMENTS

After performance targets were established for pavements (see Chapter 3 of the TAMP), investment levels and strategies to achieve those targets were developed using MnDOT’s Highway Pavement Management Application (HPMA) by modeling performance-constrained scenarios. Because this effort was already completed as a part of the MnSHIP process, the results were carried forward and adopted in the TAMP.

BRIDGES

After performance targets were established for bridges (see Chapter 3 of the TAMP), investment levels and strategies to achieve those targets were developed using MnDOT’s Pontis bridge management system, for bridge inventory and condition data, and MnDOT’s Bridge Replacement and

Improvement Management System (BRIM), for prioritizing projects and developing network-level cost estimates. This effort, too, was already completed as a part of the MnSHIP process, and these results were also carried forward and adopted in the TAMP.

HIGHWAY CULVERTS AND DEEP STORMWATER TUNNELS (HYDRAULIC INFRASTRUCTURE)

As discussed in the TAMP, MnSHIP does not explicitly break out the asset categories within the Roadside Infrastructure investment category, but highway culverts and deep stormwater tunnel needs are provided for in the investment plan. Costs specific to culvert and stormwater tunnel needs were obtained from the MnSHIP investment planning team for reporting in the TAMP.

MnDOT recognizes that fixing hydraulic assets in Very Poor condition (HydInfra Condition Level 4) is more expensive than repairing them before they have reached this condition; cheaper treatments are not feasible when assets deteriorate to a Very Poor condition. Therefore, and due to the high cost and risk of catastrophic failure associated with these assets, MnDOT has adopted a preventive maintenance strategy of applying treatments to culverts and tunnels before they reach a condition of Very Poor.

A spreadsheet-based repair projection model was developed by MnDOT to estimate the repair needs for highway culverts over the 10-year TAMP planning horizon. The projections make some general assumptions:

- Culverts degrading to a Very Poor condition were previously one level better (HydInfra Condition Level 3: Poor) and any fixes applied to culverts in Very Poor and Poor conditions restore the conditions to an Excellent (HydInfra Condition Level 1) or a Fair (HydInfra Condition Level 2) level.
- No new culverts are built over the next 10 years and none of the existing culverts are taken out of service.
- The oldest pipes are fixed first.

Using the assumptions listed above and adopting a simple deterioration model, it was estimated that approximately 600 culverts in Very Poor condition would need to be repaired each year over the next 10 years to achieve the recommended performance targets.

OVERHEAD SIGN STRUCTURES AND HIGH-MAST LIGHT TOWER STRUCTURES (OTHER TRAFFIC STRUCTURES)

The investment strategy for overhead sign structures and high-mast light tower structures was developed using an approach that considers the fraction of structures in various condition levels and makes a balanced investment according to expert input from the Other Traffic Structures Work Group.

Investment needs for these assets are based on inspection costs (which account for the bulk of the need) and assumptions about treatment needs over the next 10 years (based on discussions with the Work Group). A spreadsheet tool was developed to assist with determination of the investment needs.

INVESTMENT PLANNING WORKSHOPS

Two formal workshops were held to discuss the recommendations for investment strategies to be adopted as part of the TAMP:

- **Investment Planning Workshop #1 (November 2013):** Preliminary recommendations for the investment strategies and performance targets were discussed during this workshop. Targets for pavements and bridges were tweaked based on discussions held during this meeting. The group (TAMP Steering Committee plus representatives from MnDOT's senior leadership) also recognized that targets for highway culverts, deep stormwater tunnels, overhead sign structures, and high-mast light tower structures were largely based on expert opinion for this first TAMP, but that future TAMPs will work toward developing objective and outcome-based targets.
- **Investment Planning Workshop #2 (January 2013):** This workshop focused on finalizing the investment levels and performance targets that were incorporated into the TAMP.

FUTURE PROCESS CHANGES

Because much of the investment planning process was already completed as a part of the MnSHIP process, the efforts were not duplicated for the TAMP. The results were validated, refined, and incorporated into the TAMP after approval by the Steering Committee. In order to establish a more streamlined process moving forward, the investment planning process will be conducted as a part of future TAMPs and the outcomes will serve as the basis for MnSHIP updates (for assets covered in the TAMP).

MnDOT is also in the process of implementing management systems for asset categories beyond pavements and bridges. These systems, collectively referred to as Transportation Asset Management Systems (TAMS), will allow MnDOT to better manage roadside infrastructure through an objective, data-driven approach, which will also improve the development of investment strategies and targets. The first TAMS implementation will focus on traffic signals and lighting.

Supporting Data and Documentation

As discussed earlier, spreadsheet tools were developed to estimate the level of investment required for hydraulic infrastructure and other traffic structures over the 10-year planning horizon covered in the TAMP. Examples of these tools are included as attachments at the end of the chapter.

Attachments

Highway Culvert Target Methodology

Pipes quantity per condition category with **NO FIXING**

	year 0	year 1	year 2	year 3	year 4	year 5	year 6	year 7	year 8	year 9	year 10
condition 1,2	39810	39260	38710	38160	37610	37060	36510	35960	35410	34860	34310
condition 3	4739	4859	4979	5099	5219	5339	5459	5579	5699	5819	5939
condition 4	2844	3274	3704	4134	4564	4994	5424	5854	6284	6714	7144
										Total:	47393

FIXES NEEDED OVER 10 YEARS

condition 3 repairs for 10 years	2148
condition 3 repairs /year needed	215
condition 4 repairs for 10 years	5722
number of condition 4 repair /year needed	572
TOTAL FIXES PER YEAR	787

Prevision to reach 10-year targets/Amount of pipes required in each condition category

	year 0	year 1	year 2	year 3	year 4	year 5	year 6	year 7	year 8	year 9	year 10	TARGET
condition 1,2	39810	40047	40284	40521	40758	40995	41232	41469	41706	41943	42180	42180
condition 3	4739	4645	4550	4455	4360	4265	4171	4076	3981	3886	3791	3791
condition 4	2844	2701	2559	2417	2275	2133	1991	1848	1706	1564	1422	1422
											Total:	47393

CURRENT CONDITIONS

	2012
% Condition 4	0.06
% Condition 3	0.1
% Condition 1,2	0.84
Total culverts	47393
Amount of pipes becoming condition 4/year	430
Amount of pipes becoming condition 3/year	550

Assumptions used for the previsions:

- 1 - We assume that the pipes degrading to condition 4 were previously condition 3 pipes. Similarly, pipes degrading to condition 3 were previously in condition 2.
- 2 - The prevision assumes that no extra pipes will be built and that no pipes will be taken away. We use a total of 47,393 pipes over the ten years.
- 3 - a fixed pipe returns to a condition 1 or 2 pipe.

	Percent
2022 target for condition 4	0.03
2022 target for condition 3	0.08
fixing capability /yr	430

Highway Culvert Repair Projection Model

CONDITION 4 CULVERTS

YEARS	AGE											count	
	?	1	2	3	4	5	6	7	8	9	10		
0	2843												
1	2271	430											
2	1699	430	430	0	0	0	0	0	0	0	0		
3	1127	430	430	430	0	0	0	0	0	0	0		
4	555	430	430	430	430	0	0	0	0	0	0		
5	0	430	430	430	430	413	0	0	0	0	0	0	17
6	0	430	430	430	430	271	0	0	0	0	0	0	159
7	0	430	430	430	430	129	0	0	0	0	0	0	301
8	0	430	430	430	417	0	0	0	0	0	0	0	443
9	0	430	430	430	275	0	0	0	0	0	0	0	155
10	0	430	430	430	133	0	0	0	0	0	0	0	297

Number of Condition 4 repair/year 572

Fix existing condition 4	5
Fix New condition 4	
Added year 1	6
year 2	6
year 3	6
year 4	5
year 5	5
year 6	5
year 7	5
year 8	?
year 9	?
year 10	?

ASSUMPTIONS

- 1 - The oldest pipes are always fixed first
- 2 - 572 pipes are repaired each year

Summary of Current Overhead Sign Structure Condition

Overall Condition Rating	Description	SRF - Number of structures per rating	Structures that have Maintenance work done and/or planned construction work will move from 2,3,4,5 to 6	7-2-13 Structures per condition rating	% of total		New Totals	New Percentages
2	Critical	143	26	117	6%		42	1.78%
3	Serious	257	53	204	11%		147	6.22%
4	Poor	423	81	342	18%		137	5.80%
5	Fair	357	70	287	15%		376	15.91%
6	Satisfactory	200	49	430	23%		1595	67.50%
7	Good	32	2	32	2%		60	2.54%
8	Very Good	3	0	3	0%		6	0.25%
		281		1415			2363	100.00%

230 moved to 6

CO Active Structures	1857
Retired per Metro	4
Not inspected	438
Condition Total	<u>1415</u>

Modified percentages after structures statewide have been included. All remaining 510 structures are reported to be in 100% good condition.

Poor	36%	62% (414) of these have loose anchorages/nuts
Fair	15%	
Good	25%	

For structures not inspected, the most reasonable assumption would be to go with the Good/Fair/Poor distribution observed for the structures inspected. This can be revised in the Asset Register

Based on inspected structures:

Poor	249	17.6%	77	326	13.8%
Fair	287	20.3%	89	376	15.9%
Good	879	62.1%	272	1661	70.3%
Totals	1415		438	2363	

Summary of Overhead Sign Structures Investment History

Metro	328
Total No.	475
Others	147

Total Statewide Figures (Based on Extrapolation of Metro Numbers Statewide)								
Inspection Cycle	Year	No. of Structures Inspected	No of Structures Requiring:					
			No Maintenance	Routine Maintenance	Preventive Maintenance	Minor Rehabilitation	Major Rehabilitation	Replacement
1	2012	149	120	22	NA	7	0	0
2	2011	301	203	59	NA	39	0	0
3	2010	49	26	19	NA	4	0	0
4	2009	310	256	54	NA	0	0	0
5	2007	55	30	25	NA	0	0	0
6	2005	142	101	12	NA	0	0	0
7	2003	155	155	0	NA	0	0	0
8	2001	181	181	0	NA	0	0	0

Avg./yr	168	18.8%	17		
Std. Dev.	97				
Average + SD	265				

Only Metro										Other Structures Statewide (Extrapolated from Metro numbers)									
Inspection Cycle	Year	No. of Structures Inspected	No of Structures Requiring:							Inspection Cycle	Year	No. of Structures Inspected	No of Structures Requiring:						
			No Maintenance	Routine Maintenance	Preventive Maintenance	Minor Rehabilitation	Major Rehabilitation	Replacement	No Maintenance				Routine Maintenance	Preventive Maintenance	Minor Rehabilitation	Major Rehabilitation	Replacement		
1	2012	103	83	15	NA	5	0	0	1	2012	46	37	7	NA	2	0	0		
2	2011	208	140	41	NA	27	0	0	2	2011	93	63	18	NA	12	0	0		
3	2010	34	18	13	NA	3	0	0	3	2010	15	8	6	NA	1	0	0		
4	2009	214	177	37	NA	0	0	0	4	2009	96	79	17	NA	0	0	0		
5	2007	38	21	17	NA	0	0	0	5	2007	17	9	8	NA	0	0	0		
6	2005	98	70	8	NA	0	0	0	6	2005	44	31	4	NA	0	0	0		
7	2003	107	107	0	NA	0	0	0	7	2003	48	48	0	NA	0	0	0		
8	2001	125	125	0	NA	0	0	0	8	2001	56	56	0	NA	0	0	0		

Avg./yr	116	18.8%	12		
Std. Dev.	67				
Average + SD	183				

Avg./yr	52	18.8%	5		
Std. Dev.	30				
Average + SD	82				

Approach 1:

- Assumptions:
- 183 Structures are inspected each year from 2014 - 2023 (10 year period), which gives a total of 1830 inspections.
 - Average inspection cost of \$1000/structure.
 - Average Routine maintenance cost of \$500/structure, 18.8% of structures inspected receive routine maintenance per year.
 - Average replacement cost of \$40,000/structure, assuming 1 structure replaced per year over next 10 years.
 - Minor rehabilitation cost assumed to be \$2000 per structure (value not provided by work group), 12 structures assumed to receive minor rehab per year.

Total Inspections 10-yr inspections	2650
	10-Yr Number 10-Yr Cost
Inspection Cost (per structure)	\$1,000 2650 \$2,650,006
Routine Maintenance Cost (per structure)	\$500 499 \$249,749
Minor Rehabilitation Cost (per structure)	\$2,000 169 \$337,907
Replacement Cost (per structure)	\$40,000 10 \$400,000
Total	\$3,637,662

Approach 2:

- Assumptions:
- Using a 5-year inspection cycle, assumed that 95 structures are inspected each each on an average.
 - Average inspection cost of \$1000/structure.
 - Average Routine maintenance cost of \$500/structure, 18.8% of structures inspected receive routine maintenance per year.
 - Average replacement cost of \$40,000/structure, assuming 1 structure replaced per year over next 10 years.
 - Minor rehabilitation cost assumed to be \$2000 per structure (value not provided by work group), 12 structures assumed to receive minor rehab per year.

Total Inspections 10-yr inspections	950
	10-Yr Number 10-Yr Cost
Inspection Cost (per structure)	\$1,000 950 \$950,000
Routine Maintenance Cost (per structure)	\$500 179 \$89,532
Minor Rehabilitation Cost (per structure)	\$2,000 169 \$337,907
Replacement Cost (per structure)	\$40,000 10 \$400,000
Total	\$1,777,439

Summary of Overhead Sign Structures Investments Needed to Achieve 10-year Targets

Inventory			Inspections			Tighten Nuts			Remove Grout			Regrade footing, Replace weld			Replace foundation...			Replace Structure			10-Yr Investment
Condition	Total	Percent	No. of Cycles	Number	Cost	Fraction	Number	Cost	Fraction	Number	Cost	Fraction	Number	Cost	Fraction	Number	Cost	Fraction	Number	Cost	
Good	1661	70%	2	2335	\$2,682,654	0%	0	\$0	0%	0	\$0	0%	0	\$0	0%	0	\$0	0%	0	\$0	\$2,682,654
Fair	376	16%	2	120	\$606,979	0%	0	\$0	0%	0	\$0	0%	0	\$0	0%	0	\$0	0%	0	\$0	\$606,979
Poor	326	14%	2	90	\$526,612	40%	111	\$55,433	15%	42	\$41,575	10%	28	\$83,149	17%	47	\$1,177,948	10%	28	\$2,355,896	\$4,240,613
Total	2363	100%			\$3,816,245			\$55,433			\$41,575			\$83,149			\$1,177,948			\$2,355,896	\$7,530,246

Avg. Unit Costs/structure	\$950	\$500	\$1,000	\$3,000	\$25,000	\$85,000
Inspection %	85%	85%	85%	85%	85%	85%

User input
Computation
Output

