

Nebraska Department of Roads Transportation Asset Management Plan (TAMP)

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L.R. Rilett

Prem S. Paul Research Center at Whittier School (WHIT)

Lincoln NE 68588-0851

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<p>16. Abstract</p> <p>The goal of this project was to develop a document that describes the overarching Transportation Asset Management Plan for Nebraska. Note that this document is a summary document and that most of the technical details can be found in the supporting documents. A partial list is shown in the References section. Appendix A lists the outline of the proposed summary document.</p> <p>Note that this project summarizes what is currently being done in Nebraska as related to asset management activities defined by MAP-21. There are no recommendations or studies on current asset management practice.</p> <p>This document allows NDOR to meet the requirements of MAP-21 related to Transportation Management Plan documentation.</p> <p>This document was forwarded to FHWA for approval. It is the guiding document for all Bridge and Pavement asset management activities on the NHS at NDOR and will be updated on a regular basis according to MAP-21 guidelines.</p>			
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Chapter 1 Introduction

1.1 Overview

Nebraska has been a vital link in the nation's transportation system since prairie schooners and the Transcontinental Railroad first crossed the Great Plains. The state was the first in the nation to complete its mainline interstate system: work began in 1957 and the final link was dedicated on October 19, 1974. Today, the Nebraska Department of Roads (NDOR) oversees and maintains a vast infrastructure network that includes 96, 725 miles of public roads.

With the passage of the Moving Ahead for Progress in the 21st Century Act (MAP-21), each state transportation department is required to develop a risk-based Transportation Asset Management Plan (TAMP). In accordance with MAP-21 requirements, NDOR has developed a TAMP to preserve and improve pavements and bridges on the National Highway System (NHS), interstate and state highway systems, and additional roadways.

Transportation asset management is defined by the American Association of State Highway and Transportation Officials (AASHTO) as: “a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their life cycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well defined objectives” [13].

The TAMP provides NDOR with an integrated, comprehensive, and strategic approach to meet the needs of the system and its users. The TAMP also serves as a tool for accountability and communication to inform established asset management practices and to effectively determine investment priorities that reflect consideration of physical preservation, system efficiency, user safety, economic productivity, and environmental stewardship.

As the state of Nebraska addresses transportation asset management, NDOR will remain firmly dedicated to its mission: “We provide the best possible statewide transportation system for the movement of people and goods.” NDOR will use the following goals, developed in support of their mission statement, to meet the needs of Nebraska’s assets and citizens.

Overview of NDOR’s Goals:

1. Safety – Improve safety on Nebraska’s transportation system.
2. Fiscal Responsibility – Use financial resources wisely and make financial decisions in an open and transparent way.
3. Environmental Stewardship – Integrate environmental considerations into planning/design, construction and operational activities of Nebraska’s transportation system.
4. Project Delivery – Use known state and industry best practices, new technologies, and creativity to continually improve and deliver well designed, high quality projects, products, and services.

5. Asset Management – Operate, maintain, upgrade, and expand physical assets effectively throughout their life cycle.
6. Mobility – Improve mobility on Nebraska’s transportation system through increased reliability, capacity, and efficiency.
7. Communication, Coordination, Collaboration & Cooperation (the 4 Cs) – Collaborate with stakeholders to maximize the value of Nebraska’s transportation investments.
8. Workforce Development – Support and facilitate the development of a skilled workforce that enhances workplace productivity and increases opportunities for employees to learn new skills.

1.2 TAMP Structure

The content of the TAMP is organized into nine chapters. A brief description of each chapter is provided below.

Chapter 2: Asset Inventory and Condition – provides a brief overview of the National Highway System (NHS), inventory and condition performance of the state’s pavement and bridges, and summary of each asset’s rating scale.

Chapter 3: Asset Management, Objectives, Practices, and Measures – outlines NDOR’s objectives and strategies for successful asset management, identifies asset condition goals, and describes the process of collecting condition ratings and assessing the performance of the state’s assets.

Chapter 4: Performance Gap Identification – contains an overview of the State Highway System’s asset preservation, system modernization, and capital improvement needs. This chapter also provides summaries of the Build Nebraska, NDOR’s short-term (10 years) and long-term (20 years) planning horizons for asset management, and performance gap analyses based on inflation over the next 20 years.

Chapter 5: Life-Cycle Cost Analysis – describes pavement and bridge life cycle management practices and costs associated with: design, construction, inspection, maintenance, rehabilitation, and disposal.

Chapter 6: Future Growth and Demand – provides an overview of Nebraska’s future population and freight growth and system demand as well as a summary of investment needs to improve pavement and bridges to meet future demand. This chapter also identifies objectives and strategies for managing future demand.

Chapter 7: Risk Management Analysis – summarizes NDOR’s approach to risk-based asset management, describes system risks identified by NDOR, provides a risk register for programmatic risks, including the likelihood of a risk occurring, potential consequences of occurrence, and mitigation strategies. System and program resiliency is also highlighted.

Chapter 8: Financial Plan and Investment Strategies – summarizes the funding sources for Nebraska’s transportation system, financial reporting requirements, financial management

practices and fund allocation for asset management, strategies for prioritizing projects and investments, and the current value of the state's pavement and bridges.

Chapter 9: TAMP Implementation and Future Developments – identifies priorities for improving current asset management practices and steps for implementing and updating the TAMP.

Supplemental information that contributes to the TAMP is located in the Appendices.

Chapter 2 Asset Inventory and Condition

2.1 Overview

The Nebraska Department of Roads (NDOR) oversees and maintains an infrastructure network comprised of 96,725 miles of public roads, 3,519 bridges, 599 buildings in 119 locations, and an equipment fleet of over 2,100 cars, pickups, trucks, and graders.

The National Highway System (NHS) in Nebraska, which is the focus of this document, is 3,717 miles in length and consists of 482 miles of interstate highways, 3,063 miles of state highways, and 171 miles of local highways. There are 1,533 bridges on the NHS system: 1,464 state bridges and 69 local bridges. A map of Nebraska's National Highway System, provided by the U.S. Department of Transportation Federal Highway Administration, is shown in figure 2.1.

Billions of Nebraska's dollars have been invested to ensure the continued safety and efficiency of interstate, state highways, and local roadways ["Some Facts and Figures"]. Given this significant investment, along with increasing system demands and fiscal constraints, it is imperative that NDOR continues to practice efficient resource allocation on the NHS.

The Nebraska TAMP focuses on two major assets: pavement and bridges. The inventory lists and condition summaries contained in this chapter will serve as a foundation for evaluating the current state of NHS assets. A summary of NDOR's 2014 asset inventory and performance is shown in table 2.1. Note that additional information on the condition of all of Nebraska's pavement and bridges, including the NHS, may be found in in NDOR's 2014 Annual Report: <http://www.transportation.nebraska.gov/docs/annual-report.pdf> [#].

Table 2.1 NDOR asset inventory and condition summary on NHS

Asset	Inventory Unit	2014 NHS Inventory	2014 Performance (≥Good)
Pavement	Centerline miles	3,717.5	82.8%
Bridges	Number of bridges	1,533	62.3%

2.2 Pavement Inventory

The expanse of Nebraska pavement on the NHS currently measures 3,717 miles in length. In this document pavement is defined as the surfaced travel way width of the highway, which does not include items such as geometric deficiencies, shoulders, guardrails, or signs [Asset Management Team Final Report]. NDOR stores and accesses pavement inventory in two locations:

1. mainframe databases, and
2. Pavement Optimization Program (POP)

The POP offers a variety of data and functions for nearly every step of the asset management process, including current pavement ratings. Information on how the POP can be utilized and step-by-step instructions are detailed in the user guide:

<http://www.transportation.nebraska.gov/mat-n-tests/pdfs-docs/popmanual.pdf> [#].

In Nebraska, the NHS network is comprised of two types of pavement:

1. Portland cement concrete (PCC) (i.e., rigid)
2. Asphalt cement concrete (ACC) (i.e., flexible, bituminous, or black top).

2.3 Pavement Condition and Smoothness

2.3.1 Nebraska Serviceability Index (NSI)

The condition of Nebraska's pavement on the NHS is quantified by the Nebraska Serviceability Index (NSI), and can be used to gauge the overall health of the network or a specific segment of highway. NSI ratings are taken annually and are performed on both PCC and ACC pavements. Before an NSI value is calculated, visible surface distress is recorded during visual inspections and the rutting or faulting of a roadway is measured by Nebraska's Pathway profiling machine (detailed information on the profiling machine is contained in chapter 3, section 3). Once the data has been uploaded into the POP, the distresses are combined mathematically into pavement condition factors used to calculate the final NSI value.

Condition information is used to monitor pavement performance over time and to help determine appropriate strategies for maintenance, rehabilitation, or reconstruction. Note that the distress survey is intended primarily to characterize type and extent of pavement distress, but does not attempt to determine the cause of distress and appropriate corrective treatments.

Pavement condition is categorized according to the NSI scale. The full range of NSI condition ratings and corresponding physical descriptions are listed in table 2.2.

Table 2.2 Nebraska Serviceability Index (NSI)

Rating	Condition	Description
Very Good	90 - 100	Pavement like new
Good	70 - 89.99	Several years of service life remaining
Fair	50 - 69.99	Few years of service life remaining
Poor	30 - 49.99	Candidate for rehabilitation
Very Poor	0 - 29.99	Possible replacement

2.3.2 International Roughness Index (IRI)

The second measure of pavement performance is smoothness. Measurements of pavement smoothness, or the ride quality, are collected annually for both pavement types using the Pathway profiling machine. Collected data is evaluated according to the International Roughness Index (IRI). The IRI measures pavement roughness in terms of the number of millimeters per meter or inches per mile. The lower the IRI rating, the smoother, safer, and more satisfying the ride is to users. Table 2.3 contains the IRI rating and condition scale.

Table 2.3 International Roughness Index (IRI)

Rating	Condition (in/mi)
Good	<95
Fair	95-220
Poor	>220

The percent of pavements with NSI and IRI ratings of “good” or better and “poor” or worse on the entire state highway system, including the NHS system, are recorded in table 2.4. Current condition ratings related to cracking, rutting, and faulting are also listed in the table. The data was collected, analyzed, and provided by NDOR’s Roadway Asset Management Team.

Table 2.4 Current condition of pavement on the NHS

Asset	Inventory Unit	2014 Inventory	Inventory Condition									
			% Good, NSI >70	% Poor, NSI <50	% Good, IRI <95	% Poor, IRI >170	Good, Cracking % <5	Poor, Cracking % >10	% Good, Rutting <0.2 in.	% Poor, Rutting >0.4 in.	% Good, Faulting <0.05 in.	% Poor, Faulting >0.15 in.
Interstate NHS Highways	Centerline Miles	482.6	88.6	0.0	92.9	0.6	81.4	15.2	92.3	0.0	94.2	0.0
State NHS Highways	Centerline Miles	3063.9	82.9	2.2	66.1	6.4	75.5	18.7	77.5	1.3	55.3	3.8
Local NHS Roadways	Centerline Miles	171.0	64.9	25.7	3.4	65.3	NA	NA	44.0	13.3	29.7	15.2
Non-NHS State Highways	Centerline Miles	6227.5	74.7	2.8	56.9	33.4	46.5	42.8	63.2	4.0	25.8	5.4
Total State Highways	Centerline Miles	9945.0	72.4	2.3	60.6	24.1	56.3	33.3	68.6	3.2	53.9	5.1
Total NHS Highway system	Centerline Miles	3717.5	82.8	3.0	66.7	8.3	72.8	17.3	78.5	1.4	57.8	4.5

Note: Pavement conditions, IRI, percent cracking, rutting, and faulting as per 23 CFR Part 490 Proposed Rules § 490.307 and § 490.311. Pavement data is from May 27, 2015.

2.4 Bridge Inventory

There are currently 1,533 bridges in Nebraska on the NHS (see table 2.1). A bridge is defined as a structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between the undercoping of abutments or spring lines of arches, or extreme ends of openings for multiple boxes [Asset Management Team Final Report]. Bridge length culverts will not be included in this document. The official bridge inventory is stored and accessed by NDOR on mainframe databases as well as the Pontis software application (see chapter 3).

2.5 Bridge Condition

The condition of the deck, superstructure, and substructure of a bridge on the NHS is evaluated in accordance with National Bridge Inspection Standards (NBIS). NDOR inspectors report the conditions of these structures on a 10 point scale, with a condition code of 9 for an excellent condition and 0 for a failed condition. The full range of NBIS condition ratings and corresponding physical descriptions are listed below in table 2.6.

Table 2.6 National Bridge Inspection Standards (NBIS)

Rating	Condition	Description
9	Excellent	
8	Very Good	No problems noted
7	Good	Some minor problems
6	Satisfactory	Structural elements show some minor deterioration
5	Fair	All primary structural elements are sound but may have minor section loss, cracking, spalling, or scour
4	Poor	Advanced section loss, deterioration, spalling, or scour
3	Serious	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	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 it may be necessary to close the bridge until corrective action is taken.
1	Imminent Failure	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 put back in light service.
0	Failed	Out of service - beyond corrective action

NDOR reports the number of structurally sound and functionally adequate bridges in the state. Bridges considered “structurally deficient,” according to the Federal Highway Administration (FHWA), have one of the following:

- Condition rating of 4 (poor) or less for:
 - deck
 - superstructure
 - substructure
 - culvert and retaining walls

- An appraisal rating of 2 (requiring high priority of replacement) or less for:
 - structural condition
 - waterway adequacy

Of Nebraska’s 1,533 bridges located on the NHS, 1,464 are state bridges and 69 are local bridges. The surface area, percent of bridges rated “good” or better and “poor” or worse according to the NBIS scale, and the percent of bridges determined to be structurally deficient are shown in table 2.7. Currently, 62.3 percent of NHS bridges are rated “good,” and only 2.0 percent are rated “poor.” The percent of bridges found to be structurally deficient is 1.7 percent.

Table 2.7 Current condition of bridges on the NHS

Asset	2014 Inventory		Inventory Condition		
	Number of bridges	Area (SF)	% Good	% Poor	% Structurally Deficient
State NHS Bridges	1,464	15,572,409	62.5%	1.8%	1.8%
Local NHS Bridges	69	1,220,724	60.1%	3.6%	1.1%
Non-NHS State Bridges	2,052	9,147,982	64.6%	6.5%	6.1%
Total State Bridges	3,516	24,720,392	63.3%	3.6%	3.4%
Total NHS Bridges	1,533	16,793,134	62.3%	2.0%	1.7%

Note: Percent of good and percent of poor is by bridge and culvert area as per 23 CFR Part 490 Proposed Rules § 490.407(c)(1) and § 490.409. Percent structurally deficient as per 23 CFR Part 490 Proposed Rules §§ 490.411 and 490.413. Bridge data is from March 31, 2015.

As of April 2014, the deck area, the surface area of a bridge containing the roadway or pedestrian sidewalk area, is inspected annually to provide a more detailed analysis of the condition of NHS bridges by taking a closer look at the smaller components of bridges within their larger frames. This refined method of asset management allows NDOR to keep Nebraska's bridges in good condition for a longer period of time. Currently, 98 percent of deck areas belonging to bridges located on the NHS have been determined to be structurally sound according to FHWA requirements.

Chapter 3 Asset Management Objectives, Practices, and Measures

3.1 Overview

NDOR utilizes a performance-based approach for asset management that focuses on evaluating system performance, identifying asset needs, and establishing investment priorities.

NDOR uses the following documents as a basis for the development and implementation of pavement and bridge management practices: Nebraska's Vision 2032 Long-Range Transportation Plan (LRTP) (<http://www.transportation.nebraska.gov/lrtp/docs/LRTP-current.pdf>) [#], Funding Distribution Team Final Report (<http://www.roads.nebraska.gov/media/2813/funding-distribution-team-2008.pdf>) [#], and Nebraska's One and Six Year Surface Transportation Program (<http://www.transportation.nebraska.gov/hwy-pgm/2016-2021/ProgramBook2016.pdf>) [#].

Nebraska's Vision 2032 LRTP is an overarching policy guide that establishes the goals, objectives, and strategies to address the transportation challenges and opportunities facing the state over the next twenty years. The Funding Distribution Team Final Report contains recommendations for the allocation of highway construction funds. Nebraska's One and Six Year Surface Transportation Program consists of detailed maps and inventory lists of current and planned construction projects for each of the eight districts in the state.



Figure 3.1 NDOR process overview

Performance measures have been developed to monitor the condition of Nebraska's pavement and bridges on the National Highway System (NHS). Various strategies are used to meet the objectives to preserve, rehabilitate, and replace the major assets managed by NDOR.

3.2 NDOR Pavement and Bridge Management Objectives

Objectives of Asset Management:

1. Maintain pavement and bridges in a state of good repair

It is necessary to maintain the quality of pavement and bridges in order to improve the safety and mobility of transportation system users. Safety

considerations focus on reducing frequencies and rates of fatalities, injuries, and property damage, which in turn reduces the economic impact of these occurrences. To increase mobility, attention is given to the management of existing infrastructure by conducting routine inspections and analyzing condition data in order to prioritize maintenance and rehabilitation candidates and employ the most cost-effective treatments.

2. Optimize budget expenditures

NDOR's goal is to optimize the use of funds available to Nebraska for the greatest benefit of the state transportation system while providing funding to meet the department's goals. Progress toward this goal is accomplished by minimizing overhead costs to maximize funding for transportation services and by accurately estimating project costs when the annual program is established in order to maximize program delivery.

3. Meet or increase the expected life-span of the major assets

Quality asset management practices help minimize the costs associated with each phase of a major asset's life cycle. NDOR is mindful of these costs when weighing construction and preservation strategies because future maintenance and operating costs can exceed the initial cost of an asset over a long period of time. Regardless, assets that are well-managed tend to have longer lifespans and are more cost effective.

Strategies to Meet the Objectives:

1. Strategically preserve, rehabilitate, and replace the major assets

NDOR performs annual inspections and condition evaluations in order to implement the appropriate maintenance strategy for pavement and bridges

2. Support the development of asset management systems to include all major assets

In the past, fleet and buildings have been identified as major assets. Other assets have also been considered as potential major assets, but more data and analysis is needed before they can be included in the TAMP. NDOR is evaluating plans to create and standardize teams and forms that will develop condition measures to assess asset performance.

3. Identify elements that will be used in the measurement of the major assets

There are multiple elements that are necessary to measure assets: trained and qualified engineers, standard procedures and reporting systems, and analysis. NDOR reviews these measures to ensure their quality and accuracy.

4. Develop forms to assist in the rating of assets

Standardized forms have been created and implemented for pavement and bridge inspections and can be found in the Bridge Inspection Manual, on NDOR's

website, or as internal documents. Forms for other major asset candidates are still in development.

5. Train NDOR staff on the use of asset management systems and forms

NDOR has implemented a training program impact index to measure the effectiveness of employee training and current job tasks, which include the ability to correctly use current evaluation tools related to asset management.

6. Provide annual status updates of assets in both the Annual Report and Performance Measures Report

NDOR compiles the Annual Report, which contains current major asset condition ratings and evaluates them against asset management goals. The Performance Measures Report reviews the efficacy of the measurement system for major assets and describes NDOR's management objectives and strategies.

NDOR's information systems are a key component of the strategies used to meet asset objectives. These systems are detailed in the following section, along with the organizational processes in which they exist. A general work flow of NDOR's approach to managing pavement and bridges is depicted in figure 3.2.



Figure 3.2 Work flow of NDOR's asset management plan

3.3 Pavement Information Systems and Practices

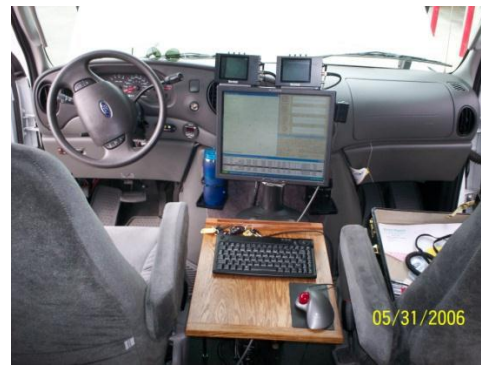
Using the Nebraska Pavement Management System (NPMS) as a guide, NDOR's Pavement Management personnel have been collecting surface data and efficiently managing the condition of Nebraska's roadways since the system's development in 1984. The scope of this system expanded to include all highways and roads on the National Highway System as of January 1, 1994.

Pavement inspections are conducted at sample locations once a year on the NHS and additional roadways. All surface texture information is collected by NDOR's Materials and Research Division through visual examinations and by using the Pathway profiling system, a specialized van equipped with lasers for measuring (see fig. 3.3). This system, which was recently updated in 2014, provides information on roadway smoothness, rut depth, texture, and faulting, as well as photos of the sample sections.

After collecting and storing data, NDOR uses interpreting programs like the Pavement Optimization Program (POP) to perform a variety of condition, maintenance, and cost-related analyses. NDOR submits these analyses in reports to provide decision makers with sound information that assists them in the decision making process.



(a) Pathway profiling van



(b) Profiling van interior computer monitor



(c) Profiling equipment and data storage

Figure 3.3 Pathway profiling system

3.4 Bridge Information Systems and Practices

All bridges are inspected once every two years by the Nebraska Bridge Inspection Program (BIP). Inspections are carried out by NDOR personnel in accordance with the BIP manual, developed by NDOR to meet the requirements of the National Bridge Inspection Standards (NBIS).

Since April 2014, NDOR has inspected bridges on the NHS using Element Level Inspection (EI) in accordance with the latest Moving Ahead for Progress in the 21st Century Act (MAP-21) requirements. This method takes the large components of a bridge and breaks them into smaller elements for condition assessment and reporting. Gathering EI data provides NDOR and additional bridge owners with a more detailed picture of the health of a bridge rather than simply relying on the National Bridge Inventory (NBI) condition ratings (superstructure, substructure, and deck) that are collected for all bridges, both on and off the NHS, since the NBIS standards were established in the 1970s.

The inspection data collected on bridges is inputted into Pontis, a software application that also stores inventory and condition data for each structural element of a bridge. Condition ratings and other functional and geometric data for bridges aid the FHWA in determining funding prioritization for maintenance and rehabilitation. Inspection and load-rating documents are completed and submitted to NDOR's Bridge Division for further analysis and to aid in local decision making.

3.5 Performance Measures

NDOR uses a performance-based approach to manage its pavement and bridge transportation assets. Each year, NDOR reviews the asset management measures and practices in order to define clear standards, provide the best service, and report on the progress made toward reaching performance goals. This information is compiled and disseminated in NDOR's annual report (<http://www.transportation.nebraska.gov/docs/annual-report.pdf>) (#).

Four indices are used to determine the overall state of pavement and bridges on the NHS:

1. Condition – The extent to which the asset is comparable to its new or as-built condition.
2. Quality expectation – The extent to which the asset is meeting the reasonable expectations of its users.
3. Functionality – The extent to which the asset is providing a reasonable level of performance.
4. Service expectation – The conditions under which the asset is still considered useful.

3.5.1 Pavement Performance Measures

NDOR's performance measures evaluate the condition and smoothness of pavement according to the Nebraska Serviceability Index (NSI) and the International Roughness Index (IRI). Condition measurements are taken annually according to the Surface Distress Survey via the Pathway profiling machine and visual inspections. For pavement management analysis on the NHS and additional roadways, surface condition data is combined using type, severity, and extent of surface distress and the rutting or faulting measurement to provide a single value

termed the Nebraska Serviceability Index (NSI). The IRI value represents pavement smoothness. A smoother, safer, and more enjoyable ride for users means a lower IRI rating.

In an effort to continue NDOR’s goal of smoother roads, the department plans to use in-place repair and thin asphalt overlay strategies on existing highways on the NHS. These strategies extend pavement life while offering a noticeable improvement in smoothness and a faster construction schedule than traditional rehabilitation or reconstruction strategies. The formulas NDOR uses to calculate NSI and IRI ratings can be found in the Appendix.

Table 3.1 shows the pavement performance measures as well as NDOR’s targets for each measure: to have at least 84% of the highway system miles rated at least “good” or “very good” (NSI ratings ≥ 70), and to have at least 84% of all miles of the highway system maintained at an acceptable ride quality of at least “good” or “very good” IRI ratings.

Table 3.1 NHS pavement performance measures

Asset Type	Performance Measure	Target
Pavement	% of pavement condition rated “good” or better	$\geq 84\%$
	% of pavement smoothness rated “good” or better	$\geq 84\%$

Table 3.2 shows the breakdown of this target as it applies to interstate, state highways, and local roads on the NHS. The “% IRI rating of ‘good’ or better” column shows the percentage of miles that need to be rated “good” or better in order to reach the pavement smoothness target. The column to the right lists the specific number of miles in each category that must be rated “good” or better. Similar information is provided for the NSI condition target.

Table 3.2 NHS pavement condition goals

Asset	Total NHS miles	% IRI rating of “good” or better	# of miles “good” or better (IRI)	% NSI rating “good” or better	# of miles “good” or better (NSI)
Interstate	482.6	99.7	481.5	?	?
State	3063.9	91.04	2789.5	?	?
Local	171.0	27.05	45.5	?	?
Total	3717.5	----	3316.5	?	?

As shown in table 3.2, the average NSI rating for the total NHS highway system is slightly below the desired target at 82.8 percent. The IRI rating for the NHS highway system is below the target as well at 66.7 percent. To achieve these goals, NDOR will focus on investing heavily in pavement preservation and in performing more preventative maintenance.

Trend lines have been developed to track the performance of NDOR’s major assets over time. Five years of information, the current year and four previous years, provides a suitable range from which to determine if pavement conditions are improving or declining.

Figure 3.4 shows the percent of NHS pavement with an IRI rating of “good” (< 95) from 2010-2014. The number of pavement sections rated “good” over the five-year period has increased 0.4 percent for interstate highways and 1.3 percent for state highways. Local roadways have experienced a 10 percent decrease in the total number of “good” ratings received across the state due to increasing budget constraints and the priority need to rehabilitate and replace pavement on the interstate and state highways. NHS interstates and highways receive priority maintenance due to a higher number of users, which lead to more damage, and their economic and strategic necessity.

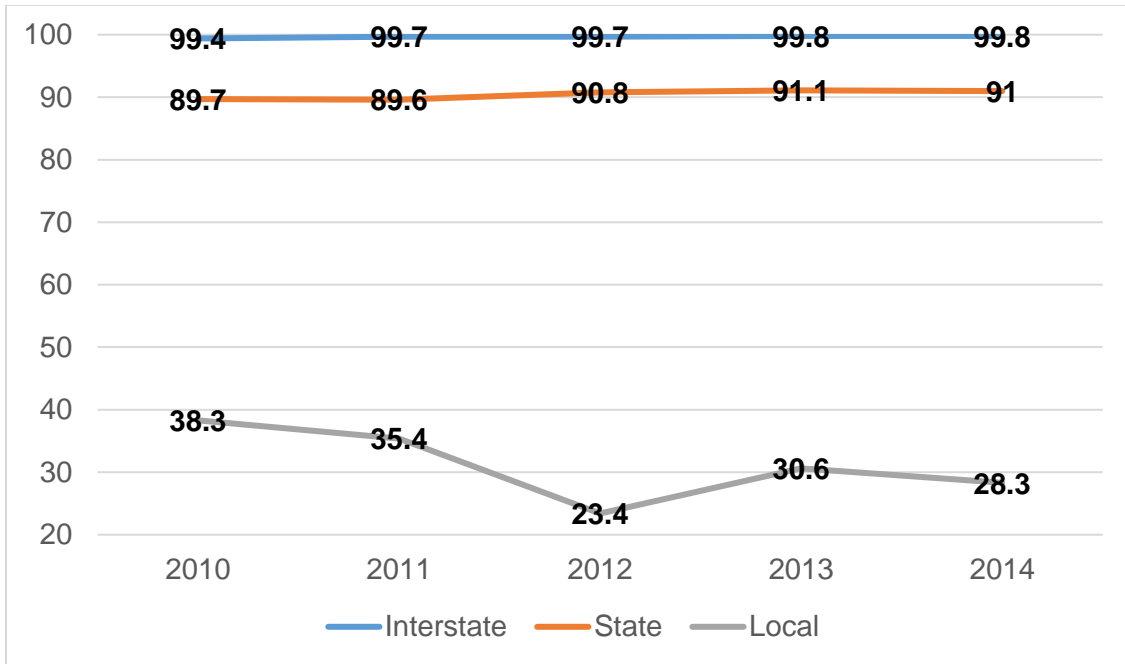


Figure 3.4 Five-year trends for percent of NHS pavement with “good” IRI rating (≥95)

3.5.2 Bridge Performance Measures

Bridge condition is evaluated according to National Bridge Inspection Standards (NBIS). NDOR uses two terms to classify and qualify bridges: structurally sound and functionally adequate. Bridges classified as structurally sound and functionally adequate are considered to have a good service expectation. To review how bridges are determined to be structurally deficient, refer back to chapter 2, section 2.5.

Bridge performance is measured by the percent of NHS bridges that are structurally sound and functionally adequate and the percent of the total deck area of bridges that are classified as structurally deficient. NDOR has identified the following targets to ensure Nebraska’s bridges are safe, efficient, and able to carry the loads necessary to keep our economy moving forward. Table 3.3 shows these performance measures as well as NDOR’s targets for each measure: to have at least 95% of NHS bridges structurally sound and functionally adequate, and to have less than 10% of the total deck area of bridges on the NHS classified as structurally deficient.

Table 3.3 NHS bridge performance measures

Asset Type	Performance Measure	Target
Bridges	% of bridges that are structurally sound and functionally adequate	≥95%
	% of total deck area of bridges that are classified as structurally deficient	<10%

In 2014, the targets for the condition of deck areas on NHS and Nebraska state-owned bridges were met. NDOR will continue to exceed these targets in the coming years and work toward meeting the remaining target. Nebraska’s current status of 93.2 percent of state bridges rated as structurally sound and functionally adequate is well above the 2014 national average of 81.6 percent and has remained so since 2005, as shown in figure 3.5.

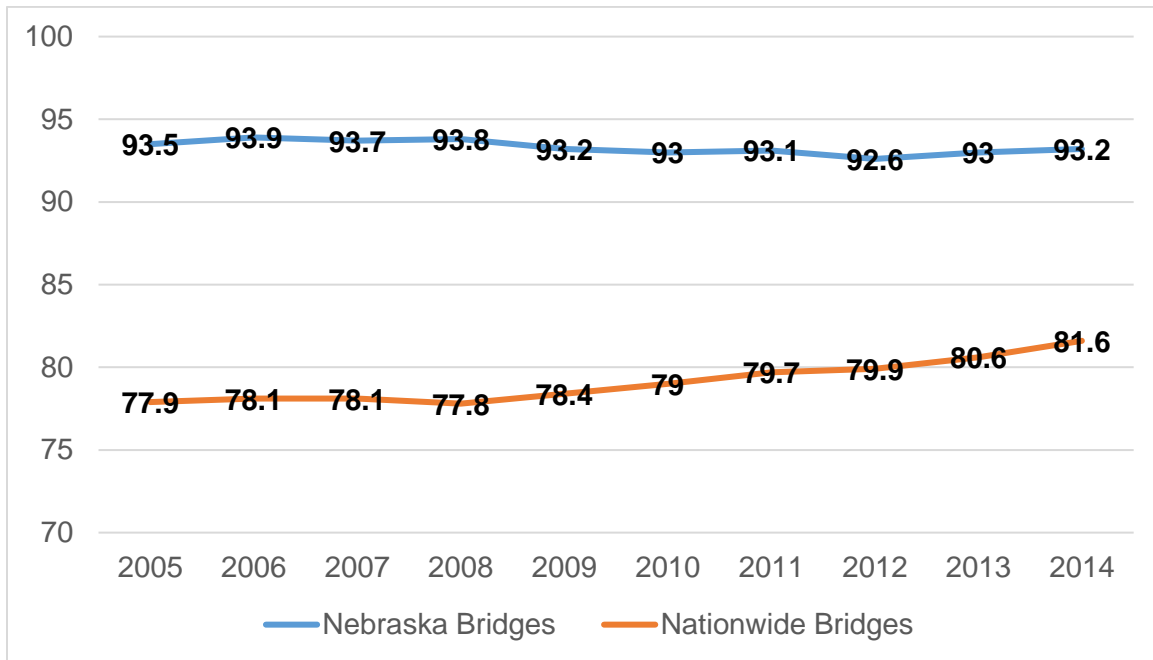


Figure 3.5 Percent of structurally sound and functionally adequate bridges

Insert graphs of bridge trends if provided

NHS numbers provided for 2013 and 2014 (2013 was first year for reporting NHS performance measures for bridges)

State values will be provided by NDOR

3.7 Self-Assessment of Asset Management Practices and Recommendations

Self-assessment is used by NDOR to update and maintain the most efficient practices for the management of the state's pavement and bridges. The historical condition data and current performance measures, in addition to estimating department needs and prioritizing candidate projects, are periodically reviewed to monitor and evaluate:

1. maintenance, rehabilitation, and reconstruction designs and techniques,
2. calibrate performance prediction curves and design procedures, and
3. provide information for special research purposes.

In accordance with state regulation, quality control (QC) and quality assurance (QA) procedures are used to maintain a high degree of accuracy and consistency in NDOR's pavement and bridge inspection programs. Information obtained during the QC inspection is used to determine necessary maintenance and repair, prioritize rehabilitation and replacement, allocate resources, and to improve new roadway and bridge designs. The accuracy and consistency of the QC inspection and documentation is vital because it not only impacts programming and funding appropriations, but even more importantly affects public safety.

A QC check is performed on every document or product that is prepared by NDOR. A QA is done to assure that the QC is completed on a small percentage of randomly selected products by an independent party. The findings of the QA evaluation are documented for future training and improvement to the Nebraska Pavement Management System (NPMS) and the Bridge Inspection Program (BIP).

Modifications to the NPMS and the BIP are made when and if statistically significant changes occur. Additionally, the professional engineers performing the condition surveys are routinely instructed on data collection and the uses of the NPMS and the BIP regarding maintenance, design, and program development. The condition rating systems are reviewed annually along with the condition raters to ensure consistency in the rating process.

NDOR's Business Technology Support Division monitors technology advances to determine if implementing new software or hardware could increase efficiency in areas such as data collection and reporting. The Communication Division ensures that information is collected and reported by the appropriate divisions and in the Annual Report, with an additional responsibility to create graphs showing the progression of each asset. These "trend lines" provide information on how well the major assets are performing over a number of years.

The current concepts and methods of pavement and bridge management will continually be reviewed and improved to ensure condition needs are being met, as well as the objectives and mission of NDOR, in addition to the safety and needs of the public that NDOR serves.

Chapter 4 Performance Gap Identification

4.1 Overview

NDOR aims to promote safe and efficient travel throughout the state, meaning that the state of good repair of Nebraska's assets is critically important. For pavements and bridges, asset condition is essential to identifying performance gaps. In this document, performance gap is defined as the difference between existing and desired performance.

NDOR determines asset needs in order to understand the ways in which existing funding levels will affect future asset management practices. This is necessary to create performance targets. NDOR has already established pavement and bridge condition targets, the details of which can be found in chapter 2. This chapter presents two additional targets: aspirational targets, which represent desired outcomes without considering fiscal constraints, and constrained targets, which are used to manage system performance within the confines of available resources.

A performance gap results when there is a difference between the ideal condition of the assets and what is realistically achievable given projected funding levels. The target recommendations presented in this chapter reflect the judgment of NDOR staff and provide points of reference for evaluating the sufficiency of NDOR's planned investment.

4.2 Needs Assessment

NDOR closely monitors the current and projected needs of the Nebraska State Highway System to address the issue of gap analysis and to ensure efficient management plans are developed with consideration to funding availability. Since 2014, the needs of the State Highway System are divided into three categories. The total projected 20-year needs (in today's dollars) for each category are shown in figure 4.1.

1) Asset preservation – maintenance of the system

The NSI rating that is derived from annual condition evaluations is used in the Pavement Optimization Program (POP) to identify pavement restoration needs. The POP calculates the cost to maintain the State Highway System and to replace interstate pavements at the end of their service life. NDOR uses a bridge needs program that takes into consideration factors such as condition, deterioration rate, age, traffic, and cost/benefit to determine when to apply the proper treatments. The 20-year asset preservation needs for pavement (\$6.2 billion) and bridges (\$700 million) total \$6.9 billion.

2) System modernization – safety, geometric, or mobility improvements that do not add capacity to the roadway

The roadway system modernization needs are compiled by calculating the construction costs required to correct deficiencies. Modernization needs for bridges are determined by the necessity to widen bridges and remodel bridge rails to meet current standards. The 20-year system modernization needs for roadways (\$1.1 billion) and bridges (\$250 million) total \$1.6 billion, with the addition of rail and rural transit modernization.

3) Capital improvements – improvements that add capacity or support economic growth

Urban capacity needs (population>5,000) are determined by roadways with NSI ratings and average daily traffic (ADT) that require additional lanes. Urban bridge needs are extracted from the bridge needs program output and are included in this category. Costs for planning and research to investigate new strategies and to develop these projects are also included. Grade separation needs include all on-system, at-grade crossings that are expected to warrant a grade separation due to a projected exposure factor of 75,000 or greater within the next 20 years. The 20-year capital improvements needs for roadway expansion (\$2.4 billion) and grade separations (\$200 million) total \$2.6 billion.

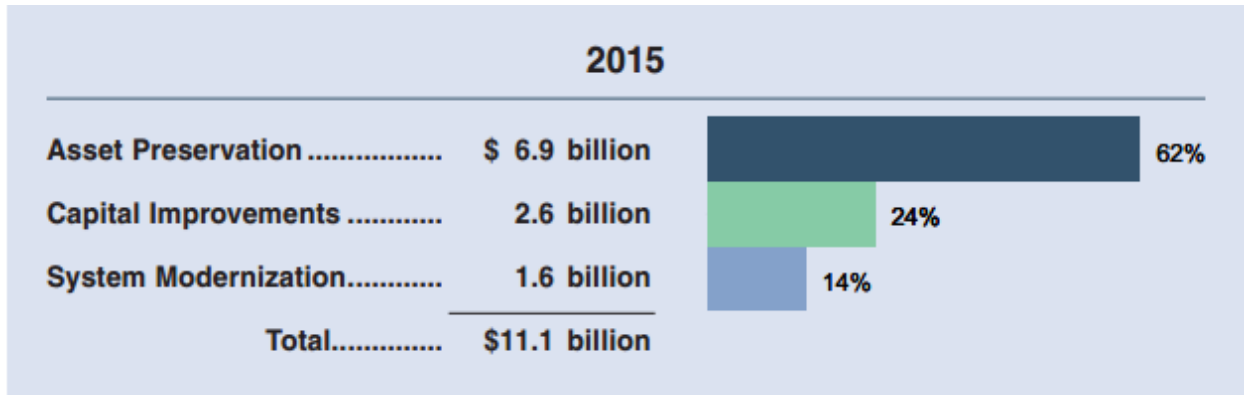


Figure 4.1 Summary of 20-Year Pavement and Bridge Needs

4.3 Build Nebraska Act

In 2011, Nebraska’s legislature passed the Build Nebraska Act (BNA) in response to current surface transportation needs and insufficient funding. This 20-year funding mechanism reassigned 1/4 of 1 cent of the existing general state sales tax receipts to state and local highways and roadways. NDOR will use 85% of the reassigned funds for expansion and reconstruction of the expressway system and federally designated High Priority Corridors, construction of new highways, and other high priority projects for the State Highway System. These funds, which first became available in the fall of 2013, are estimated to generate \$1.2 billion over the 20 year period. The BNA will direct the remaining 15% to counties and municipalities for road and street purposes.

The 20-year time frame of the BNA has been broken down into two 10 year periods for both projects and funding. The short-term plan, which consists of the first ten years, began in fiscal year 2014 – 2015, while the long-term plan will take effect in the fiscal year 2024 -2025. The projects and funding associated with the BNA are being completed in conjunction with NDOR’s existing short- and long-term plans. Short- and long-term planning horizons are an essential part of the implementation of the maintenance practices that keep Nebraska roads and bridges in a good state.

4.4 Short-Term Plan

NDOR's short-term planning horizons for asset management is 10 years. The short-term plan outlines how the current and upcoming construction projects in Nebraska's eight districts will be funded within a 10 year time frame. As part of this plan, NDOR has developed two categories of targets for asset condition: aspirational and constrained. NDOR's main priority in any planning development is to provide the safest and most efficient roadways for its users. Aspirational targets have been developed to reflect this priority. NDOR has also developed constrained targets that indicate the condition of pavement and bridge assets that NDOR plans to achieve given the constraints of available resources. The aspirational and constrained targets for the current condition of Nebraska's pavement and bridges are shown in tables 4.1 and 4.2, respectively.

Table 4.1 Short-term pavement condition targets

Asset	2014 Condition Inventory (% poor, NSI <50)	Aspirational Target (% poor)	Constrained Target/Short-term Anticipated Outcome (% poor)
Interstate NHS Highways	0.0	?	?
State NHS Highways	2.2	?	?
Local NHS Roadways	25.7	?	?
Non-NHS State Highways	2.8	?	?
Total State Highways	2.3	?	?
Total NHS Highway System	3.0	?	?

Table 4.2 Short-term bridge condition targets

Asset	2014 Condition Inventory (% poor)	Aspirational Target (% poor)	Constrained Target/Short-term Anticipated Outcome (% poor)
State NHS Bridges	1.8	?	?
Local NHS Bridges	3.6	?	?
Non-NHS State Bridges	6.5	?	?
Total State Bridges	3.6	?	?
Total NHS Bridges	2.0	?	?

Analysis of each table will follow if data is provided and NDOR decides to use aspirational and constrained targets.

4.5 Long-Term Plan

In addition to the short-term planning horizon, NDOR also determines and communicates investment priorities and asset management activities over a 20 year planning horizon. Developed in 2013, NDOR's Vision 2032 represents Nebraska's long-range guide for multi-modal transportation. Long-range transportation planning is a process that builds upon the past and studies the present to help prepare for the challenges of the future. Vision 2032 is an overarching policy guide that establishes the goals, objectives, and strategies to address the transportation challenges and opportunities facing Nebraska over the next 20 years. NDOR is committed to updating the Long Range Transportation Plan (LRTP) periodically to reflect current system needs and to provide a fresh approach to associated programs and policies.

The Goals of NDOR's Vision 2032:

1. *Safety* – Improve safety on Nebraska's transportation system
2. *Mobility* – Improve mobility on Nebraska's transportation system through the increased reliability, capacity, and efficiency.
3. *Environmental Stewardship* – Integrate environmental considerations into planning/design, construction, and operational activities of Nebraska's transportation system.
4. *Coordination and Cooperation* – Collaborate with stakeholders to maximize the value of Nebraska's transportation policies and investments.

NDOR has established performance measures and defined specific strategies that focus on meeting the goals and objectives of Vision 2032, the details of which can be found in Nebraska's Long-Range Transportation Plan (<http://www.transportation.nebraska.gov/lrtp/docs/LRTP-current.pdf>) [also cited in ch. 3, keep here also? #].

Improving mobility is the primary goal connected with asset management practices and maintaining Nebraska's transportation system in a state of good repair. Considering the widening gap between infrastructure costs and revenue, NDOR recognizes the need to invest in preserving the existing system. Sustaining quality infrastructure will require an increasing emphasis on maintaining current assets, establishing supportive maintenance cycles, and ensuring adequate capital to support all modes of transportation. This also means using new strategies, technologies, and products that yield long-term benefits and require less maintenance.

Possibly insert tables of long-term aspirational and constrained targets here, or move a general chart of the two targets without a date range from after the short-term plan section to here, followed by analysis of the table.

4.6 Performance Gap

NDOR analyzes and tracks the impact of recent capital investments, identifies capital needs, establishes statewide priorities for projected revenue, and identifies strategies to ensure that

resources are used efficiently and effectively. The current needs for the next 20 years are \$11.1 billion, in today's dollars. With inflation applied at 5 percent for FY-2017 and FY-2018, and 3 percent for the remaining 18 years, over the next 20 years the total cost of the 2015 needs are estimated at \$16.1 billion (see figure 4.2).

As the State Highway System needs continue to increase, so do vehicle miles traveled and the cost of preserving and maintaining Nebraska's transportation system. Asset needs will never be completely eliminated due to annual deterioration. NDOR continues to explore new technology and materials, which may lead to improved pavement performance and extend pavement life.

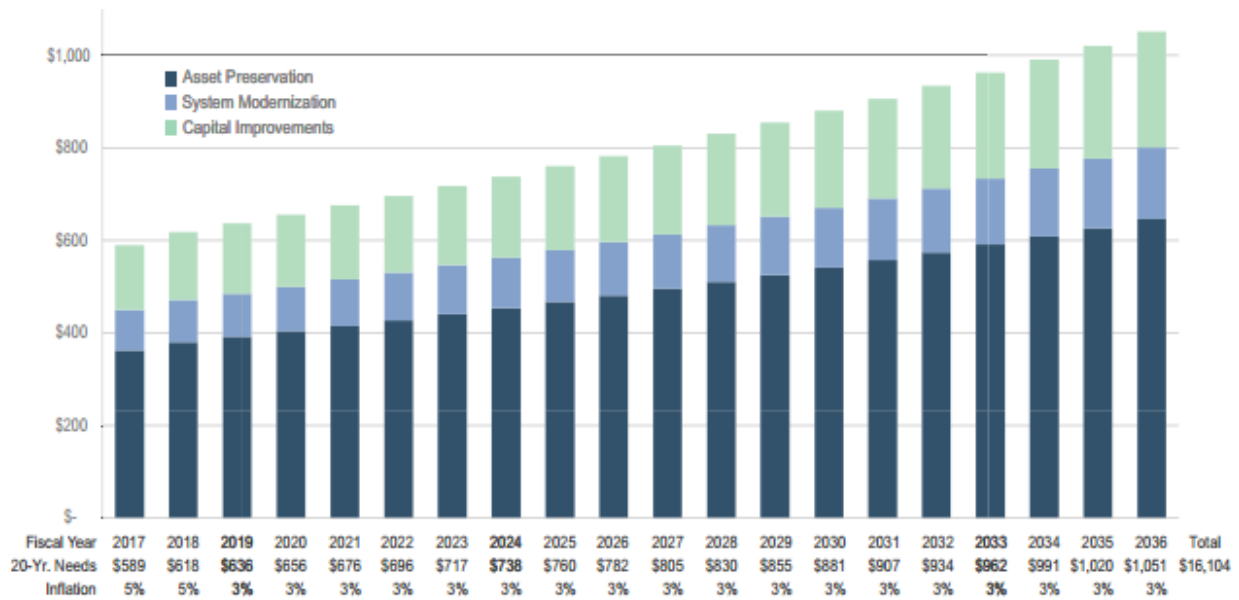


Figure 4.2 2015 State Highway System inflated needs in millions

Additional information will be included if the following can be provided:

1. Future condition levels for pavement and bridges (for a comparison with existing condition levels)? Are the future condition levels based on how the condition will be given financial constraints? Or, is it just the predicted state of deterioration in the future?

Chapter 5 Life-Cycle Cost Analysis

5.1 Overview

Nebraska's transportation network continually undergoes wear and tear from everyday use by the public, physical and chemical deterioration, and the damaging impact of natural elements, such as flash flooding and tornadoes. NDOR's asset management practices are in place to extend the level of service of Nebraska's valuable pavement and bridges for as long as possible while minimizing associated costs. These practices focus on all phases of an asset's life cycle, which is made up of design, construction, inspection, maintenance, repair, rehabilitation, replacement, and disposal. These phases are shown in figure 5.1.

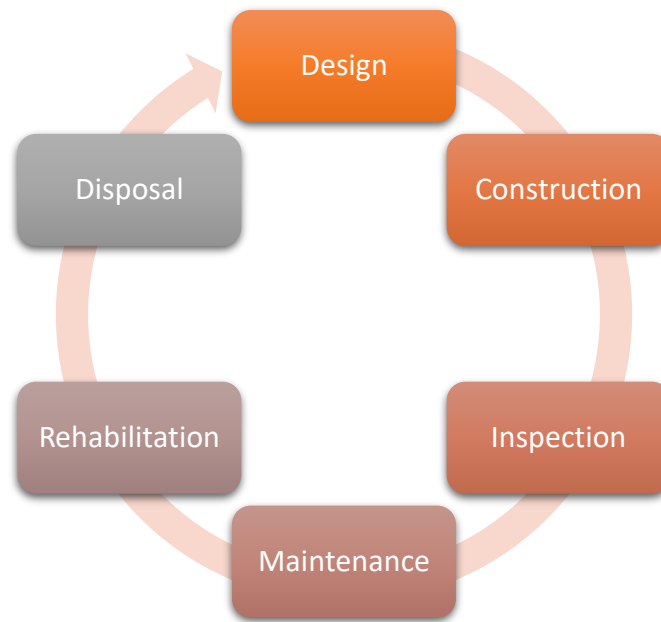


Figure 5.1 Pavement and bridge life cycle phases

5.2 Pavement Life Cycle

5.2.1 Pavement Design, Construction, and Inspection

A life cycle is the time from the construction of pavement until its disposal and potential replacement, including the years of constant maintenance in between. Exceptional design and construction of pavement is a key first step to ensuring a quality ride, a long service life, and a safe roadway for users. To that end, between \$450-500 million of federal and local matching funds is expended every year on construction projects.

In order to determine the funding provisions for each project, pavement is continually inspected for deterioration and distress levels are evaluated and recorded to determine necessary maintenance strategies, the process of which is described in chapter 3.

Roadway condition data and financial information must be carefully reviewed to decide which roadways are prime candidates for construction. NDOR is responsible for providing the interstate program report, the prioritization report of other rural highway segments, and the inventory report of the Nebraska highway system. This information is given to the district engineers and their highway commissioners to use for assisting in establishing future construction programs. These reports provide decision makers with supplemental, yet comprehensive information that assists them in their decision making process.

The Pavement Optimization Program (POP) also supplements the current decision making processes that exists at the project level by producing a list of candidates that have the best benefit/cost ratio for improvement with a limited budget. The POP program analyzes the projected deterioration of pavement sections for up to a 20 year period and selects the most efficient strategies based on the best benefit/cost ratios for each year for applied annual budgets. Another benefit of the POP program is that close adherence to this type of ranking or prioritization provides a greater economic benefit to the taxpayers. NDOR also uses the PaveCARE program to summarize distresses for ACC and PCC pavement and track the performance of rehabilitation strategies, including maintenance costs.

When ranking and selecting rehabilitation candidates, NDOR also takes into account the remaining service life (RSL) of a pavement. Nebraska's approach for deriving RSL is to project the time it will take in years for the pavement to deteriorate to a given threshold condition from its current condition state. This method is based on the assumptions that: (1) the current condition state reflects the true quality of the pavement, and (2) the deterioration of the pavement is generally consistent over time. Neither assumption is wholly true, but for pavement management accomplished to date, the method has provided a reasonable forecast of RSL.

5.2.2 Pavement Maintenance, Rehabilitation, and Disposal

Pavement deteriorates with age and use, typically at an ever-increasing rate: the accumulation of each subsequent distress makes it easier for new distresses to develop. Maintenance strategies help slow the rate of deterioration by identifying and addressing specific pavement deficiencies that contribute to overall deterioration. Maintenance methods can be categorized into three types:

1. Preventative maintenance: A planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, slows future deterioration, and maintains or improves the functional condition of the system (without increasing the structural capacity). Surface treatments that are less than two inches in thickness are not considered to add structural capacity.

Examples: crack sealing, dowel bar retrofitting, armor coating/chip sealing, fog sealing, broom or scrub seals, rut-filling (in some cases), and thin overlays.

2. Corrective maintenance: Performed after a deficiency occurs in the pavement, such as moderate to severe rutting, raveling, or extensive cracking. This may also be referred to as "reactive" maintenance.

Examples: structural overlays (3 inches or greater), milling, patching, and crack repair.

3. **Emergency maintenance:** Performed during an emergency situation, such as a blowup or severe pothole that needs repair immediately. This could also include temporary treatments that hold the surface together until a more permanent treatment can be performed.

Emergency maintenance differs in every situation, but is often related to safety and time, with cost not being a primary consideration. Likewise, materials that may not be acceptable for prevention or corrective maintenance may be the best choice for emergency situations.

Performing preventative maintenance activities on pavement in good condition is very effective in extending the life of the asset. The effectiveness of the treatment is directly related to the condition of the pavement. Additionally, preventative maintenance has been shown to be six to ten times more cost-effective than a “do nothing” strategy. Conservatively, \$1.00 spent for preventive maintenance will provide the same pavement condition that costs \$4.00-5.00 if rehabilitation is needed. In regard to pavement, rehabilitation is defined as the act of repairing portions of an existing pavement to reset the deterioration process. By extending the life of a pavement until it needs rehabilitation, preventative maintenance allows NDOR to even out the budget for both maintenance and construction.

The differences between preventive and corrective maintenance occur in the timing and cost. Corrective maintenance is reactive, meaning it is done after a road is in need of repair, so the cost is greater. Delays in corrective maintenance result in even larger costs since defects and their severity continue to increase. There are no clear boundaries between when a treatment is preventative versus corrective, or corrective versus emergency. The overlap between the three types of maintenance can be seen in figure 5.2.

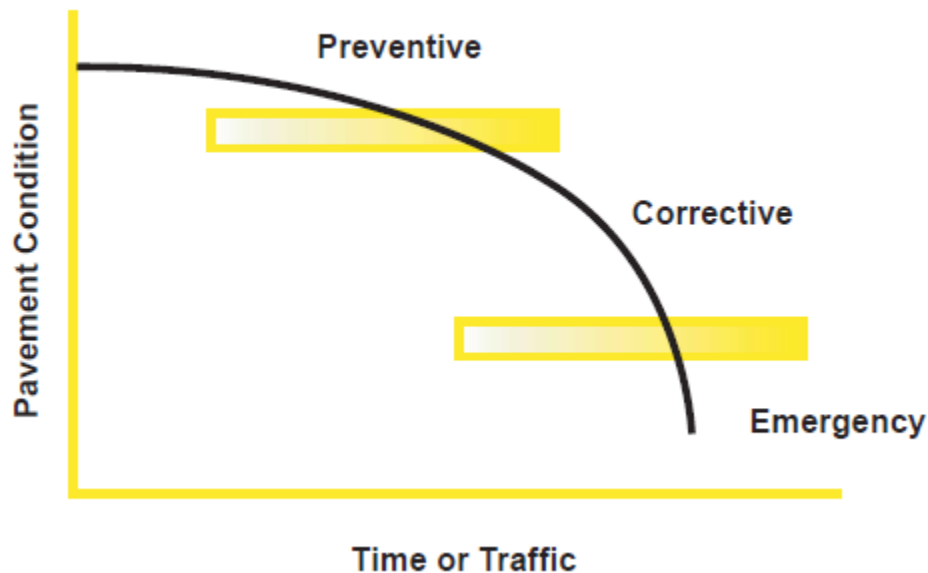


Figure 5.2 Pavement maintenance strategy overlap

Experience shows that pavements have a life ranging from 15 to 30 years, depending on the area of the state and how much traffic they carry. To keep pavement in good condition, NDOR

resurfaces 500 miles, or about five percent, of the system each year.

An important aspect of pavement repair is the concept of excessive maintenance costs. It is possible to extend the life of a severely distressed pavement by providing extensive heavy maintenance, or rehabilitation, but this strategy requires a higher financial investment. Table 5.1 helps illustrate the average cost distribution for each level of required maintenance that NDOR performs.

Table 5.1 Average 5-year maintenance costs and related condition

Pavement Description	Cost per Lane Mile
Good	Under \$250
Fair	\$250 to \$700
Poor	Over \$700

Note: The maintenance cost reflects work performed by NDOR for surface and shoulder work only, and does not include contract maintenance costs.

Recommended maintenance treatments for pavement can be found in NDOR's Pavement Maintenance Manual: <http://www.transportation.nebraska.gov/docs/pavement.pdf>. A brief breakdown of specific maintenance treatments, their associated costs, and the number of years these treatments extend the life time of the pavement is provided in tables 5.2-5.3 below.

Table 5.2 ACC pavement maintenance treatment cost and expected life

Treatment	Average Cost ¹ (mile)	Expected Life (years)
Crack seal / fill	\$0.55-\$0.60/lin.ft. ²	3-5
Fog seal	\$1,750-\$2,500	1-4
Scrub seal	\$7,000-\$8,000	2-5
Slurry seal ³	\$40,000-\$45,000	3-8
Chip seal / armor coat	\$8,000-\$9,000	3-6
Microsurfacing	\$41,000-\$43,000	3-8
Mill (1")	\$7,500-\$8,500	1-4
Cold-in-place recycle	\$100,000-\$115,000	8-12
Hot-in-place recycle	\$22,000-\$25,000	3-6
Thin cold mix overlay	\$18,000-\$25,000	3-5
Thin hot mix overlay	\$45,000-\$55,000	5-8
Pavement extension program (2" PEP)	\$80,000-\$120,000	7-9
Thick overlay (5")	\$195,000-\$215,000	8-15
Total reconstruction	\$525,000-\$550,000	20+

¹ Costs shown are for a 24' roadway unless otherwise noted.
² Varies depending on extent of cracking. Amounts to \$7,000-\$9,000/mi. assuming transverse crack spacing of 30' and two full-length longitudinal cracks.
³ Includes a 1/2" surface treatment over a leveling course. Cost for leveling course alone = \$9,000-\$12,000.

Table 5.3 PCC pavement maintenance treatment cost and expected life

Treatment	Average Cost ¹ (mile)	Expected Life (years)
Crack & joint seal / fill	\$1.00-\$1.75/lin.ft. ²	4-7
Partial / full depth slab / joint repair	\$95-\$110/sq.yd.	10-15
Thin hot mix overlay (1 1/2")	\$55,000-\$75,000	6-10
Mudjacking	\$80-\$120/sq.yd.	10-15
Diamond grinding	\$38,700-\$115,400 ³	12-15
Cross stitching	\$9-\$10/bar ⁴	10-15
Slab replacement	\$50-\$100/sq.yd. ⁵	20+
Thick hot mix overlay	\$195,000-\$215,000	8-12

¹ Since some of the treatments are often limited to one lane costs shown are per lane0mile unless otherwise noted.
² Varies but ranges from \$25,000-\$35,000 per two-lane mile with surfaced shoulders. Random, working cracks on high end of estimate.
³ Diamond grinding = \$38,700/lane-mile; diamond grinding + dowel bar retrofit = \$115,400/lane-mile. Both figures include all associated repairs and sealing.
⁴ Cross stitching bars placed at 2' intervals.
⁵ Smaller per unit cost for large quantities (\$700,000/two-lane mile).

Historically and currently, there are more candidates for major reconstruction or rehabilitation than can be included in the highway construction program. These projects may be excluded for various reasons, but the assets are kept in service with extensive major maintenance. NDOR's current pavement management policy is to keep a historical record of projects deteriorating to a condition that warrants their inclusion as candidates for major rehabilitation. If these projects are not included in NDOR's construction program, which follows a six-year time frame, they are carried forward to the next year of analysis. These projects then compete with those that have deteriorated to the extent to justify their inclusion in the program. The projects carried forward will be ranked again on the basis of their existing condition.

The current funds available to complete annual pavement maintenance projects on the NHS have been distributed between Nebraska's interstate highways, state highways, and local roadways. The breakdown of allowed costs can be seen in table 5.4.

Table 5.4 Current annual maintenance costs allowed for NHS pavement

Asset	2014 Inventory (centerline miles)	2014 Performance (% poor, NSI<50)	2014 Annual Maintenance Cost
Interstate NHS Highways	482.6	0.0	\$103,500
State NHS Highways	3,063.9	2.2	\$2,902,900
NHS Local Roadways	171.0	25.7	N/A

When the cost of maintenance becomes too high or pavement reaches a poor level of serviceability, it is generally considered to have reached the end of its design life. At this point, the pavement must be disposed of and replaced or reconstructed, resetting the deterioration process. As of 2014, the replacement cost for NHS pavement is \$2.56 billion for both ACC and PCC pavement, as shown in chapter 2.8.

5.3 Bridge Life Cycle

5.3.1 Bridge Design, Construction, and Inspection

The life cycle of a bridge begins with design and construction. All public road bridges are designed and constructed to meet the minimum standards of the Nebraska Board of Public Roads Classifications and Standards for the geometric and structural design of bridges (see Minimum Standards created pursuant to Neb. Rev. Stat. § 39-2113). These standards apply to the original construction of a bridge as well as any reconstruction, rehabilitation, or retrofit that occurs later in a bridge's lifespan.

Initial inspections are performed on new or reconstructed bridges prior to opening for traffic. Initial inspections provide a baseline for the condition of a structure. Routine inspections, which are subject to the National Bridge Inspection Standards (NBIS), are also performed annually to assess bridge condition (see chapter 3.4.1 for inspection details). NDOR's Bridge Inspection Program (BIP) performs a load rating test on each new or reconstructed bridge in accordance with the BIP manual and NBIS requirements. Under the NBIS, NDOR is responsible for the inspection of all highway bridges located on public roadways except for bridges that are federally or tribally owned. The public entity with jurisdiction for any bridge located on a public road in Nebraska provides copies of all bridge plans to NDOR, including hydraulic design reports, load rating reports, and inspection reports. If structural damage occurs at any point in a bridge's life cycle, due to environmental or human-related causes, a damage inspection is conducted.

Bridge damage has many different causes that make it necessary for NDOR to develop various corresponding mitigation strategies. For example, scour damage, such as that caused by flooding, requires careful inspection of bridges. Scour is the result of the erosive action of flowing water that excavates and transports material from the bed and banks of streams. Bridges and roadways that cross Nebraska floodplains are an encroachment on the natural floodplain. Therefore, to resist the effects of scour, bridge design includes consideration of hydraulic constraints, cost, risks, regulatory requirements, channel behavior, environmental impacts, engineering requirements, and social concerns. These considerations help ensure the safety of the traveling public and minimize the cost and adverse effects that result from bridge closures.

Scour assessments are performed by utilizing hydraulic, geotechnical, and structural data to determine the vulnerability of existing bridges to failure from flood events. General (contraction) scour and local (pier and abutment) scour can be estimated for a bridge, allowing the substructure to be designed to withstand the calculated effects. Bridges built before 1980 were not likely designed in accordance with current methods for calculating scour, nor do they have properly designed countermeasures. In such instances, many bridges may be susceptible to scour that causes damage or failure during flood events. Additionally, properly designed bridges may become unstable from erosion due to changes in channel behavior at the site (i.e. lateral migration and long-term degradation). Structures threatened by scour, lateral migration, and long-term degradation are identified and monitored by NDOR. A Plan of Action (POA) document is prepared by the bridge owner to establish specific instructions for managing and monitoring the structure that contains a critical level of scour.

The map in figure 5.3 shows the location and dispersion of bridges where accumulation of scour is at a critical level throughout the state as of February 2015. Scour is particularly prominent in southeast Nebraska, where the area soils are susceptible to erosion.

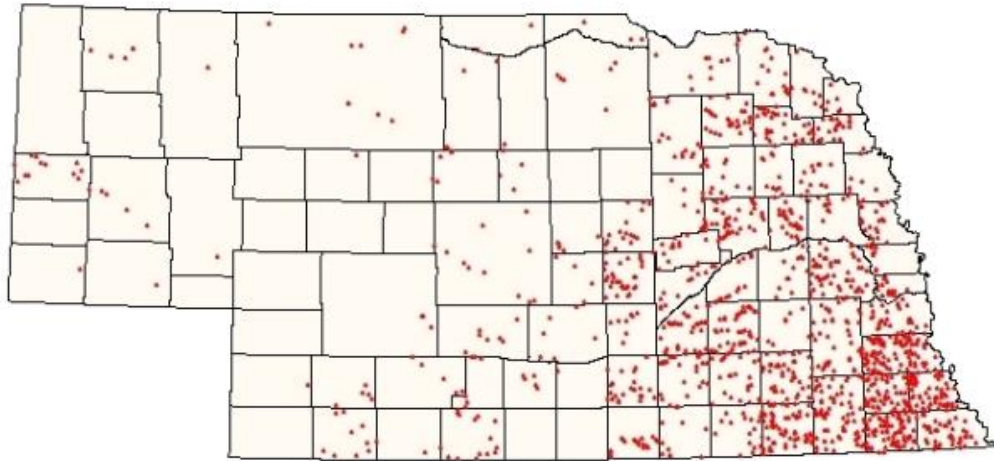


Figure 5.3 Map of Nebraska bridges with a critical level of scour

In addition to taking precautions to reduce the accumulation of damage on a bridge and repairing structures when damage does occur, efforts are made by NDOR to reduce the unintentional negative impacts that asset construction and maintenance can have on the environment. In 2010, NDOR and FHWA entered a Programmatic Agreement (PA) regarding the environmental impact of bridge inspection. This PA was developed to outline the policy and procedures for environmentally approved federally-funded actions that involve specific transportation improvement activities. NDOR has agreed to comply with the following conditions when conducting bridge inspections: (1) keep noise to a minimum to avoid disturbing nesting or roosting birds, (2) leave any nest containing eggs or young undisturbed, (3) do not remove any physical samples from a bridge nor collecting geotechnical samples, and (4) do not store or stockpile materials and equipment in known or potential wetlands and streams that exhibit a clear “bed and bank” channel.

5.3.2 Bridge Maintenance, Rehabilitation, and Disposal

Like pavement, bridge quality decreases over time due to general wear and tear as well as damage inflicted by the environment or users. Preventative and corrective maintenance practices are necessary to reduce the number of extensive repairs and associated costs required to keep Nebraska’s bridges operating at a quality level of service.

Bridge maintenance, as defined by the Nebraska State Statute, means the act, operation, continuous process of repair, reconstruction, or preservation of the whole or any part of any highway, including surface, shoulders, roadsides, traffic control devices, structures, waterways, and drainage facilities, for the purpose of keeping it at, near, or improving upon its original standard of usefulness and safety (Neb. Rev. Stat. § 39-101(6)) [Bridge Inspection Manual].

NDOR performs maintenance to preserve the good condition of the bridge via general upkeep and the removal of hazards. This includes:

- Cleaning roadway expansion devices

- Sweeping decks
- Clearing plugged floor drains
- Removing debris from superstructure and bearings
- Removing debris rafts from bents, piers, and abutments
- Clearing trees from a channel
- Filling in erosion (on side slopes or banks, under approach slabs, and at culvert ends)
- Removing silt from culvert waterway openings
- Sealing cracks

When damage occurs beyond the scope of regular maintenance, bridge repair is completed. In general, repair work attempts to bring a bridge back to its prior condition, and in emergency cases, complete this work within an accelerated time frame. Examples include:

- Driving a new pile next to an existing one that has deteriorated
- Replacing wingwall or backwall within its prior dimensions
- Replacing cracked timber stringers
- Patching a bridge deck
- Girder end repairs
- Any repair or alteration of a damaged element (e.g., girder stuck by over-height vehicle)

A third method of ensuring the quality and performance of bridges both on and off the NHS is reconstruction and rehabilitation, which are defined by the BIP manual as any work that changes the bridge roadway width, the load carrying capacity (increase or decrease), structural or geometric changes, or anything requiring a professional engineer to complete a design, seal, and sign plans and specifications. Reconstruction is completed when a bridge incurs damage that compromises its serviceability or faces increased growth and demand that leads to structural changes. Examples of reconstruction/rehabilitation include:

- Replacing the substructure
- Replacing the existing stringers with different size or type
- Replacing the superstructure
- Replacing the deck
- Bridge widening
- Deck alteration that effectively increases dead load (i.e., replacement of a timber deck with a concrete deck)
- Addition of new spans
- Converting pin and hangers to continuous design
- Converting simple spans to continuous design (e.g., conversion of simple prestressed girders with continuous re-deck)
- Substructure modification that includes new pile spacing or configuration, or cap alterations (e.g., repairs, jackets, concrete encasement, additional bent)
- Modification/alteration to fracture critical details (e.g., pins, link plates, redundant catch systems)
- Modification/alteration or addition of fatigue prone details (e.g., cover plate, pins, link plates)

Accounts of maintenance, repair, and reconstruction activities, along with construction and maintenance costs, are kept on record by each county. This includes reports containing information on inspections, preventative and corrective measures, and any subsequent follow-

ups. Maintaining up-to-date records on bridge assets helps NDOR engineers to make informed decisions about future maintenance and repair.

Table 5.5 Current annual maintenance costs allowed for NHS bridges

Asset	2014 Inventory (number of bridges)	Total Area (SF)	2014 Performance (% poor)	2014 Annual Maintenance Cost
State NHS Bridges	1,464	15,572,409	1.8	?
Local NHS Bridges	69	1,220,724	3.6	?

Similar to pavement, when bridge maintenance exceeds the asset’s value or the bridge is damaged beyond repair, it is disposed of and replaced. As of 2014, the replacement cost for Nebraska’s bridges on the NHS is \$2.41 billion, as shown in chapter 2.8.

5.4 Performance Summary

Can further information be provided on?:

Lifecycle Cost Analysis:

1. Time period of life-cycle cost analysis for pavement and bridges?
2. Annualized life-cycle costs for NHS pavement, NHS bridges, non-NHS pavement, and non-NHS bridges (per lane-mile and per bridge, if possible). This cost shows how much it costs per year to maintain an asset when construction, inspection, maintenance, and disposal costs are totaled and divided by the LCCA period (number of years of the assets’ life cycle).
3. Life-cycle cost for NHS pavement, NHS bridges, non-NHS pavement, and non-NHS bridges (total cost to build, inspect, maintain, and dispose of an asset over the analysis period when the costs incurred in the future years are converted to current dollars).

Chapter 6 Future Growth and Demand

6.1 Overview

NDOR employs effective asset management practices that consider how future user demand will burden the current system. Population growth, changes in traffic volume, and advancements in technology will have substantial impacts on the future condition of Nebraska's assets. As our state grows, our infrastructure must grow with it. It is important for Nebraska to be flexible and respond to the state's transportation needs now and in the future.

6.2 Future Growth

6.2.1 Population Growth

From 1990 to 2005, 38 of Nebraska's counties experienced 0 to 20 percent population growth, while four counties had population growth that exceeded 20 percent. Over the next 20 years, Nebraska's population will continue to increase. Most of the projected population growth is expected to occur in counties along I-80 and to the east, with much of the growth in the state's urbanized areas (see figure 6.1). In total, NDOR predicts that Nebraska's total population will exceed 2 million by 2030.

Population growth, in turn, will increase the demand for jobs, homes, goods, and services. These demands will require additional planning, construction, and maintenance to ensure accessibility to living and working opportunities as well as reductions in freight traffic volumes. Commuters in urban areas, and millennials in particular, are increasingly using alternative modes of travel, such as walking, biking, and transit services. The continued expansion of multiuse trails to serve pedestrians and bicyclists also encourage an increase in alternative modes of transportation for both work and non-work trips. It is projected through 2025 that transit usage will grow annually by 1 percent in Lincoln and 2 percent in Omaha.

Additional transit services may need to be provided as Nebraska's elderly population ages. By 2030, it is projected that an average of 8.4 percent of the total Nebraska population will be 75 and over. The usage and demand for paratransit services is likely grow with the aging population in Nebraska, particularly in rural counties.

Ultimately, an increase in population means more users on the roadways, more wear and tear on the existing infrastructure, and the construction of new roadways and bridges. The need for expanding transportation system capacity will continue to be in eastern Nebraska, in urbanized areas, and along the I-80 corridor, while the need for infrastructure renewal, system preservation, mobility, accessibility and maintenance will continue to be spread throughout the state.

Forecast of Nebraska Population Change 2005 to 2030

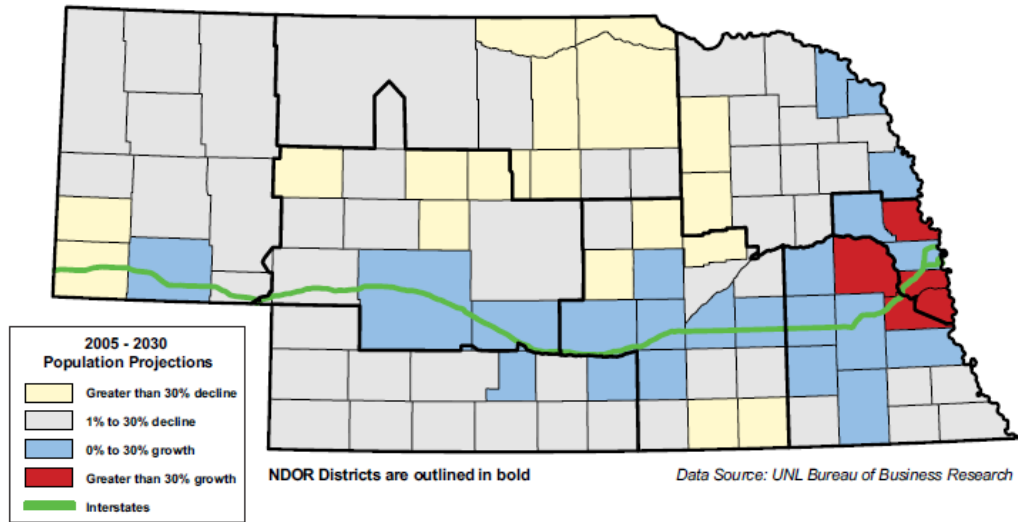


Figure 6.1 Forecast of Nebraska population change 2005-2030

6.2.2 Freight Growth

The economic well-being of Nebraska, as well as the United States depends on efficient freight movement. Estimates from the Federal Highway Administration’s Freight Analysis Framework (a federal program that integrates data from a variety of sources to estimate freight flows) show that truck-based freight will increase from 222.37 million tons in 2007 to 373 million tons in 2040, representing a 67.7 percent increase. NDOR will take into account the increasing freight traffic on Nebraska’s highways and the resulting wear on highway infrastructure.

6.2.3 Vehicle Miles of Travel (VMT)

The Nebraska highway and roadway network serves as the primary mode of transportation for both personal and freight travel within the state. The projected annual VMT growth provides an indicator of future demands on the state’s transportation system. The total VMT is forecasted to grow on the interstate and remaining state roads by 54 percent through 2028. The projected annual VMT growth is approximately 2.2 percent, in comparison to the projected population growth of just below 1.0 percent per year.

6.3 Investment Needs

An essential component of NDOR’s demand management strategies is the ability to estimate the current and future transportation needs across the state. NDOR has a well-established process for defining Nebraska’s 20-year state highway needs, with consistent data and an annual State Highway Needs Assessment. However, there is no consistent data or criteria for projecting non-state highway needs in metropolitan areas, cities, counties, or rural areas.

Chapter 4 reports the projected 20-year pavement and bridge needs to be \$11.1 billion (\$16.1 billion adjusted with inflation) for the categories of asset preservation, capital improvements, and system modernization. Due to declining revenues and increasing inflation, NDOR reviewed the process for allocating funds for highway improvements in 2008. The subsequent Funding Distribution Team's Final Report provides recommendations to improve the roadway system regardless of the gap between funding levels and asset needs (<http://www.roads.nebraska.gov/media/2813/funding-distribution-team-2008.pdf>) [9]. Top priority is given to preserving the existing highway and bridge assets. Second priority is to allocate funds for capital improvements.

6.4 Demand Management

In order to manage future demand, NDOR has developed objectives and strategies that will enhance Nebraska's multimodal capabilities, keep the transportation system in a state of good repair, and minimize delay. Demand strategies include capacity-adding improvements to positively impact mobility, safety, the economy, and communities. NDOR focuses on providing valuable leadership in order to enhance existing collaborations, develop new partnerships, and close the widening gap between infrastructure costs and revenues.

NDOR's Demand Management Objectives:

1. Maintain the system in a state of good repair
2. Manage the use of existing infrastructure by expanding mobility options through policies, programs, and technology
3. Develop a proactive coordination plan between stakeholders to ensure effective management and operation of Nebraska's transportation system

NDOR's Demand Management Strategies:

1. Strategically replace and rehabilitate transportation assets
2. Continue the current highway improvement program and ensure it is collaborative and transparent
3. Continue partnerships/programs (e.g. grant programs) to assist local transit carriers in optimizing their transit operations
4. Identify stakeholders to optimize information sharing, communication, and coordination networks in support of effective and integrated transportation policies
5. Integrate state freight planning efforts into all local planning agencies and private stakeholder activities
6. Identify public and private resources for successful implementation of transportation projects, with special attention to opportunities presented by inter-disciplinary or multi-modal funding sources

7. Involve local governments, groups with direct transportation interests, and citizens of Nebraska in updating and using the Long Range Transportation Plan

These objectives and strategies are written so that they can be easily implemented and monitored in the future.

Chapter 7 Risk Management Analysis

NDOR's Outline for the Chapter:

- a. Define key programmatic risks associated with implementation of the TAMP (e.g., cost escalations, budget cuts, and environmental delays)
- b. Define system risks that could adversely affect the NHS (e.g., asset failure and external events such as floods, earthquakes, and hurricanes)
- c. Provide a map showing the NHS assets most at risk
- d. Include a risk register that provides the following for each programmatic risk – likelihood of occurrence, consequences of occurrence, and mitigation activities
- e. Resiliency

7.1 Overview

The Federal Highway Administration defines risk as the positive or negative effects of uncertainty or variability upon agency objectives [12]. Natural disasters, economic disruptions, and other unexpected events can reduce a transportation system's level of service as well as the agency's ability to achieve its goals. NDOR's approach to risk-based asset management involves identifying and understanding the potential threats to Nebraska's transportation system in order to successfully plan for system and program disruptions, develop mitigation strategies, and improve infrastructure resiliency.

7.2 System Risks

NDOR has identified several system risks that could adversely affect infrastructure on the National Highway system. The potential negative impacts of each risk is described below.

Premature deterioration – can reduce an asset's level of service and result in higher maintenance costs.

Asset failure – severe stress or damage to an asset that leads to the necessity of replacement.

Natural events – natural disasters (e.g., flooding and tornadoes) can lead to delays in construction and maintenance and cause severe damage or destruction to a structure and the overall condition of an asset.

Hazardous materials – spills from the transport of hazardous materials can severely damage or destroy an asset.

7.3 Programmatic Risks

NDOR has identified several programmatic risks that have the potential to impact the implementation of the TAMP.

Cost escalations – rising prices of maintenance and construction materials and

services can lead to project delays and additional costs.

Economic Inflation – rising levels of inflation can lead to the completion of fewer projects for the fiscal year.

Reduced funding – decreasing and unstable funding levels reduce NDOR's ability to maintain assets at a high level of service and complete new projects.

Environmental delays – weather conditions unsuitable for performing construction, maintenance, or rehabilitation lead to delays and additional costs.

The following risk register contains the likelihood of each risk occurring, potential consequences of adverse impacts, and mitigation strategies (see table 7.1)

Table 7.1 Programmatic risk register

Risk	Likelihood of Occurrence	Consequence(s) of Occurrence	Mitigation Strategies
Cost Escalations			
Economic Inflation			
Reduced Funding			
Environmental Delays			
Others?			

7.4 Resiliency

System resiliency and program preparedness are essential to a risk management plan. A resilient agency is able to anticipate, prepare for, and adapt to changing conditions and recover quickly from disruptions. The resiliency of the state's infrastructure depends on the proper use and management of an asset throughout its service life. In order to attain a high level of resiliency for pavement and bridges, NDOR performs high-quality construction, maintenance, and rehabilitation efforts.

System resiliency also requires the mitigation of everyday disruptions. Severe weather, traffic accidents, construction, and road closures are routine events that can increase travel time and reduce the safety of drivers. Moving people and freight across Nebraska's transportation system safely and efficiently is a state priority. If safe and uncongested alternative routes are not available when routine inconveniences occur, a deficiency in resiliency is indicated.

NDOR employs several strategies to improve the operating efficiency of the state's transportation system and to reduce the duration of incident response and clearance times. NDOR has increased the use of Intelligent Transportation Systems (ITS) to improve the functionality of roadways, develops incident management plans with law enforcement and emergency responders, and strives to integrate state freight planning efforts into all local planning agencies and private stakeholder activities.

Additional information is needed for the following considerations in order to be included in this chapter.

1. Definitions for program and system risks could use clarification. Are there others that should be added to the list?
2. Do pavements and bridges face a different set of risks? If the risks they face do not differ in type, do they differ in risk rating or the level of threat a risk holds for each asset?
3. Describe the process NDOR used to develop the risk register and/or their risk-assessment plan.
4. Plans/details on updating the initial risk register?
5. Which category of risks (system or programmatic) is a greater threat to NE's transportation system?
6. Location of NHS assets at greatest risk? (to be shown in a map)
7. How will asset management funding be affected by the occurrence of certain risks?

Chapter 8 Financial Plan and Investment Strategies

8.1 Overview

NDOR's investment priorities consider federal requirements and state laws, revenue trends, level-of-service provided by the transportation system, and input from the public and stakeholders. Priority will be given to preserving the condition of existing infrastructure with an additional focus on improving the safety and efficient travel of multi-modal users.

In the face of declining revenues and high inflation, it is important for NDOR to develop investment strategies that will minimize life-cycle costs. The practice of timely investments in preventative maintenance treatments and capital improvements will help increase the service life of pavement and bridges while reducing costs.

NDOR is highly committed to maintaining fiscal responsibility, which involves remaining within budget, using financial resources wisely, and making financial decisions in an open and transparent way. NDOR has established two measures for the greatest benefit of the state transportation system: (1) minimize overhead costs to maximize funding for transportation purposes, and (2) accurately estimate project costs in order to maximize program delivery.

To remain ready for future growth and maintain the economic competitiveness of Nebraska, NDOR will continue to make sound investments in transportation services and infrastructure as well as update and improve investment strategies.

8.2 Funding Sources

Nebraska's transportation program is financed by two major funding sources – state and federal funds. Federal funds are derived from user revenues paid into the Federal Highway Trust Fund:

1. 90 percent from federal motor fuel taxes, and
2. 10 percent from heavy vehicle sales and use fees and heavy tire taxes.

Federal-aid highway funding made available to Nebraska is shared between the state, cities, and counties. The Department of Roads purchases the federal funding authority for cities, counties, and bridges from locals with 80 cents for each dollar.

State funds come from three primary user revenue sources:

1. 60 percent from motor fuel taxes,
2. 30 percent from sales tax on new and used motor vehicles, trailers, and semi-trailers, and
3. 10 percent from motor vehicle registrations and related fees.

NDOR receives 60 percent of state funds. The remaining 40 percent is divided among Nebraska's cities and counties.

Revenues are initially deposited in the federal and state highway trust funds and distributed to the state through formulas established by law, both at the state and federal level. The revenues received by NDOR are comprised of 56 percent state funds, 40 percent federal funds, and 4 percent local funds.

Additional funding for the state has been provided by the Build Nebraska Act. This 20-year funding mechanism (from July 1, 2013 through June 30, 2033), passed into law in 2011, designates 1/4 of 1 percent of general fund sales tax revenue for Nebraska roadways. This revenue is distributed 85% into the State Highway Capital Improvement Fund and 15% into the Highway Allocation Fund for the cities and counties. The State Highway Capital Improvement Fund is administered by NDOR. At least 25% is to be used for the construction of the state expressway system and federally designated high priority corridors, with the remaining funds for surface transportation projects of highest priority as determined by NDOR.

Legislative Bill 657, which was signed into law on May 20, 2015, increased state funding by an additional \$10 million. Legislative Bill 610A, passed on May 14, 2015, increased the motor fuel tax by 1 1/2 cents, and is estimated to generate an additional \$2.5 million in revenue for the state highway system and an additional \$4 million for the local roadway system.

NDOR's funding sources and revenue allocation are shown below in figure 8.1.

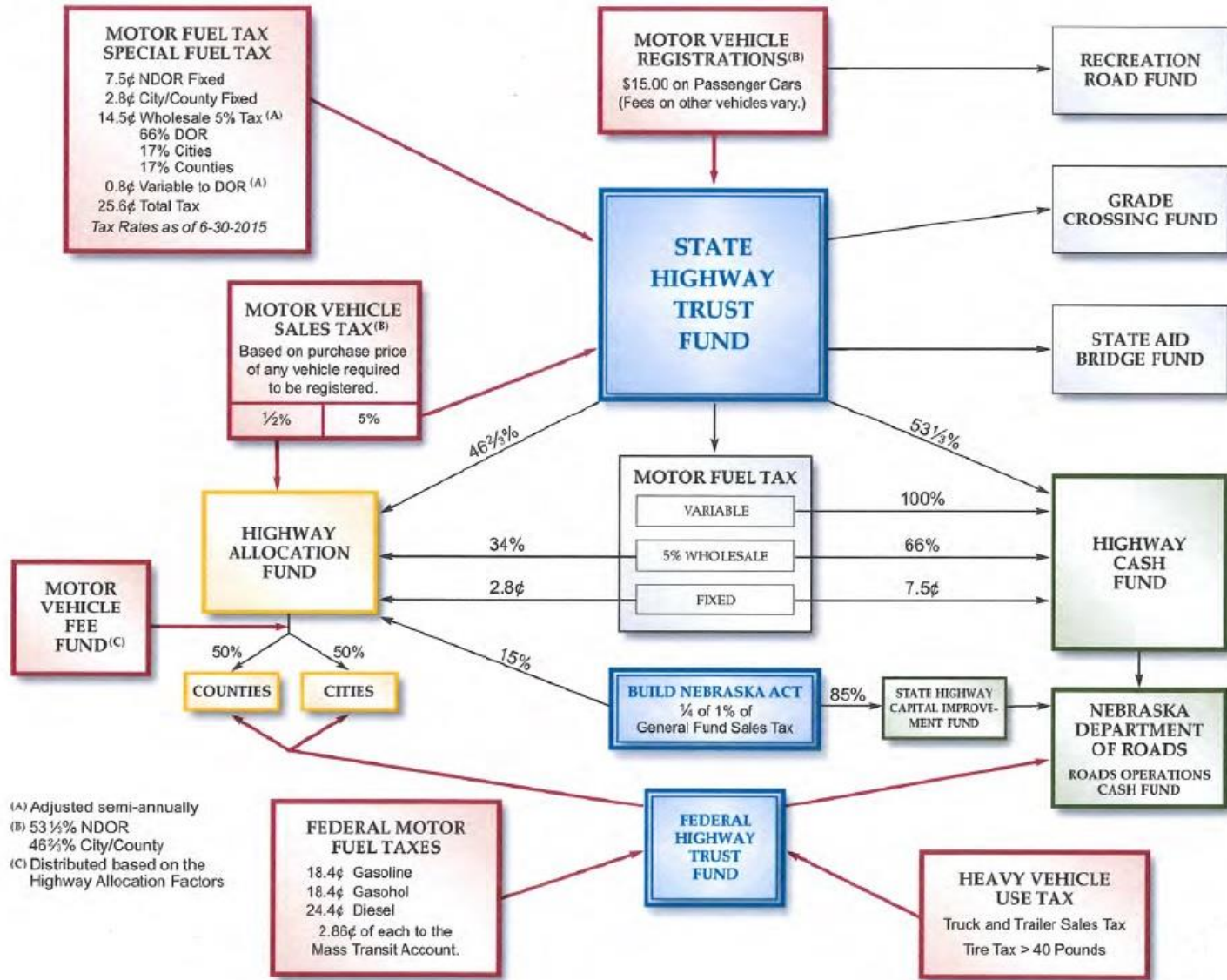


Figure 8.1 Overview of NDOR's revenue and spending

8.3 Financial Management

NDOR gives top priority to preserving the state's existing highway and bridge assets. After all asset preservation needs have been met, funds are allocated for capital improvements. The process of ranking statewide capital improvements follows a two-tier system, which considers (1) the engineering economics of the project, and (2) factors relating to the importance of the proposed improvements to the entire state. Capital improvement projects generally involve a correction of vertical or horizontal alignment, removal and replacement of the surfacing and base, increase in capacity, or construction on a new alignment.

Following the creation of the annual needs analysis in 1988, NDOR established a policy to ensure that state highway construction funding was distributed based on "needs." Each year, NDOR completes an assessment of the highway system comparing roadways and bridges with established criteria. This evaluation is based upon conformance with design standards and output from the Bridge Management System (BMS) and the Pavement Management System (PMS). These assessments establish the dollar value of the needs in each district and for the state as a whole. Each of the eight districts receives a construction budget based upon the percentage of the needs in their district as compared to the total statewide primary highway needs.

8.4 Financial Reporting Requirements

NDOR annually reports a financial statement in compliance with Governmental Accounting Standards Board (GASB) Statement Number 34: Basic Financial Statements – and Management Discussion and Analysis – for State and Local Governments. Statement No. 34 was issued in 1999 to establish financial reporting standards for U.S. state and local governments. The three most significant additions to the governmental financial report are the management's discussion and analysis (MD&A) section, government-wide financial statements, and major fund reporting.

1. The MD&A is intended to make the financial report easier to understand and more meaningful for a broader audience. The management's analysis explains the changes in finances from prior to current fiscal years and identifies key issues that have or will affect the overall financial health of the government.
2. Government-wide financial statements include statements of net assets and activities that detail a government's financial bottom line.
3. Major fund reporting requires the largest or most significant fund to be reported individually in a separate column and the non-major funds to be grouped together in a single column. This requirement is intended to improve transparency compared to the former method used to aggregate and report funds according to type.

8.5 Asset Management Fund Allocation

The funds available for asset management in FY-2017, beginning July 1, 2016, are estimated to be approximately \$500 million. On average, 77 percent of highway user revenues is spent on surface transportation construction to preserve, maintain, and improve the existing \$7.5 billion

infrastructure. Approximately 17 percent is spent on routine maintenance of the highways for snow removal, mowing, ditch cleaning, litter pickup, sign and signal repairs, striping, guardrail repair, pothole patching, and other such activities. About 5 percent is spent on supportive services that include supplies, equipment, buildings, and administrative expenses. Nearly 1 percent is used for public transit and rail functions administered by NDOR.

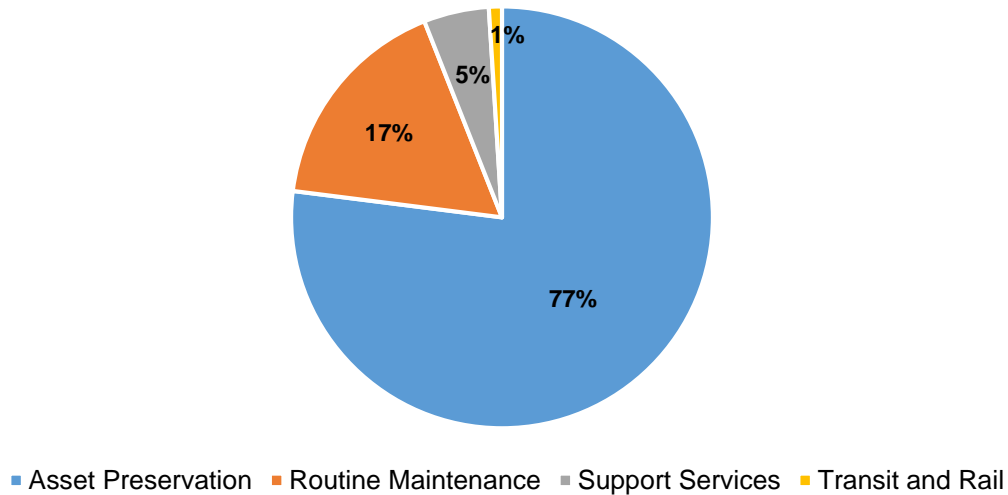


Figure 8.2 NDOR fund allocation

The state highway system inflated needs is estimated at \$589 million in FY-2017. Given that funds are projected to fall short, NDOR will prioritize construction and preservation projects based on the aforementioned process.

8.6 Current Value of the Assets

Nebraska’s pavement and bridges require a substantial investment to guarantee the state’s economic viability and the safety and efficient mobility of asset users. Therefore, it is necessary to preserve the value of these assets and extend their service lives by balancing monetary investment with asset condition and maintenance. The current replacement value for each of NDOR’s assets as of 2014 are shown in table 8.1.

Table 8.1 Summary of current replacement value of assets

Asset	Current Replacement Value
Pavement (Bituminous and PCC)	\$2.56 billion
Bridge	\$2.41 billion

8.7 Strategies to Determine Ranking and Investment

Each project begins with a Project Initiation Form (DR-73), which describes the location, proposed scope of work, current condition of the roadway, and other important information about the proposed project that allows the reviewing authorities to accomplish their tasks. The completed DR-73 is first classified as an asset preservation or a capital improvement project. If a project is classified as an asset preservation project, the DR-73 is forwarded to the appropriate divisions for their input as to scope, work to be performed, and estimated cost. The project will be scheduled to coincide with the pavement or bridge needs.

Depending upon purpose and need, capital improvement projects generally require a more complete analysis as to the appropriate scope required to meet the needs of the roadway. A review is conducted to evaluate the needs of the roadway segment, the appropriate treatment, environmental impacts, specific project issues, and estimated costs, and the project is ranked as either Tier I or Tier II. Once a capital improvement project has been ranked relative to the other capital improvement projects, scheduling will be based upon its ranking, project delivery timeline, and other pertinent factors.

The following information was requested in NDOR's original outline. Additional information is needed from NDOR to include the following:

1. Where asset management funds are coming from if more specificity is desired other than what is already stated in this chapter.
2. How funds for asset management will be allocated in the short and long term.
3. Describe the implications of various funding levels in terms of asset valuation and financial sustainability.
4. Key work strategies resulting from the above analyses, including typical unit costs and typical timing.

Chapter 9 Asset Management Process Improvements

The TAMP will be reviewed and updated routinely or as needed to ensure that it remains effective and useful as Nebraska's transportation system grows and changes. Updates to the TAMP will focus on strengthening long-term investment and risk mitigation strategies as well as evaluating the progress toward condition and performance targets for the National Highway System and additional roadways. Following implementation of the TAMP, NDOR will:

1. establish a routine schedule for updating the TAMP,
2. communicate the content of the TAMP to partner agencies,
3. gather sufficient data on additional assets to incorporate into future versions, and
4. update asset inventory and condition information to reflect the present state of the transportation system.

Many of NDOR's asset management objectives and policies were already established prior to the development of the TAMP. Therefore, the success of the additions proposed in this document will largely be dependent on their incorporation within NDOR's existing business practices.

Additional information needed:

1. What are NDOR's priorities for asset management improvement, including risk factors and anticipated problems?

Appendix A References

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Appendix B Glossary

Asphalt Cement Concrete (ACC): ACC pavement (also referred to as bituminous pavement) is a flexible pavement that is composed of mineral aggregate that is bound together with asphalt, poured in layers, and then compacted.

asset: the physical transportation infrastructure (e.g., pavement and bridges) or resources that adds value to an agency (e.g., equipment and materials, human resources, etc.).

asset management: a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their life cycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well defined objective.

asset preservation: maintenance of the transportation system.

bituminous pavement: a pavement comprising an upper layer or layers of aggregate mixed with a bituminous binder, such as asphalt, coal tars, and natural tars for purposes of this terminology; surface treatments such as chip seals, slurry seals, sand seals, and cape seals are also included.

bridge: a structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

capital improvement: an improvement that adds capacity or supports economic growth

corrective maintenance: maintenance performed after a deficiency occurs in the pavement, such as moderate to severe rutting, raveling, or extensive cracking.

crack: fissure or discontinuity of the pavement surface not necessarily extending through the entire thickness of the pavement. Cracks generally develop after initial construction of the pavement and may be caused by thermal effects, excess loadings, or excess deflections.

culvert: a structure designed hydraulically to take advantage of submergence to increase hydraulic capacity. Culverts, as distinguished from bridges, are usually covered with embankment and are composed of structural material around the entire perimeter, although some are supported on spread footings with the streambed serving as the bottom of the culvert. Culverts may qualify to be considered "bridge" length.

distress: a condition of pavement structure that reduces serviceability or leads to a reduction in serviceability.

emergency maintenance: maintenance performed during an emergency situation, such as a blowup or severe pothole that need repair.

faulting: difference in elevation across a joint or crack. Faulting commonly occurs at transverse joints of PCC pavements that do not have adequate load transfer.

International Roughness Index (IRI): a scale for determining the roughness quality of a pavement surface.

joint: a pavement discontinuity made necessary by design or by interruption of a paving operation.

level of service (LOS): a qualitative measure that refers to the quality of traffic management, which is related to transportation system users' perception of asset condition or agency services.

life-cycle: the length of time that encompasses all stages of an asset: construction, operation, maintenance, rehabilitation, reconstruction, or disposal.

life-cycle cost: is the sum of all recurring and non-recurring costs over an asset's lifespan. Life-cycle cost analysis helps determine cost-effective asset management activities and investments.

Nebraska Serviceability Index (NSI): a value on a scale of 0 to 100 with 0 the worst and 100 the best condition. It represents the condition of the pavement at the time of measurement. This value is used for development of remaining life values.

National Bridge Inspection Standards (NBIS): federal regulations establishing requirements for inspection procedures, frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of a State bridge inventory. The NBIS apply to all structures defined as bridges located on all public roads.

performance gap: the difference between existing and desired performance.

performance measure: an indicator (usually qualitative) of the quality and serviceability of a transportation system or a specific asset to its users.

Portland Cement Concrete Pavement (PCC): the rigid concrete layer of a pavement structure that is in direct contact with traffic.

Present Serviceability Index (PSI): this is a numerical value indicating the ride quality of the pavements. PSI is a function of roughness IRI, cracking, and rutting. It is on a scale of 0 to 5 with 0 being the worst condition and 5 the best.

preservation: the application of treatments at the proper time to prevent or correct the deterioration of an asset in order to extend its service life.

preventative maintenance: a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, slows future deterioration, and maintains or improves the functional condition of the system without increasing the structural capacity.

rehabilitation: the use of several treatments to correct physical or functional defects that reduce the serviceability of an asset. Rehabilitation activities are generally more extensive than repair and may involve replacing the defective parts of an asset but not the entire structure.

repair: a treatment, to a less extensive degree than rehabilitation activities, that is applied to an asset to correct a physical or functional defect that reduces an asset's Level of Service.

replacement: the disposal of an existing asset and substitution of a new asset in the same location to serve the same functional requirements or additional requirements.

risk: the positive or negative effects of uncertainty or variability upon agency objectives.

routine maintenance: non-urgent maintenance activities that are performed on a scheduled basis.

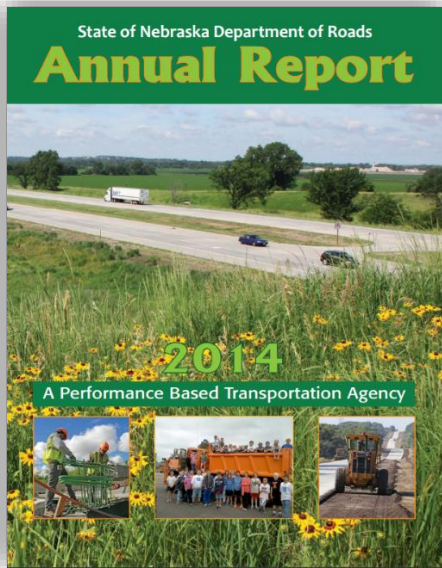
rutting: Longitudinal surface depressions in the wheel path of an HMA pavement, caused by plastic movement of the HMA mix, inadequate compaction, or abrasion from studded tires. It may have associated transverse displacement. Rutting is measured only on bituminous pavements.

serviceability: the ability of a pavement to provide a safe and comfortable ride to its users.

system modernization: safety, geometric, or mobility improvements that do not add capacity to the roadway.

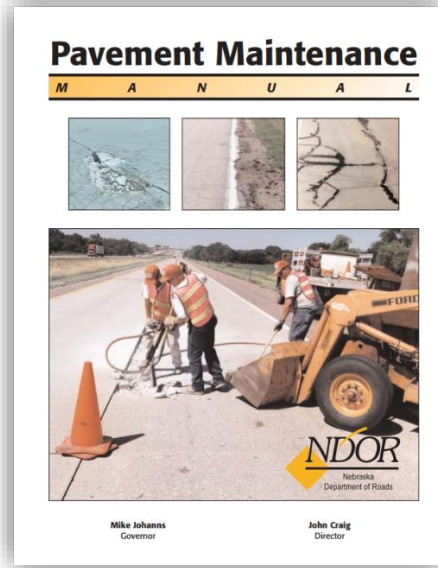
Appendix C NDOR Reports and Manuals

Annual Report 2014



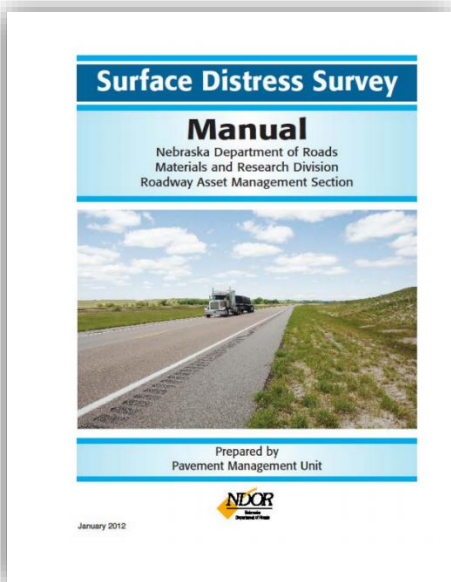
<http://www.transportation.nebraska.gov/docs/annual-report.pdf>

Pavement Maintenance Manual



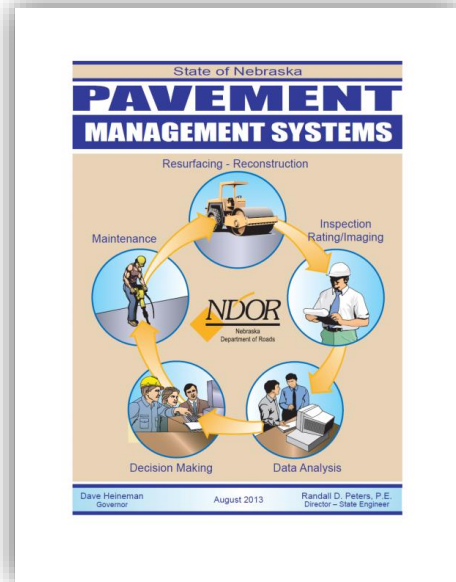
<http://www.transportation.nebraska.gov/docs/pavement.pdf>

The Surface Distress Manual



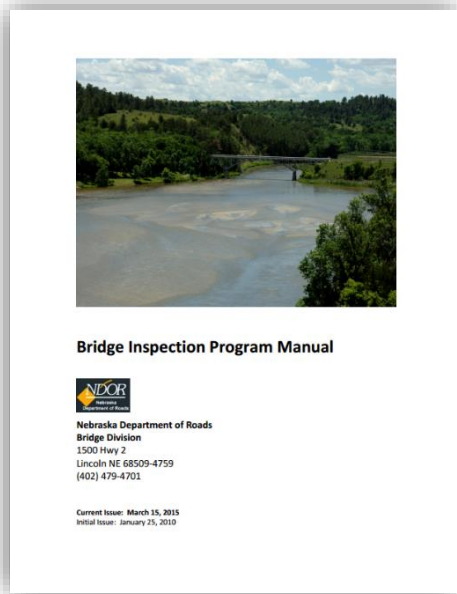
<http://www.transportation.nebraska.gov/mat-n-tests/pdfs-docs/surfacedistresssurveymanual.pdf>

Pavement Management Systems Manual



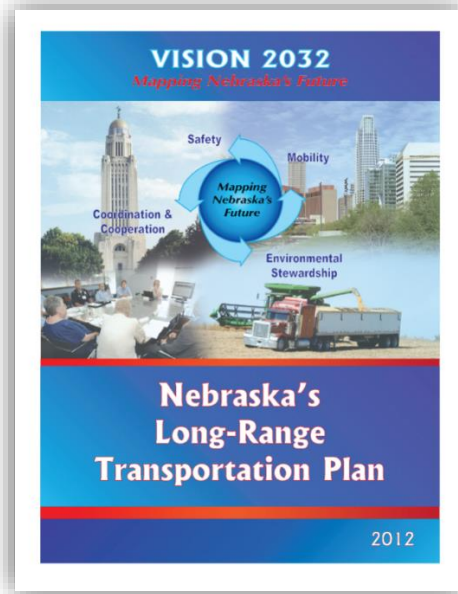
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Bridge Inspection Program Manual



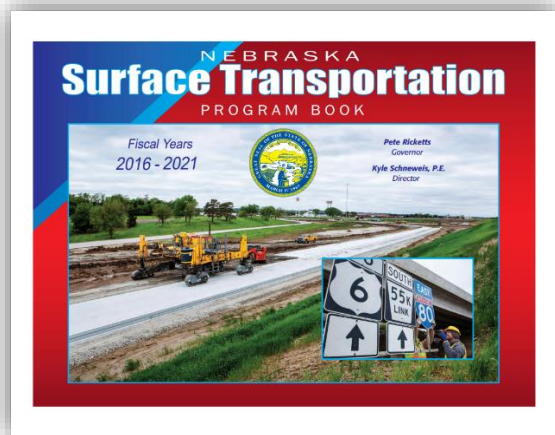
<http://www.transportation.nebraska.gov/design/bridge/bipm/NDOR-BIP-Manual.pdf>

Nebraska's Long-Range Transportation Plan



<http://www.transportation.nebraska.gov/lrtp/docs/LRTP-current.pdf>

Nebraska Surface Transportation Program Book



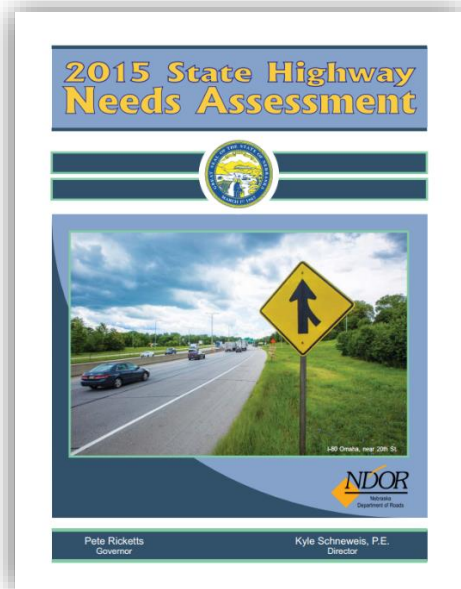
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Roadway Asset Management



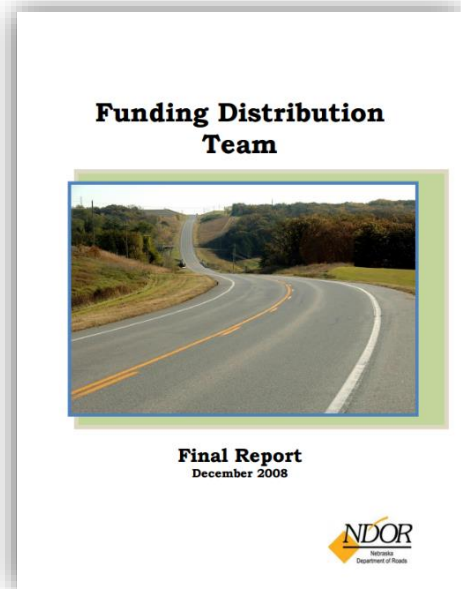
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2015 State Highway Needs Assessment



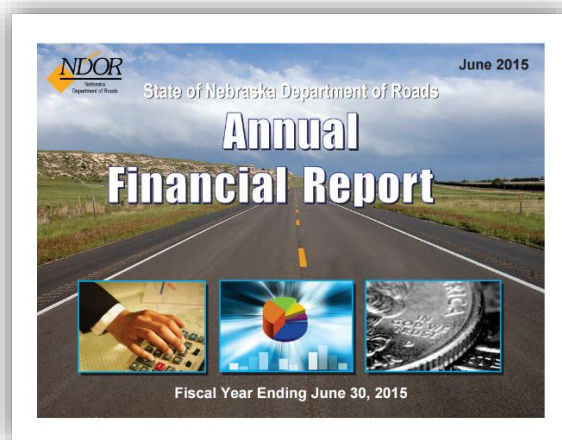
<http://www.roads.nebraska.gov/media/3587/2015-needs.pdf>

Funding Distribution Team Final Report



<http://www.roads.nebraska.gov/media/2813/funding-distribution-team-2008.pdf>

Annual Financial Report



<http://www.roads.nebraska.gov/media/2818/2015-financial-report.pdf>

Appendix D Historical NSI Rating Scale

Since 1985, the Nebraska Serviceability Index, or NSI, has been used to calculate pavement condition. The NSI formula has undergone minor changes since its inception. In 2015, NDOR altered the previous NSI scale from five condition measures to three. Table A.1 shows the scale that was used until 2015. The current processes of conducting pavement inspections and deriving NSI values (see in chapter 3) remain the same. The following table serves as a reference for NSI values recorded in NDOR reports submitted before 2015, which are included in the TAMP (see Appendix C).

Table A.1 Nebraska Serviceability Index (NSI)

Rating	Condition	Description
Very Good	90 - 100	Pavement like new
Good	70 - 89.99	Several years of service life remaining
Fair	50 - 69.99	Few years of service life remaining
Poor	30 - 49.99	Candidate for rehabilitation
Very Poor	0 - 29.99	Possible replacement