2019

Transportation Asset Management Plan

NEBRASKA

Good Life. Great Journey.

DEPARTMENT OF TRANSPORTATION

Signature Page

The Nebraska Department of Transportation (NDOT) in cooperation with the Federal Highway Administration (FHWA), hereby submits this initial Transportation Asset Management Plan (TAMP) for certification review for the TAMP process by the FHWA as per 23 U.S.C. 119(e)(6).

APPROVED BY THE NEBRASKA DEPARTMENT OF TRANSPORTATION

This 20th day of June, 2019

Signature
Kyle Schneweis
Director

CERTIFIED BY THE FHWA NEBRASKA DIVISION OFFICE

This 28th day of August, 2019

Signature
Joseph A. Werning
Division Administrator

Disclaimer

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Passage of the Moving Ahead for Progress in the 21st Century Act (MAP-21) required each state transportation agency to develop a risk-based Transportation Asset Management Plan (TAMP) for the National Highway System (NHS).

The Nebraska Department of Transportation's (NDOT) TAMP describes current asset management practices to increase transparency. This TAMP highlights one of the agency's eight strategic goals: "Asset Management – To operate, maintain, upgrade and expand physical assets effectively throughout their life cycle" and describes many of the detailed processes that support and guide decisions for project development and delivery.

NDOT's asset management process follows the below steps which are described in detail throughout this document.

1. Inspections are performed to assess and monitor the condition and performance of roads and bridges. Performance gaps, the difference between existing and desired performance, are identified and options to minimize those gaps for at the lowest practicable cost are considered.

2. Existing funding levels and their over-all impact on asset management practices are evaluated to develop meaningful performance targets and to ensure Nebraska Roads and Bridges are maintained in a State of Good Repair (SOGR)[1].

3. Condition and desired performance targets are used in a life-cycle cost analysis to determine District allocations and identify projects for inclusion on a 10-year project candidate list.

4. NDOT Division and District personnel review currently scheduled work and prioritize new projects from the 10-year project candidate list for inclusion in the Surface Transportation Program book.

5. The Surface Transportation Program Book[2] and Surface Transportation Improvement Program (STIP)[3] are published.

6. After construction work is complete, pavement condition is documented during annual inspection.

7. System-wide condition and performance are compared with established targets.

[1] For a definition of "State of Good Repair", see Appendix B.
[2] The Nebraska Surface Transportation Book can be found at: https://dot.nebraska.gov/projects/publications/program-book/
[3] The State's Transportation Improvement Program can be found at: http://dot.nebraska.gov/projects/publications/stip/

Implementation of the TAMP is a continuation of Nebraska's asset management process which has resulted in a SOGR for the highway system. Asset management practices involve technical details and processes that are defined in this TAMP. NDOT's decision-making process considers life-cycle costs, preservation-strategy effectiveness, deterioration rates, and potential risks to the highway system. Other considerations that can affect asset management processes include:

- Funding – Determining if there are enough funds to construct a project, given the statewide needs of the entire state transportation network.
- Environmental – Identifying any environmental concerns that control timing or strategies for the project.
- Deliverability – Verifying that NDOT can survey, design and acquire right-of-way necessary to construct the project when needed.
- Constructability – Analyzing whether or not the project conflicts with other construction projects in the vicinity. Analyzing whether or not the project can be done safely and with minimal impact on mobility for transportation users.
- Staffing – Confirming there is enough field personnel in the area to handle the workload.
- Stakeholder input – Taking into consideration comments and inquiries from the public, business interests and local governments regarding concerns about timing, plans and costs related to a project.

NDOT does all of this with a commitment to the safety of our statewide transportation system users and making sound investments in the network. Effective asset management is essential to meeting NDOTs mission: "We provide the best possible statewide transportation system for the movement of people and goods."

This Transportation Asset Management Plan can be found at the following link.
https://dot.nebraska.gov/news-media/publications/

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. In fact, Nebraska was the first state in the nation to complete its mainline interstate system with work beginning in 1957 and the final link being dedicated on October 19, 1974. Today, the Nebraska Department of Transportation (NDOT) manages 10,000 miles of public roads that includes about 96 percent of the National Highway System (NHS). NDOT also reports on an infrastructure network that includes approximately 97,000 miles of public roads.

NDOT is comprised of eight individual districts that oversee the maintenance, operations, and construction of the roads within their district. A central office in District 1 performs planning, programming, research, and design for highway projects. A map showing administrative districts is shown in Figure 1.

With the passage of the Moving Ahead for Progress in the 21st Century Act (MAP-21), each state transportation agency is required to develop a risk-based Transportation Asset Management Plan (TAMP) for the National Highway System (NHS).

Transportation asset management is defined in MAP-21 as: “a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the life cycle of the assets at a minimum practicable cost”.

Many of NDOT’s asset management objectives and policies were established prior to the passage of MAP-21. As a result, NDOT’s TAMP captures the current processes, procedures, and methods used to manage assets. This TAMP describes NDOT’s strategic approach to meet the needs of the system and its users not only on the NHS, but all highways and bridges owned by the State.

This plan covers a 10-year financial period and will be reviewed and recertified by the Federal Highway Administration (FHWA) every four years.

Overview of NDOT's Strategic 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 established 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) – Involve 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.

Table 1 National Goals and NDOT Strategies

***National* Performance Goal**	**Strategies to Achieve Goal**
(1) Safety. To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.	NDOT TAMP strategies support the goals and objectives of the Highway Safety Improvement Program (HSIP), our Nebraska's Performance-Based Strategic Traffic Safety Plan, and the Nebraska Strategic Highway Safety Plan (N-SHSP). Implementing these strategies will reduce traffic fatalities and serious injury.
(2) Infrastructure condition. To maintain the highway infrastructure asset system in a state of good repair.	The strategies in the TAMP are integrated with the Statewide Transportation Improvement Plan (STIP), the Transportation Improvement Plans (TIPs), and the Surface Transportation Plan to maintain highways assets. A state of good repair will be promoted through implementation of these plans.
(3) Congestion reduction. To achieve a significant reduction in congestion on the National Highway System.	Properly selected and timed preservation strategies extend the service life of pavement and minimize traffic congestion associated with lengthy reconstruction projects. Strategies for selecting repair work candidates described in the TAMP maintain the existing capacity with least long-term impact to level of service.
(4) System reliability. To improve the efficiency of the surface transportation system.	The implementation of the TAMP ensures roadways are maintained in a State of Good Repair, leading to a reliable transportation network.
(5) Freight movement and economic vitality. To improve the National Highway Freight Network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.	Freight movements on Nebraska roadways include a wide range of commodities, including agricultural products produced in rural areas. Maintaining roadways in an efficient and timely manner allows products from rural areas to reach wider national and international markets and promotes the economic vitality of our state and nation.

(6) Environmental sustainability. To enhance the performance of the transportation system while protecting and enhancing the natural environment.	NEPA CE Assignment occurred in the fall of 2018. This allows NDOT to deliver safety and highway improvement projects to the public faster while preserving environmental quality. The program allows for more flexibility in project decision-making, while maintaining existing requirements for environmental consultation, review, and compliance. NDOT is building stronger relationships with stakeholders and public agencies through direct engagement and ownership of NEPA decision-making.
(7) Reduced project delivery delays. To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.	NDOT reduced delays in project development and delivery processes by strengthening our project and program management and improving connections between project delivery and construction efforts. NDOT created new teams responsible for stewardship of project cost, scope and schedule and developed new change control procedures to improve agency work practices.

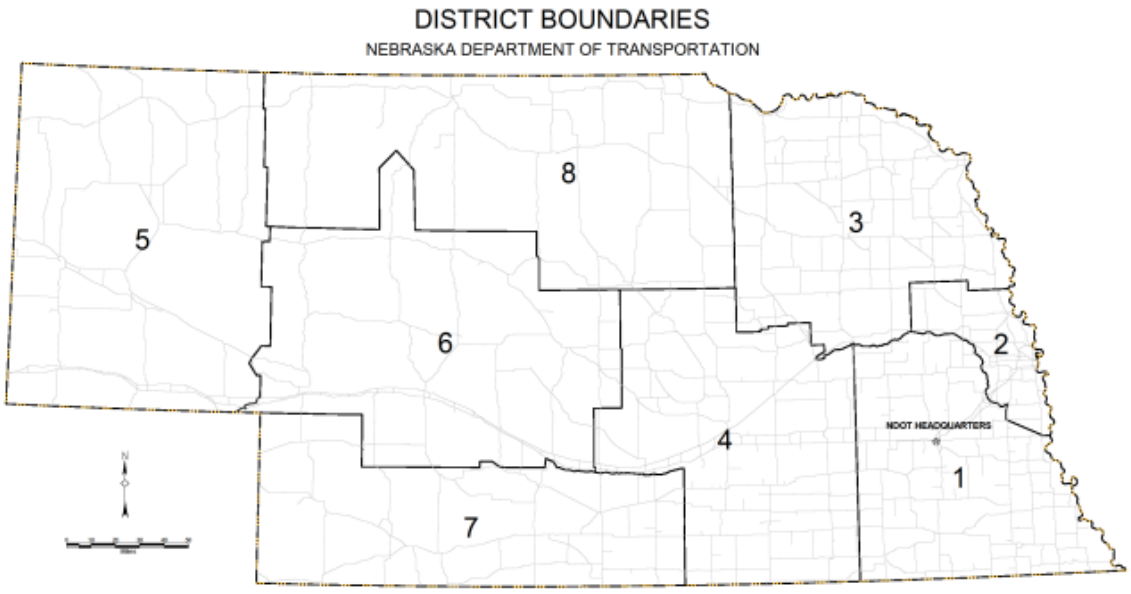

Figure 1 NDOT's District Boundaries

1.2 TAMP Framework

The content of the Nebraska Transportation Asset Management Plan (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 State and National Highway System (NHS), a summary of pavement and bridge inventory, how the condition of the inventory is collected and measured and the general condition of the assets.

Chapter 3: Asset Management, Objectives, Practices, and Measures – Outlines the Nebraska Department of Transportation's (NDOT) objectives and strategies for successful asset management, identifies asset condition goals, and describes the process of assessing the performance of the State's assets.

Chapter 4: Performance Gap Identification –This chapter provides summaries of NDOT's short-term (10-year), long-term (20-year), and planning horizons for asset management, and performance gap analyses.

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, freight growth, and system demand.

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

Chapter 8: Financial Plan and Investment Strategies – Summarizes the funding sources for Nebraska's transportation system, financial reporting requirements, financial management practices, funding levels and allocation processes that support asset management planning.

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

Chapter 2 Asset Inventory and Condition

2.1 Overview

The Nebraska Transportation Asset Management Plan (TAMP) focuses on two major assets: pavement and bridges on the National Highway System (NHS). The Nebraska Department of Transportation (NDOT) manages and reports on all state-owned pavements and bridges; the NHS is not managed separately from the State system. Local owners in coordination with the State, manage the subgroup of locally owned NHS pavements and bridges. Additional asset classes may be included in future editions of the TAMP.

NDOT is directly responsible for operating and maintaining approximately 10,000 miles of roads and 3,500 bridges[4, 5]. Additionally, NDOT is responsible for reporting on an infrastructure network of approximately 97,000 miles of public roads and more than 15,000 bridges in the state. NDOT uses the information collected to provide numerous reports to the public, other State and local agencies. Yearly reports are provided to the Federal Highway Performance Monitoring System (HPMS) and the FHWA National Bridge Inventory System[6,7].

The NHS in Nebraska, which is a focus of this document, is approximately 3,700 miles in length, with about 13 percent being interstate highways, 83 percent State highways, and 4 percent locally owned roadways. The NHS includes about 1,500 bridges, with approximately 96 percent located on State highways and the rest on the local system. A map of Nebraska's NHS is shown in Figure 2[8].

NDOT collects all pavement inventory and condition data for the interstate, state-owned highways, and locally owned NHS routes. Bridge inventory and condition is collected by NDOT for state-owned bridges. Bridge inventory and condition for locally owned bridges is collected by the local agencies and supplied to NDOT using BrM, a web-based software that is licensed from the American Association of State Highway and Transportation Officials and has been customized for NDOT use.

Summaries of pavement and bridge inventory on the NHS, the State Highway System and the local roadway networks, is found on the NDOT Materials and Research website[9] and the NDOT Bridge Division website[10]. A summary of the NDOT's historical asset performance for the State Highway System is found in the NDOT Annual Report[11].

[4] Nebraska bridge inventory details are available at: http://dot.nebraska.gov/business-center/bridge/
[5] Nebraska pavement inventory is available at: http://dot.nebraska.gov/business-center/materials/
[6] All states bridge inventory is available from the FHWA at: https://www.fhwa.dot.gov/bridge/britab.cfm
[7] All states pavement inventory data is available from the FHWA at: https://www.fhwa.dot.gov/policyinformation/statistics.cfm
[8] Nebraska's NHS system map is available at: https://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/ or http://dot.nebraska.gov/travel/map-library/
[9] Nebraska pavement inventory is available at: http://dot.nebraska.gov/business-center/materials/
[10] Nebraska bridge inventory is available at: http://dot.nebraska.gov/business-center/bridge/
[11] Nebraska's Annual Report can be found at: http://dot.nebraska.gov/news-media/annual-report/

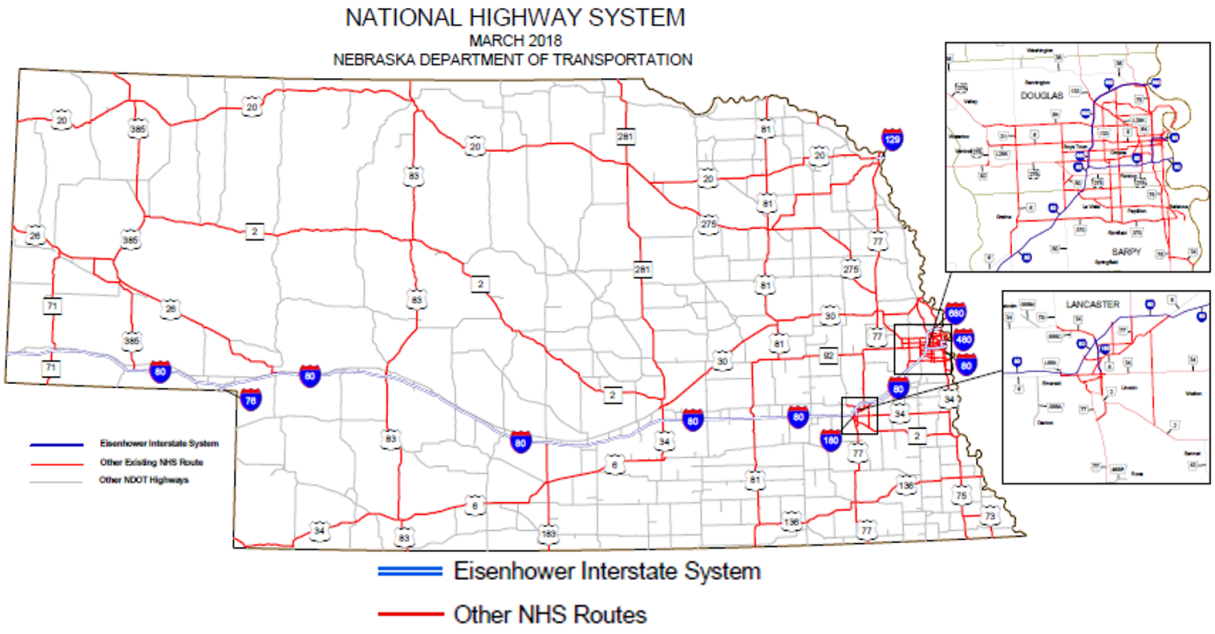

Figure 2 National Highway System in Nebraska

2.2 Asset Values

Nebraska's pavement and bridges require a substantial investment to guarantee the state's economic viability and the safe and efficient mobility of users. Therefore, it is necessary to maintain the condition of these assets and extend their service lives in the most cost effective way. The current value for state-owned NHS pavements is approximately $5.6 billion. The annual investment required to maintain the interstate system at its current condition is approximately $80 million and the investment needed to maintain the non-interstate, state-owned NHS in its current condition is approximately $116 million. The current value of the NHS bridges is approximately $2.5 billion, which requires an annual investment of approximately $20 million to maintain in the current condition.

2.3 Pavement Inventory

The expanse of Nebraska pavement on the NHS currently measures approximately 3,700 miles measured along the centerline of each highway. The number of lane miles that make up the NHS is approximately 10,100 and can be seen in Table 2. In this document, pavement is defined as the surfaced travel way width of the highway, which does not include roadway appurtenances such as shoulders, guardrails, sign structures, lighting, or signs. NDOT's main source for pavement inventory and condition data is found in a mainframe relational database with the route number and reference posts as the keys. A summary of the tables in the database is replicated in sequel for use in NDOT's Pavement Optimization Program (POP).

The POP application offers a variety of data and functions for nearly every step of the asset management process, including current pavement condition ratings. For more information on POP, see Section 3.3.1, the pavement management systems manual[12], or the pavement optimization program-user guide[13].

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

1. Jointed Portland cement concrete (PCC) (i.e., rigid)
2. Asphalt cement concrete (ACC) (i.e., flexible, bituminous, or black top).
3. Composite pavement (ACC over PCC) these types are considered ACC in all analysis

Table 2 NHS Lane Miles by System

System	Number of Lane Miles
Interstate	2,114
Non-Interstate State Highways	7,476
Local	496
Intermodal Connector	3

2.4 Pavement Condition

NDOT uses two main pavement condition measures in the determination of performance. The Nebraska Serviceability Index (NSI) and the International Roughness Index (IRI). With the passage of MAP-21, Nebraska's pavement condition will also be rated as Good, Fair, or Poor according to Federal rules.

[12] The Pavement Management Systems Manual can be found at: http://dot.nebraska.gov/business-center/materials/

[13] The Pavement Optimization Program – User Guide can be found at: http://dot.nebraska.gov/business-center/materials/

2.4.1 Nebraska Serviceability Index (NSI)

The Nebraska Serviceability Index (NSI) is a rating used to gauge the overall health of the highway network or a specific segment of highway. This rating is used to manage all pavements on the State Highway System including the NHS. NSI ratings are computed 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 is intended primarily to characterize severity and extent of pavement distress as described in the Surface Distress Survey Manual[14]. This characterization identifies distresses, but does not attempt to determine the cause of distress nor does it identify appropriate corrective treatments.

Additional condition metrics of a roadway are measured by NDOT's profiling vehicle, the inertial profiling system, a specialized van furnished with equipment to take multiple measurements (see Figure 3). This system, which was updated in 2014, provides information on roadway smoothness, rut depth, texture, and faulting, as well as photos of the pavement sections. All pavement condition data is collected in accordance with NDOT's Data Quality Management Program[15].

(a) Inertial profiling van

(b) Profiling van interior computer monitor

(c) Profiling equipment and data storage

Figure 3 Inertial Profiling Equipment

[14] The Surface Distress Survey Manual can found at: http://dot.nebraska.gov/business-center/materials/

[15] The Data Quality Management Program can be found at: http://dot.nebraska.gov/business-center/materials/

Once data from the visual inspections and the profiler is uploaded into the database, a function is used to combine the distress and condition measurements into pavement condition factors, which are 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. A complete description of this process may be found in the Pavement Management System Manual[16] or see Section 3.3.1 for more details.

NSI is the primary value used to manage pavement assets and is one of the main performance measures tracked by NDOT. The full range of NSI condition ratings and corresponding physical descriptions are categorized according to the NSI scale listed in Table 3. A summary of the condition of various systems as they relate to NSI is shown in Figure 4, which is reported in NDOT's Annual Report[17].

Table 3 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

NDOT has historically reported the percent of the highway system rated as good and very good, based on NSI, for in the Annual Report and will continue to do so. For more information on Federal and State performance measures, see section 3.5.

[16] The Pavement Management System Manual can be found at: http://dot.nebraska.gov/business-center/materials/

[17] The Annual Report can be found at: http://dot.nebraska.gov/news-media/annual-report/

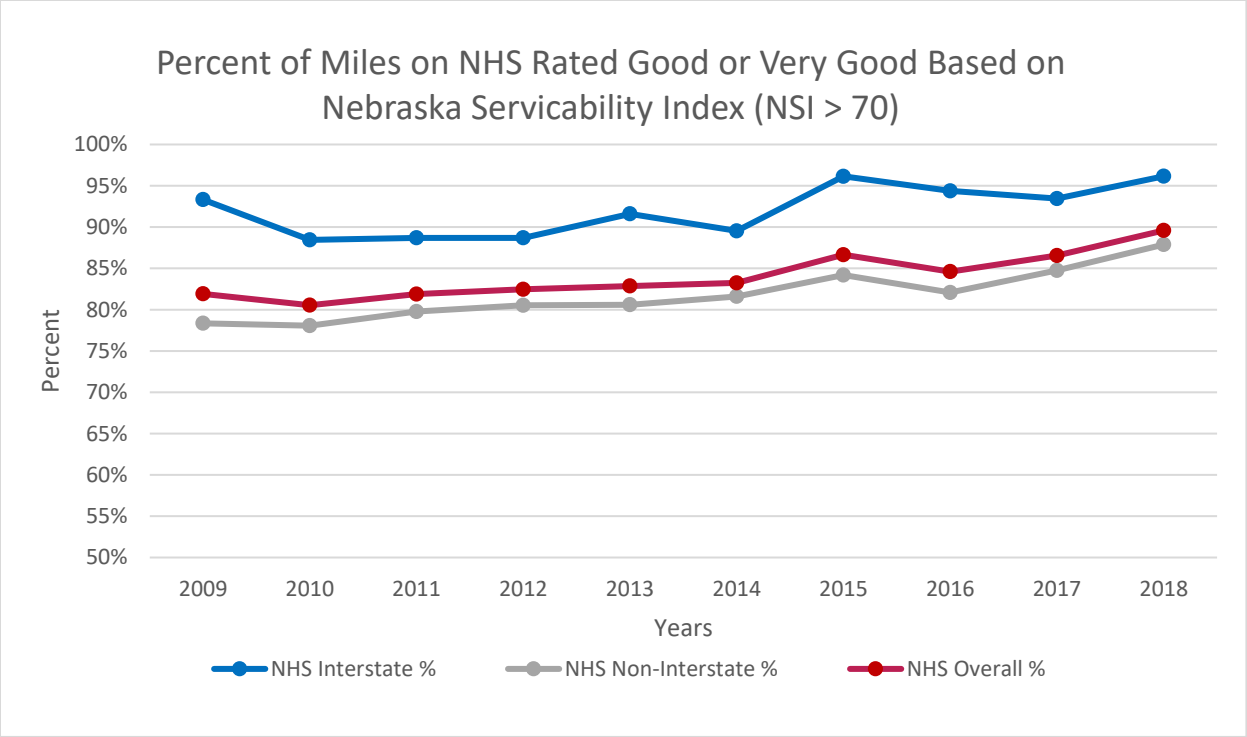

Figure 4 Percent of miles on NHS rated Good or Very Good based on NSI > 70

2.4.2 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 inertial profiling van. Collected data is evaluated according to the International Roughness Index (IRI), which is a scale for roughness based on the simulated response of a generic motor vehicle to the roughness in a single wheel path of the road surface. Nebraska collects the IRI for both wheel paths and calculates an average IRI that is reported for all segments.

Its value is determined by obtaining a suitably accurate measurement of the profile of the road, processing it through an algorithm that simulates the way a reference vehicle would respond to the roughness inputs, and accumulating the suspension travel. IRI is reported in terms of inches/mile. The lower the IRI rating, the smoother, safer, and more satisfying the ride is to users. Table 4 contains the IRI rating and scale.

Table 4 International Roughness Index (IRI)

Rating	Scale (in/mi)
Good	<95
Fair	95-170
Poor	>170

The smoothness of roads, as measured by IRI, is critical to the safety and mobility of the traveling public. The IRI value is one of the main performance measures tracked by NDOT, which is reported in the annual report. A summary of the condition of the NHS as it relates to IRI rating is shown in Figure 5.

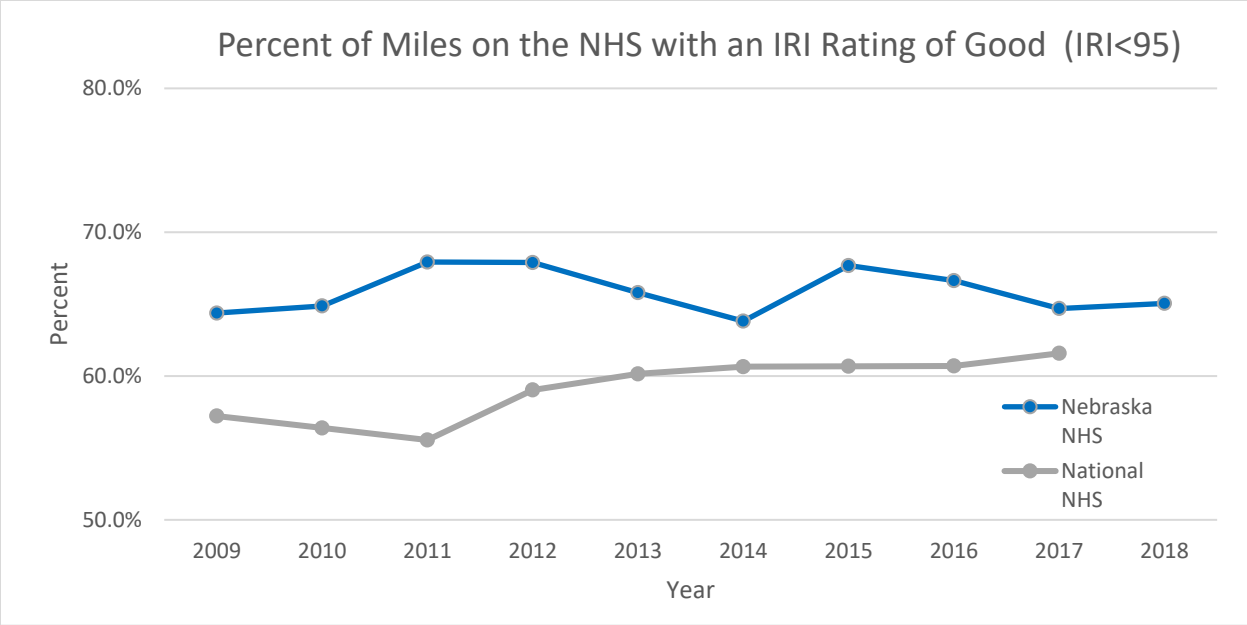

Figure 5 Percent of miles on the NHS with an IRI rating of Good based on IRI< 95 in/mi

2.4.3 Rutting, Cracking, Faulting, and the Present Serviceability Index (PSI)

In addition to the NSI and IRI ratings on the Nebraska State Highway System, current condition ratings related to cracking, rutting, faulting, and PSI are available upon request from the Materials & Research Division. Factors for the deterioration of these ratings are used in the Life Cycle Cost Analysis.

2.4.4 Federal Pavement Condition Ratings

Federal pavement condition ratings of good, fair, or poor for a pavement section will be based on the combined values of good, fair or poor condition for IRI, cracking, rutting, and faulting. See Table 5 and Section 3.5 for more details.

Table 5 Federal Rating Scale for Pavement Condition Metrics

Rating	Good	Fair	Poor
IRI (inches/mile)	< 95	95-170	>170
Present Serviceability Rating (PSR)* (0.0-5.0 value)	≥4.0	2.0-4.0	≤2.0
Cracking Percent (%)	<5	CRCP: 5-10 Jointed: 5-15 Asphalt 5-20	>10 >15 >20
Rutting (inches)	<0.20	0.20-0.40	>0.40
Faulting (inches)	<0.10	0.10-0.15	>0.15

*PSR may be substituted for IRI on routes with speed limits <40 mph

2.5 Bridge Inventory

The Nebraska Bridge Inspection Program Manual defines a bridge 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”[18]. There are currently more than 3,500 bridges on the State Highway System. The NHS includes about 1,450 bridges on the State system and about 80 bridges on local roadway networks[19]. Ninety

[18] 3-NBI.3 FHWA Coding Manual Definitions from the Bridge Inspection Program Manual http://dot.nebraska.gov/business-center/bridge/inspection/

[19] Nebraska bridge inventory and condition reports are available at: http://dot.nebraska.gov/business-center/bridge/

five percent of NHS bridge deck area is on the State Highway System. All bridge inspection information for both state and local bridges is stored and maintained by NDOT. Below, the graphs in Figures 6 – 8 provide an overview of the age, types of bridges, and bridge size on the State and NHS networks.

For a complete listing of State and NHS bridges, see the FHWA National Bridge Inventory[20].

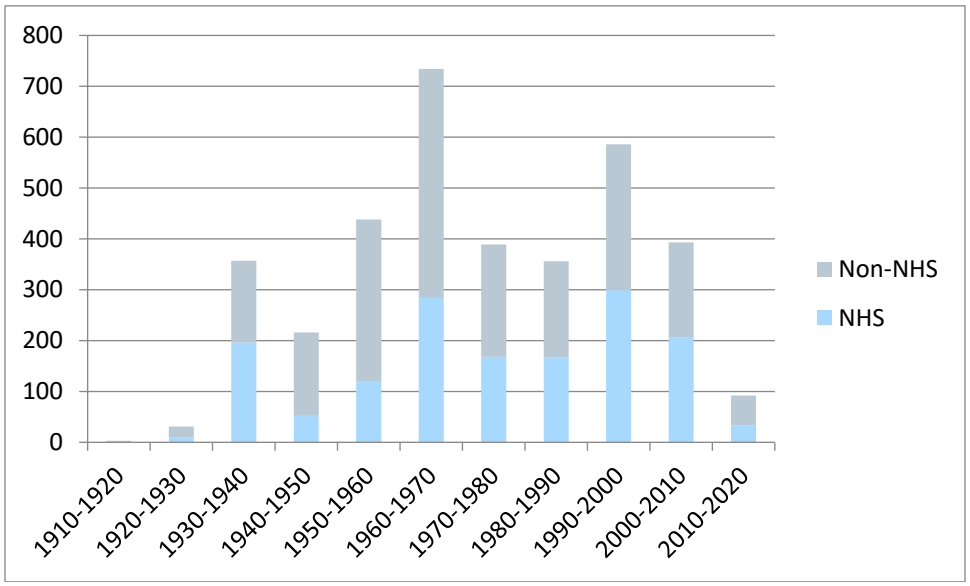

Figure 6 Number of State-Owned Bridges Constructed per Decade*

*It should be noted that year of construction is not known exactly for some older bridges. For these bridges, it has been an agency practice to code the year of construction as 1935.

[20] https://www.fhwa.dot.gov/bridge/nbi.cfm

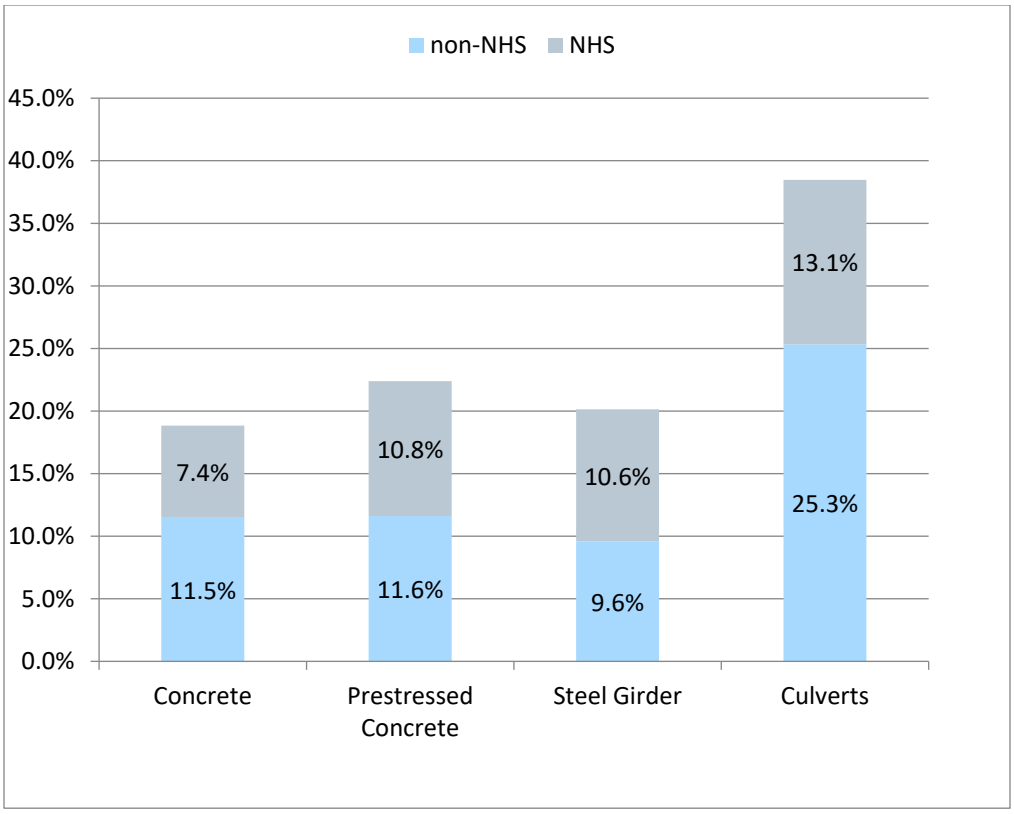

Figure 7 Prevalence of Structure Types (percent of total number)

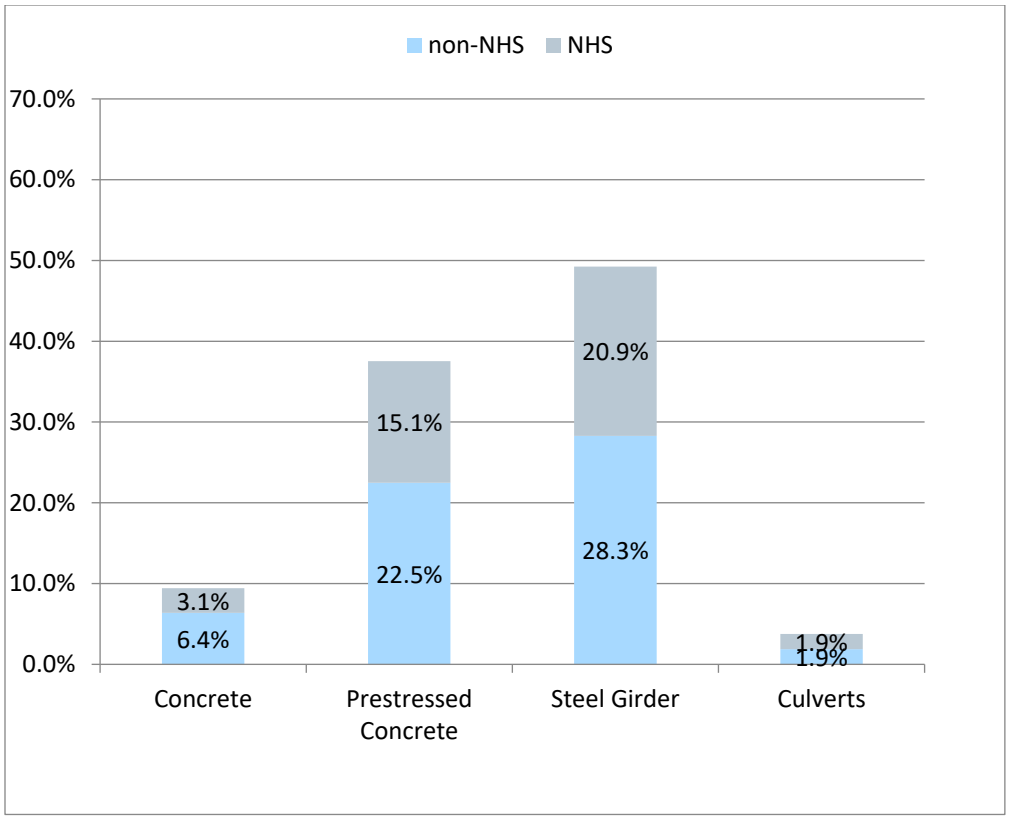

Figure 8 Prevalence of Structure Types (percent of total deck area)

Bridge length is determined by the requirements to span a waterway, roadway, or railroad under the bridge. The width of bridges is determined by the traffic requirements on the bridge as defined in the Nebraska Minimum Design Standards.

Due to low life cycle cost and maintenance needs, concrete box culverts are the preferred bridge type on the State and NHS systems. When longer or higher structures are needed, other bridge types are built.

The average (non-culvert) bridge on the non-NHS, State system is about 39.0 ft. wide and 210.1 ft. long and about 52.2ft wide and 304.5 ft. long on the combined State and Local System NHS.

2.6 Bridge Condition

NDOT reports bridges in Good, Fair and Poor condition based on National Bridge Inspection program data. Bridges are considered to be in Good condition if all major National Bridge Inspection components (bridge deck, bridge superstructure and bridge substructure or culvert) are in good condition or better (9, 8, 7). Bridges are considered to be in poor condition if one or more of the major components is in poor condition or worse (4 or less). Bridges that do not

meet the criteria for good or poor condition are considered to be in fair condition (5 or 6).[21] Changes to the definition of the term “Structural Deficiency” mean that this term is equivalent to “Poor” condition[22]. Figure 9 shows the relationship between bridge age and condition.

The current status of bridges in good, fair or poor condition can be found in the Bridge Condition Report on the NDOT Bridge Division website: http://dot.nebraska.gov/business-center/bridge/.

Over time, bridges deteriorate due to exposure to adverse conditions.

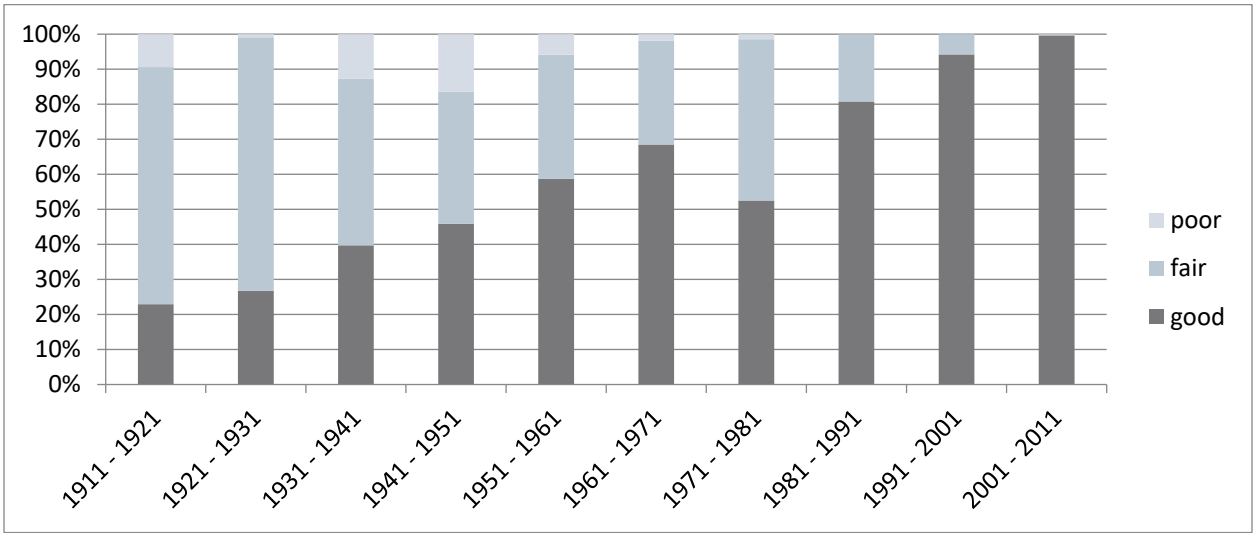

Figure 9 Condition of State Bridge Inventory by Year Constructed

[21] These measures for Bridge Condition were adopted by NDOT after review of 23 CFR § 490.409
[22] 23 CFR § 490.405

Chapter 3 Asset Management Objectives, Practices, and Measures

3.1 Overview

NDOT uses a performance-based approach for asset management that focuses on evaluating system performance, identifying asset needs, and establishing investment priorities. Performance measures have been developed to monitor the condition of Nebraska's pavement and bridges. Performance measures are reported separately for the State system and the National Highway System (NHS), but the State system is the asset pool for competing project development. Various strategies are used to meet the objectives to preserve, rehabilitate, and replace the major assets managed by NDOT. No changes have been made to the pavement and bridges asset management processes since the Initial Process TAMP approval. The following subsection describes the various program and policy documents that inform processes used to manage NDOT assets.

3.1.1 Asset Management Resources and References

Programming and planning documents can be found at the following links:

1. *Nebraska's Long-Range Transportation Plan (LRTP)*
   http://dot.nebraska.gov/projects/publications/lrtp/

   a. Nebraska's LRTP defines methods for measuring performance and monitoring progress toward plan goals and objectives, providing a vision for transportation development 20 years into the future. This plan is updated every 5 to 7 years.

2. *State Highways Needs Assessment*
   http://dot.nebraska.gov/business-center/financial-reports/

   a. The State Highways Needs Assessment is a report presented to the State Legislature on a yearly basis that provides 20-year revenue projections and quantifies the cost to remove geometric deficiencies, address capacity needs, and preserve the highway system at a preferred condition level. It is a tool to communicate the funding level gaps over a 20-year period.

3. *NDOT's Annual Report*
   http://dot.nebraska.gov/news-media/annual-report/

   a. NDOT's Annual Report gives a yearly update on key performance measures for the NDOT including; Safety, Fiscal Responsibility, Environmental Stewardship, Project Delivery, Asset Management, Mobility, The 4 C's, Communication, Coordination, Collaboration, & Cooperation, and finally Workforce Development.

4. *Nebraska's Surface Transportation Program*
http://dot.nebraska.gov/projects/publications/program-book/

   a. Nebraska's Surface Transportation Program is an annual plan that consists of detailed maps, inventory lists, and preliminary estimates of current and planned construction projects for each of the eight districts in the state.

5. *NDOT STIP Guidelines*
http://dot.nebraska.gov/projects/publications/stip/

   a. These guidelines describe the practices and procedures used by the NDOT, FHWA and the MPOs to develop and maintain the STIP and TIPs.

6. *Nebraska's State Transportation Improvement Program (STIP) and the Metropolitan Planning Organizations (MPOs) Transportation Improvement Program (TIP)*
http://dot.nebraska.gov/projects/publications/stip/

   a. The Statewide Transportation Improvement Program (STIP) is NDOT's 4-year Highway Improvement Program developed under Title 23 United States Code (USC), Section 135 Statewide Planning, (f) Statewide Transportation Improvement Program. It includes by reference the Transportation Improvement Programs (TIP's) from the Grand Island, Omaha, Lincoln, and South Sioux City MPOs. It is updated annually.

7. *The MPOs Transportation Improvement Programs (TIP's) affecting the Nebraska's STIP can be found at the following locations:*

   a. Grand Island Area Metropolitan Planning Organization
https://www.grand-island.com/government/city-clerk/boards-and-commissions/mpo
   b. Lancaster County Planning Commission
http://www.lancastercountyplanning.org/148/Transportation-Improvement-Program
   c. Omaha-Council Bluffs Metropolitan Area Planning Agency
http://mapacog.org/services/transportation/planning/
   d. Siouxland Interstate Metropolitan Planning Council
https://simpco.org/divisions/transportation-planning/

8. *The MPOs Long Range Transportation Plans that inform MPO TIPs can found at the following locations:*

   a. Grand Island Area Metropolitan Planning Organization https://www.grand-island.com/departments/public-works/metropolitan-planning-organization/giampo-long-range-transportation-plan

b. Lancaster County Planning Commission
https://lincoln.ne.gov/city/plan/lrtpupdate/final/lrtp.pdf

c. Omaha-Council Bluffs Metropolitan Area Planning Agency
http://mapacog.org/projects/lrtp/

d. Siouxland Interstate Metropolitan Planning Council
http://simpco.org/divisions/transportation-planning/long-range-transportation-plans-lrtp/

9. *The NDOT Operating Manual for MPO Transportation Planning (MPO Manual)*
https://dot.nebraska.gov/business-center/lpa/mpo/

The Manual provides guidance to the Nebraska MPOs and the NDOT Strategic Planning Division, Program Management Division, and Local Assistance Division staff for carrying out metropolitan transportation planning responsibilities that use federal transportation planning funds. Local owners are responsible for the operation and maintenance of NHS routes under their jurisdiction.

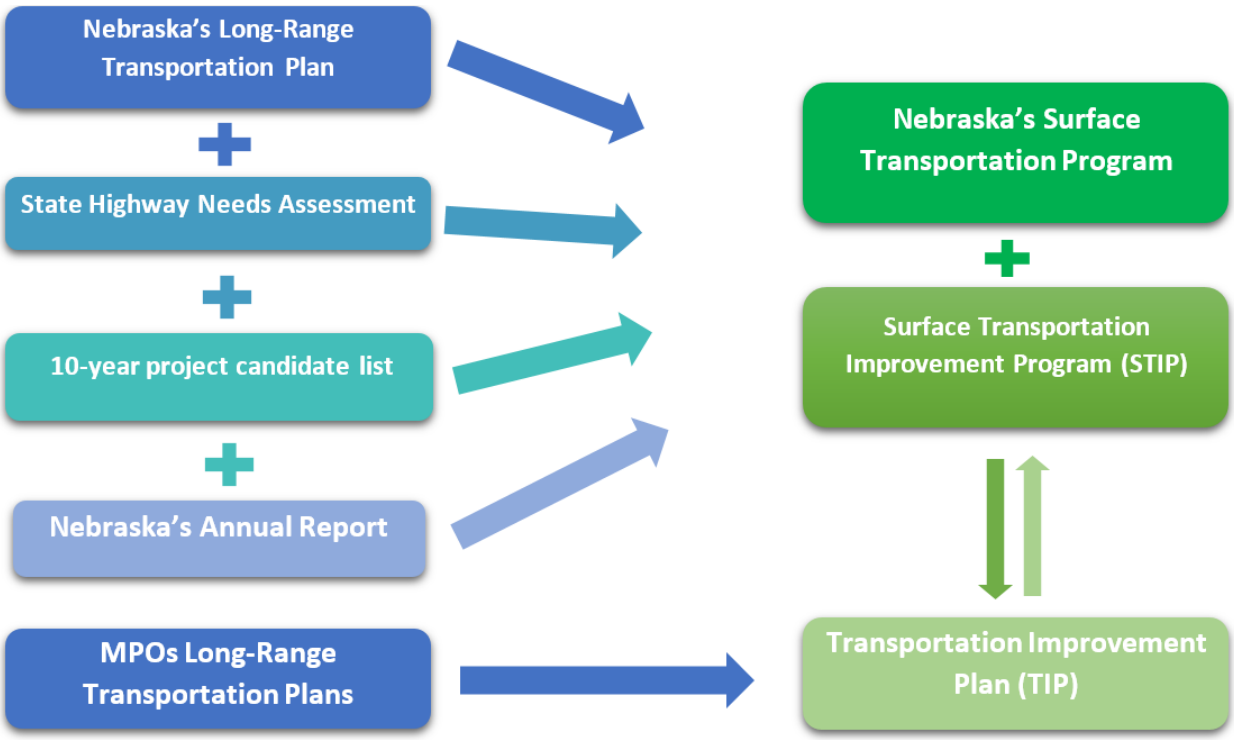

Figure 10 NDOT's Process Overview

The programming and policy reference documents described in section 3.1.1 are shown in Figure 10 to demonstrate how they inform the selection of projects for the State's program and STIP, along with the selection of projects for MPOs TIPs. The diagram is intended to show the general nature of how each of these documents inform the decision making process. Understandably, the process by which decision makers arrive at a program of projects is the result of careful review of available information. This includes the review of data, stakeholder values and input, schedules and a host of other considerations. NDOT communicates these considerations to MPOs and stakeholders in a variety of ways including, Technical Advisory Committee meetings, ad hoc meetings, emails, news releases, etc. Some of these communication protocols are described in the NDOT MPO Planning Manual[23].

3.2 Pavement and Bridge Management Objectives

NDOT's major objectives:

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

   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

   NDOT's goal is to optimize the use of funds available to Nebraska for the greatest benefit of the State Transportation System. Progress toward this goal is accomplished by minimizing overhead costs to maximize funding for transportation services. NDOT is committed to objective and transparent processes that consider needs, available and projected funding, risks, operational constraints, minimized life cycle costs, and matching the level of service to public expectations. The construction program is developed to balance trade-offs between competing objectives and maximize performance at the lowest possible life cycle cost.

[23] The NDOT MPO Planning manual can be found at: https://dot.nebraska.gov/media/6846/mpo-operating-manual.pdf

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

   Good asset management practices help provide the best use of resources at each phase of a major asset's life cycle. NDOT uses life cycle costs when evaluating construction and preservation strategies. Future maintenance and operating costs can exceed the initial cost of an asset over a long period of time. Higher initial costs can provide substantial long-term cost savings. Assets that are well managed tend to have longer life spans and are more cost effective. The uncertainty associated with long-term decisions is addressed with probabilistic analysis to determine the most likely outcomes among competing alternatives.

Strategies to meet the major objectives

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

   NDOT performs regular inspections and condition evaluations in order to implement the appropriate strategy at the appropriate time for pavement and bridges. Strategies are evaluated at project and systemic levels. Deliverable projects that meet agency goals are prioritized in the program. High priority projects with deliverability obstacles are evaluated to determine and address obstacles, then reconsidered for optimal program strategies and timing. NDOT programs use-in-place repair and thin asphalt overlay strategies, where cost effective, on existing highways. These strategies extend pavement life while offering a noticeable improvement in smoothness and a faster construction schedule than traditional rehabilitation or reconstruction strategies.

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.

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

   There are multiple elements necessary to measure assets: trained and qualified employees, standard procedures and reporting systems, and analysis. NDOT reviews these measures to ensure their quality and accuracy and updates these when necessary.

4. Continue and expand methods to assist in the assessment of assets

   Standardized methods have been created and implemented for pavement and bridge inspections and can be found in the Surface Distress Survey Manual[24] and the Bridge Inspection Manual[25]. Methods for other major asset candidates are still under consideration and in development.

5. Train NDOT staff on the use of asset management systems and methods

   NDOT has implemented training programs for both pavement and bridge inspectors. Pavement raters and profiler drivers attend training on a yearly basis. Profiler drivers work with the vendor before collection season to calibrate the profiler vans sensors and learn any new software updates. Pavement raters spend time in the field as a group to reinforce survey methods and build consistency. Bridge inspection training is provided by the National Highway Institute (NHI). The Nebraska Local Technical Assistance Program (LTAP) facilitates NHI bridge inspector training. Bridge inspection is evaluated through a contracted Quality Assurance program. The NDOT Bridge management employees have on-going training through in-house seminars and collaborative research with the University of Nebraska.

6. Provide annual status updates of assets in the NDOT Annual Report[26]

   NDOT produces an Annual Report, which contains historical trends and current major asset condition performance ratings. The current ratings are evaluated against asset management targets.

NDOT's information systems are a key component of the strategies used to meet asset objectives. NDOT's Business Technology Support Division monitors and evaluates technological advances to determine if new software or data management practices could increase efficiency and effectiveness of data collection and reporting.

A general workflow of NDOT's approach to managing pavement and bridges is depicted in Figure 11. The workflow is a continuous process consisting of a) inspection and rating, b) analyzing the data, c) making decisions on how to address any issues, d) on-going maintenance and/or resurfacing and reconstruction, as appropriate.

[24] The surface distress survey manual can be found at: http://dot.nebraska.gov/business-center/materials/
[25] The Bridge Inspection Manual can be found at: http://dot.nebraska.gov/business-center/bridge/inspection/
[26] The Annual Report can be found at: *http://dot.nebraska.gov/news-media/annual-report/*

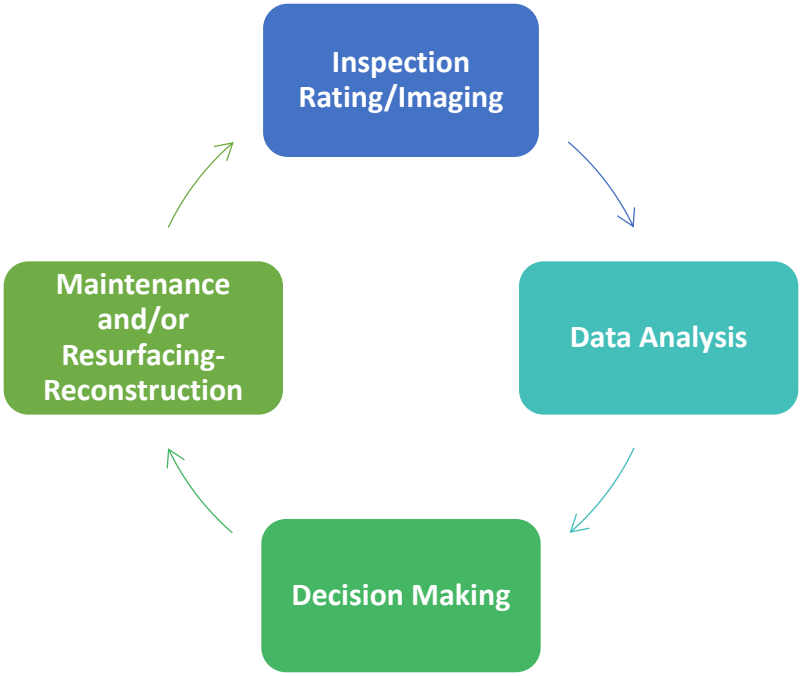

Figure 11 Workflow of NDOT's Asset Management Plan

3.3 Pavement Information Systems and Practices

3.3.1 Pavement Information Systems

Using the Nebraska Pavement Management System manual (NPMS)[27] as a guide, Pavement Asset Management personnel have been collecting and storing surface data and efficiently managing the condition of Nebraska's roadways since the system's development in 1984. The initial system was developed based on the American Association of State and Highway Transportation Officials "Guidelines on Pavement Management". In 1994, the scope of this system expanded to include all local roads on the National Highway System (NHS).

To further improve Nebraska's pavement management system, the Pavement Optimization Program (POP) was developed in house and put on-line in 2004. POP is a comprehensive program that utilizes all pertinent data, including inventory, pavement condition, performance targets, programmed projects, traffic volumes, deterioration rates, and current pavement strategy costs to manage pavement assets. POP also allows managers the ability to run a Life Cycle Cost Analysis based on benefit/cost by selecting pavement condition target levels, time periods, and funding levels (see

[27] The Pavement Management System Manual can be found at: http://dot.nebraska.gov/business-center/materials/

Chapter 5 for more details). In 2012, Nebraska introduced a prioritization assessment component, which ranks potential pavement section projects using several system factors (see Section 4.3.1 for more details).

The POP application has two main components, the Pavement Management Data tab and the Life Cycle Cost Analysis tab as shown in Figure 12 below. For either tab, the user can select the area of interest (statewide, district, or highway) and the system (all systems, interstate, expressways, NHS) to be viewed or analyzed.

The Pavement Management Data component allows users to view all pertinent data for the area/system selected as shown in Figure 13 below. Each highway is broken down into historical project length pavement sections for inventory and analysis purposes. Some of the key elements for each pavement section are:

- Highway Number, Reference post range, Location, Length
- Age, Surface type, Number of lanes
- Condition ratings, Geometric deficiencies
- Maintenance cost per lane mile
- Current and Future Average Daily Traffic Counts for both cars and trucks
- Optimum and Critical years for rehabilitation
- Number of Crashes and the 5-year average

In addition to these elements, users can view cross-sections, roadway images, and history graphs.

The Life Cycle Cost Analysis component allows users to run analysis on the areas of interest and system in two different ways.

1. Users can compute the cost to maintain a selected NSI value or condition level over a selected number of years.

2. Users can compute the resulting NSI value or condition level, over a selected number of years, given a specific budget.

Both of these options use the following factors in the analysis:

- Current condition ratings for age, NSI, PSI, cracking, rutting, and faulting
- Deterioration rates for NSI, PSI, cracking, rutting, and faulting
- Length, strategy types and cost per mile as shown in Tables 16 & 17

Both types of analysis use the above factors and decision trees as shown in Figures 14 and 15 to assign a proper strategy to pavement sections at the proper time to either compute the cost to achieve the desired condition or the resulting condition from a set budget.

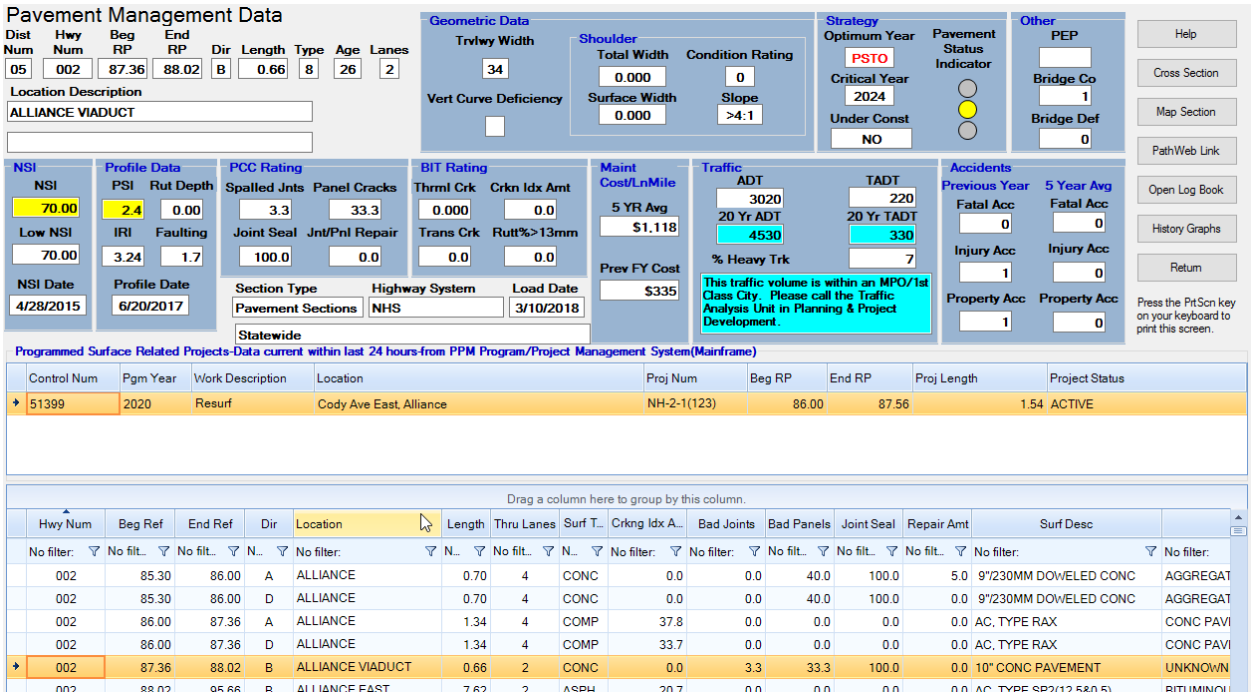

Figure 12 POP Main Screen

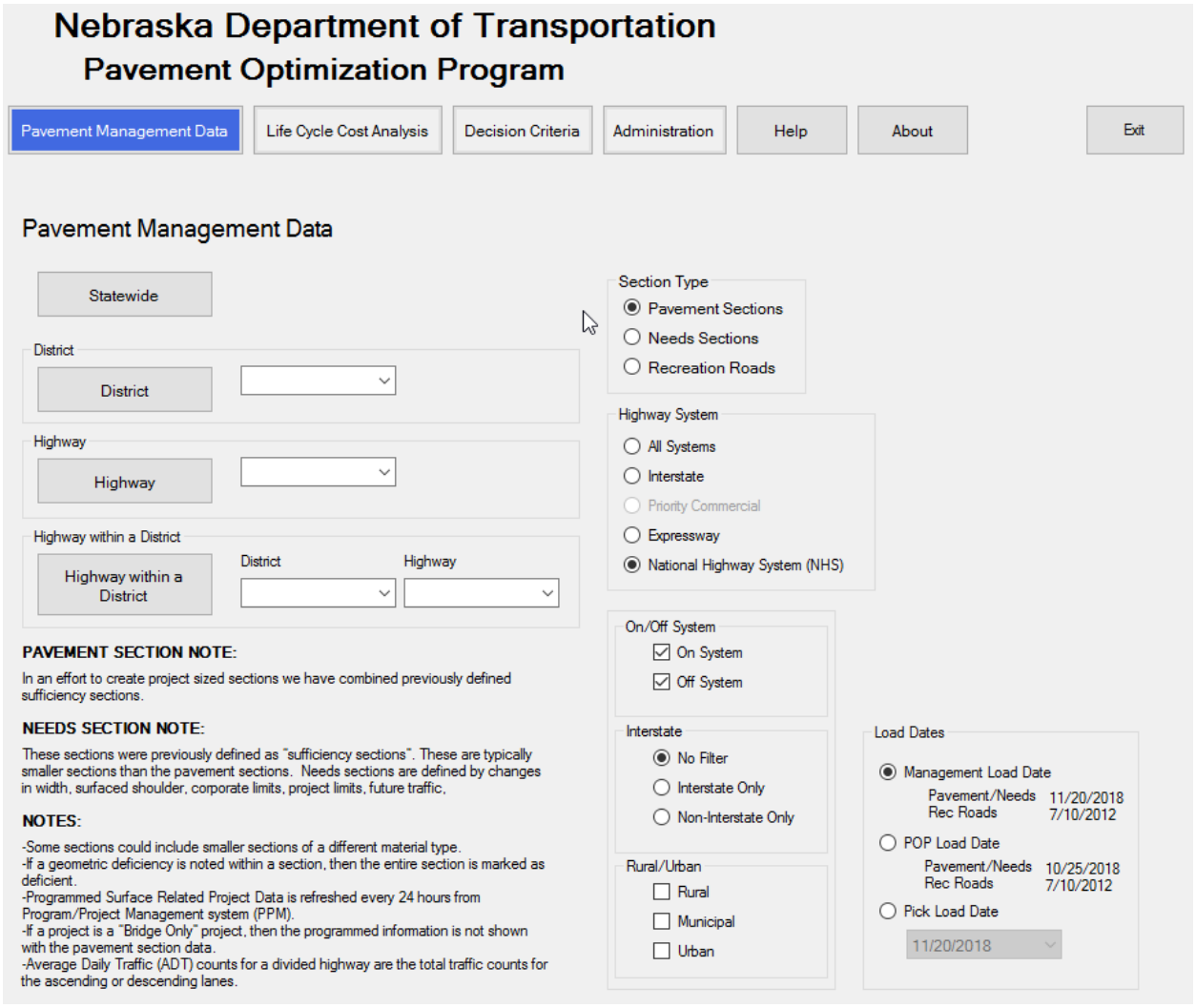

Figure 13 POP Pavement Management Data Screen

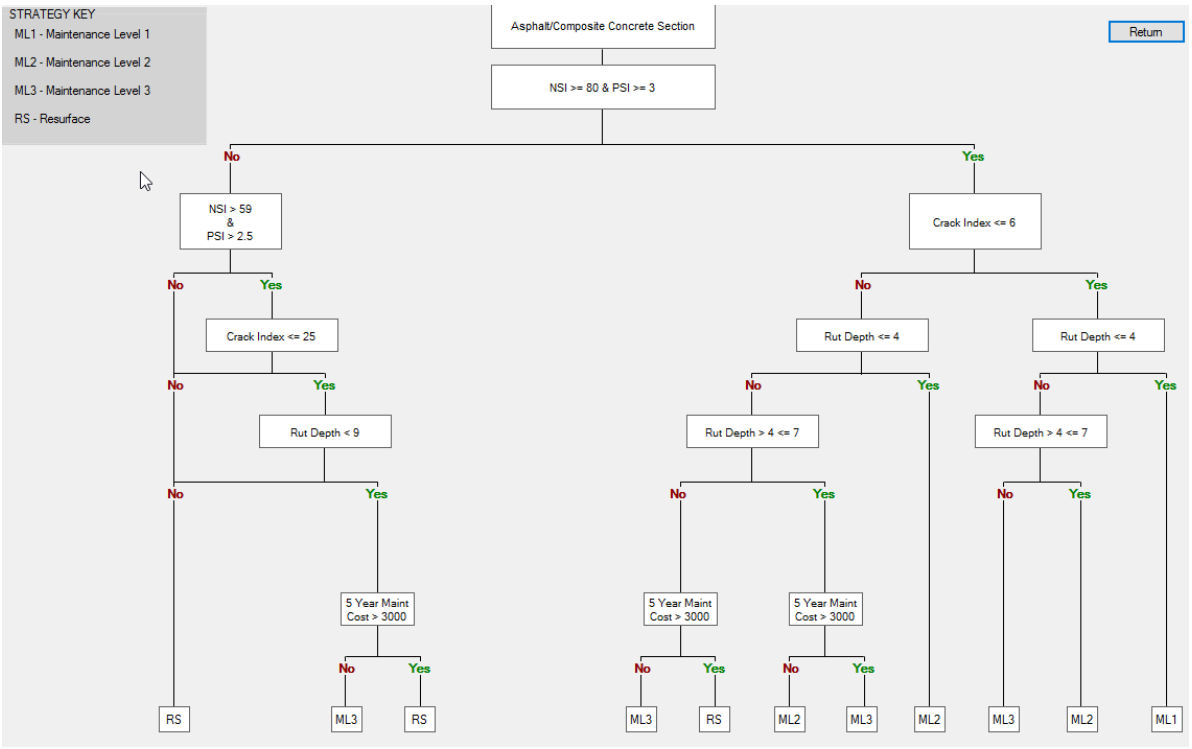

Figure 14 POP Asphalt Decision Tree

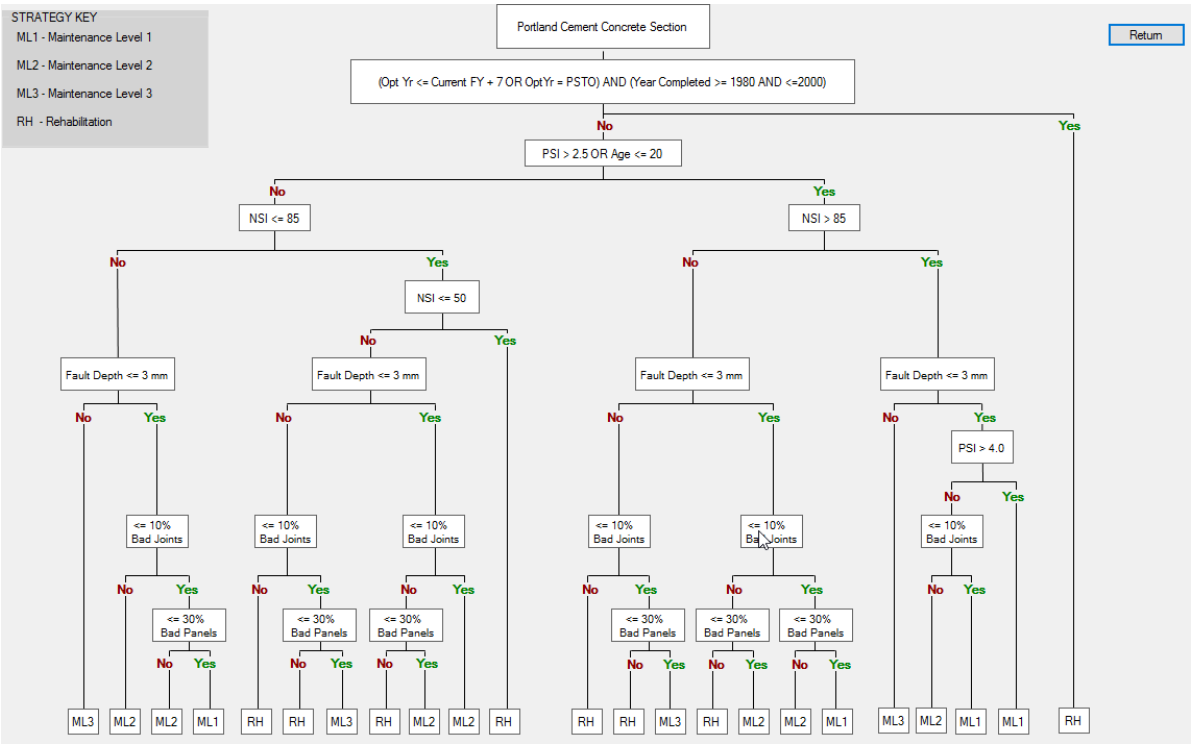

Figure 15 POP Concrete Decision Tree

3.3.2 Pavement Data and Pavement Program Allocation Development

NDOT uses the Life Cycle Cost Analysis in POP to perform a variety of condition, maintenance, and cost-related analyses.

One of the key practices is the development of the "Needs Assessment" report, required by the Nebraska State Legislature since 1988[28]. The 20-year assessment communicates the cost to eliminate geometric deficiencies, address capacity, and obtain Nebraska's condition target for NSI, which identifies potential gaps in funding levels.

Another key practice to pavement asset management is the development of the 10-year project candidate lists for each district (see Figure 24). A 10-year Life Cycle Cost Analysis is run in POP to bring the entire system to a selected performance target. This analysis prioritizes projects, which identifies the right improvement strategy, the cost, and the right time for each highway pavement section. These project candidate lists are provided to the NDOT Program Management Division and each of the eight NDOT District Engineers to assist in the development of their annual transportation programs. Similar project candidate lists are provided to MPOs as a tool to help in the development of their individual TIP's. See Figure 17.
In addition to the practices above, due to the importance of the interstate, NDOT has an Interstate Task Force that reviews programmed projects for the interstate by driving the system annually to verify the timing and strategy for planned work. The task force uses the latest condition and project data as a resource for this review. After the field review, the task force meets to finalize the interstate projects for the upcoming year.

3.4 Bridge Information Systems and Practices

3.4.1 Bridge Inventory and Appraisal Data Collection and Storage

The NDOT Bridge Division manages the inspection program for the State Highway System and the inspection data repository for all bridges in Nebraska (both State and Local systems). Bridge inventory and inspection data and documents are collected and maintained in accordance with the guidelines and requirements in the Nebraska Bridge Inspection Program Manual (NBI Program Manual)[29].

Since April 2014, NDOT has inspected bridges on the NHS and State systems using Element Level Inspection. NDOT has collected NBI method general condition data since 1998.

Inspection reports and data are recorded by bridge inspectors using BrM, a web-based software that is licensed from AASHTO and has been customized for NDOT use. Data from the bridge inspection reports is maintained in a SQL server database and stored on a State system server along with bridge inspection photographs, plans and other documents. BrM allows State and local bridge owners and managers to directly access the inspection records and contains many features that support bridge management.

[28] Needs assessment statutes are available at: https://nebraskalegislature.gov/laws/statutes.php?statute=39-1365
[29] The NBIP Manual can be found at: http://dot.nebraska.gov/business-center/bridge/inspection/

3.4.2 Bridge Data Quality Assurance and Maintenance

Quality control for bridge inspection reports is described in Section 1.9 of the NBIP Manual. NDOT contracts with an independent bridge inspection consultant to conduct a bridge inspection review process to maintain high standards for bridge inspection reporting.

All inspection data is reviewed prior to the annual submittal to the FHWA using an automated online National Bridge Inventory File Check feature. This process checks for common errors and inconsistencies with inspection appraisal and inventory data.

After submittal to the FHWA, bridge inspection records are reviewed for compliance with the National Bridge Inspection Oversight Program Metrics[30]. These 23 metrics are intended to assure compliance with the National Bridge Inspection Standards (NBIS) at 23 CFR Part 650, Subpart C.

Decisions for bridge inspection and bridge management require current, accurate and sufficiently detailed data. Access to bridge data for decision makers can be provided through BrM. This application has features for generating bridge inspection reports, exporting tables of bridge data, and exporting KML files that can be opened in programs such as Google Earth. Inventory, inspection and construction program data can also be accessed directly. These direct links to bridge information ensure that the most current information is used to guide decisions.

3.4.3 Bridge Data and Bridge Program Allocation Development

Current and historic bridge inspection data, inventory data and documentation are used to guide bridge programming decisions. Strategies for bridge work are developed for three groups of bridges. The consequences and likelihood of condition and serviceability changes are evaluated for these groups of bridges.

- poor condition bridges that need major work such as replacement
- bridges that are on roadway projects, which can provide an opportunity to perform bridge work without additional traffic disruption
- good condition bridges that are high-asset value candidates for preservation

Bridge inspection data is screened by an automated risk-based decision tree process for major work (Re-decking, Rehabilitation and Replacement)[31]. The NDOT Bridge Management Section performs an engineering review of the automated results and other inspection data to identify and confirm candidates for bridge work programming. Low-condition bridges that are candidates for major replacement or rehabilitation work are prioritized. Top priority candidates are assigned a suggested year for inclusion in the construction program. Lower priority candidates are included for a 10-year planning

[30] The 23 Metrics for the Oversight of the National Bridge Inspection Program https://www.fhwa.dot.gov/bridge/nbis.cfm

[31] See Appendix C for an illustration of the major bridge work decision tree.

horizon. These lower priority candidates are reviewed annually for inclusion in the construction program.

Similarly, good condition bridges with high-asset value are identified as preservation candidates in an automated process.[32] Next, an engineering review evaluates and specifies preservation strategies. There is a window of opportunity for application of preservation treatments. Prioritization for preservation work increases with time, before bridges deteriorate from good to fair condition. Top-priority bridges are suggested for programming.

Roadway projects provide a significant opportunity for bridge work without causing added traffic disruption. Most bridge preservation strategies are delivered in coordination with roadway projects. On average, roadway projects occur about every 15-20 years in the vicinity of State and NHS bridges. As roadway projects are developed, any bridges that are in the roadway project limits are reviewed by the Bridge Management Section. Typical work that is performed on bridges in conjunction with roadway work are concrete repairs and application of bridge deck preservation treatments such as epoxy polymer overlays, or asphalt overlay with a waterproofing membrane system and joint replacement.

Bridge management decisions are augmented by a combination of in-house and customized commercial software including AASHTOWare BrM and the FHWA Life Cycle Cost Analysis tool RealCost. Categories of repair strategies are evaluated with Life-Cycle Cost Analysis to assure long-term cost effectiveness.[33]

3.5 Performance Measures

NDOT uses a performance-based approach to manage its pavement and bridge transportation assets. Each year, NDOT 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 NDOT's Annual Report[34].

Moving forward, NDOT will continue to use state performance measures for management of assets and reporting to the NDOT Annual Report. In addition, NDOT will report the following pavement indices to the FHWA to be used in determining national performance measures:

1. Average IRI
2. Cracking Percentage
3. Average Depth of Rutting
4. Average Height of Faulting

[32] See Appendix C for more information about candidate selection for preservation and major work. The Bridge Management Manual

[33] Unit costs can be found at: http://dot.nebraska.gov/business-center/business-opp/hwy-bridge-lp/item-history/

[34] The annual report can be found at: http://dot.nebraska.gov/news-media/annual-report/

These indices will be used to determine whether a pavement section is considered Good, Fair, or Poor.

NDOT will report the following bridge indices to the FHWA to be used in determining national performance measures:

1. Deck rating
2. Superstructure rating
3. Substructure rating
4. Culvert rating

These indices will be used to determine whether a structure is considered Good, Fair, or Poor.

Additional historical indices used by NDOT to measure the performance of the State highway system are:

1. Number of Fatalities
2. Serious Injury Crashes
3. Motor Vehicle Crashes
4. Overhead as a Percentage of Annual Expenditures
5. Accuracy of Project Estimates in the One-Year Program
6. Construction Competitiveness
7. Corrective Action for Environmental Commitments
8. Percent of Projects Delivered in the One-Year Program
9. Percent of Projects Delivered in the Five-Year Program
10. Percent of Projects Completed Within the Number of Days Allowed
11. Number of Years to Prepare an Asset Preservation Project for Construction
12. Average Time to Complete the NEPA CE for Federally Funded Construction Projects
13. Percent of Miles of Pavement Rated Good or Better based on NSI
14. Percent of Miles on the NHS with IRI <95 in/mi
15. Percent of State-Owned Bridges in Good Condition
16. Percent of Total Deck Area Structurally Deficient
17. Omaha Urban Freeway Incident Clearance Time
18. Rural Interstate 80 Reliability

3.5.1 Pavement Performance Measures

NDOT's performance measures evaluate the condition and smoothness of pavement according to the Nebraska Serviceability Index (NSI) and the International Roughness Index (IRI). These performance measures are tracked in NDOT's Annual Report. For the purpose of this report, NDOT is setting state performance measure targets for NSI only.

Nebraska manages and sets targets for all non-interstate state highways the same regardless of whether they are on the NHS or not. The interstate system, being NDOT's highest priority has its own performance measure target.

Table 6 shows the pavement performance measures as well as NDOT's targets for each measure.

Table 6 State Pavement Performance Measures

Asset Type	Performance Measure	Target
Pavement	Weighted average NSI for the interstate system	≥86
	Weighted average NSI for the non-interstate NHS system	≥80

To achieve these goals, NDOT will invest in pavement preservation and preventative maintenance. NHS interstates and highways receive appropriate pavement designs and maintenance strategies to accommodate higher number of users and their economic and strategic importance.

As required by MAP-21, states must set national performance measures targets for pavements. These targets will be used to determine if Nebraska is making significant progress toward meeting the national performance measures targets.

Table 7 shows the national pavement performance measures for the NHS as well as NDOT's targets for each measure. These targets are set very conservatively due to limited cracking data.

Table 7 National Pavement Performance Measures

Asset Type	Performance Measure	2 and 4 Year Targets
Pavement	Percent of pavements on the interstate system in good condition	≥ 50
	Percent of pavements on the interstate system in poor condition	≤ 5
	Percent of pavements on the non-interstate National Highway System in good condition	≥ 40
	Percent of pavements on the non-interstate National Highway System in poor condition	≥ 10

3.5.2 Bridge Performance Measures

NDOT performance targets:

Table 8 State Bridge Performance Measures and Targets

Asset Type	Performance Measure	Target
Bridge	Percent of the total deck area of bridges in the state on the National Highway System located on bridges that have been classified as structurally deficient	≤ 10
	Percent of bridges on the State system and NHS in good or fair condition	≥ 95

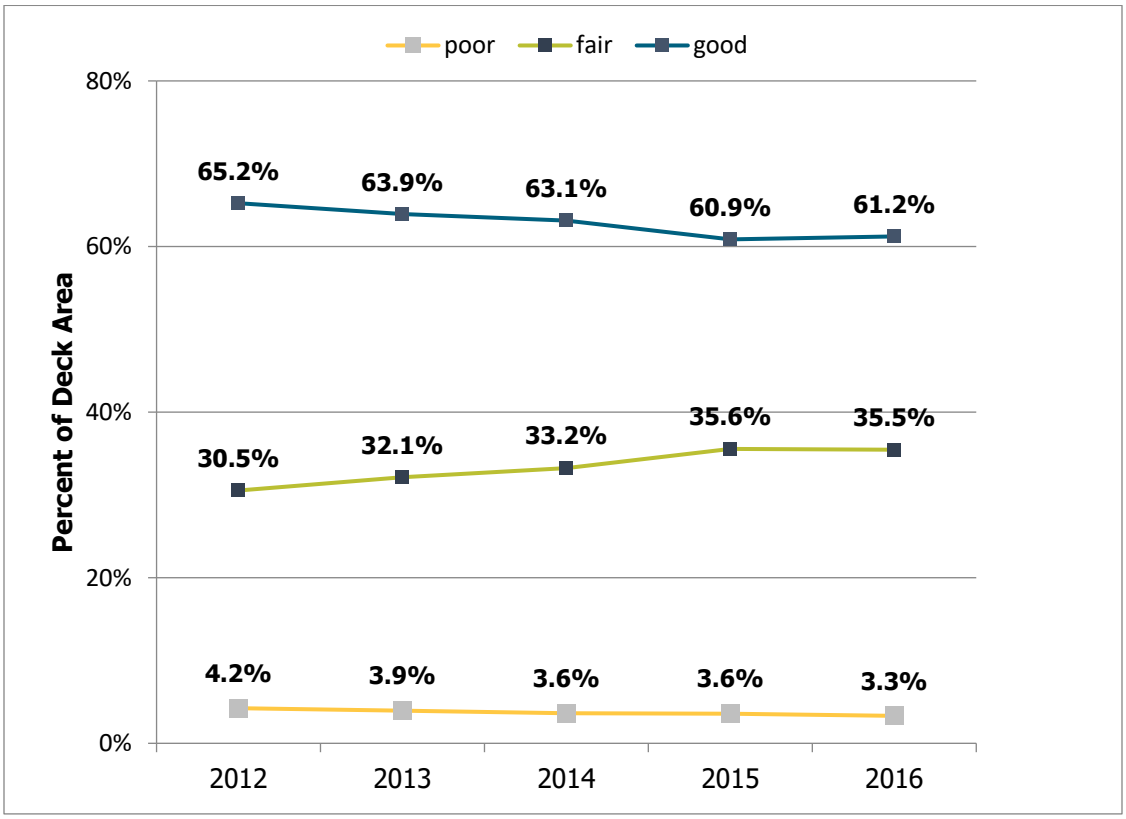

Figure 16 Historical Trends for State System Bridges in Good, Fair and Poor Condition (includes most of NHS

In recent years, Nebraska has achieved its performance goals for bridges on the NHS and State Highway System as shown in Figure 16.

Current Nebraska bridge performance measures are available in the NDOT Annual Report[35]. This report does not include the 61 NHS bridges that are not owned by the State. Additional information about Nebraska State, Local, and NHS system bridge conditions can be found in the Bridge Condition Report on the NDOT Bridge Division webpage[36].

Bridges are determined to be structurally deficient and good, fair or poor condition, as described in Chapter 2, Section 2.5 of this report.

As for pavements, states must set national performance measures targets for bridges. These targets will be used to determine if Nebraska is making significant progress toward meeting the national performance measures targets.

Table 9 shows the national bridge performance measures for the NHS.

Table 9 National Bridge Performance Measures

Asset Type	Performance Measure	2 and 4 Year Targets
Bridge	Percent of NHS bridges classified as in good condition	55 percent or more
	Percent of NHS bridges classified as in poor condition (structurally deficient)	10 percent or less

3.5.3 Locally-Owned NHS Performance Measures

The NDOT has coordinated with the state's four MPOs to help in the selection of performance measures for locally owned NHS routes. The NDOT has held two meetings with the MPOs to discuss the requirements and the performance measures Nebraska uses and why.

NDOT followed up with the MPOs on language for the NDOT/MPOs LRTPs and TIPs. This coordination helped the MPOs select their final PM2 performance measures after NDOT's performance targets were accepted.

Below are excerpts from the Lincoln and Omaha MPO LRTP's stating that they will be supporting NDOT PM2 performance measures. The Grand Island and South Sioux City MPOs do not own any NHS routes.

Lincoln MPO LRTP 2040 Amended May 2018, *"The Lincoln MPO has agreed to support the NDOT Statewide Performance Measure Targets to maintain Pavement Condition and Bridge Condition for the National Highway Performance Program (PM-2)".*

[35] The NDOT Annual Report can be found at: http://dot.nebraska.gov/news-media/annual-report/
[36] NDOT Bridge Division webpage can be found at: http://dot.nebraska.gov/business-center/bridge/

MAPA's LRTP 2040 Amended January 31, 2019. *"MAPA has chosen to support the Targets submitted by the Iowa and Nebraska Departments of Transportation in their most recent baseline period performance reports. The MPO supports those targets by reviewing and programming all Interstate and National Highway System projects within its boundary that are included in the DOTs' Transportation Improvement Programs".*

For more information, refer to Section 3.1.1.

NDOT will provide MPOs with a suggested 10-year pavement and bridge project candidate list for the local NHS routes as a tool to aid in their decision-making process. For examples of the pavement candidate list, see Figure 17.

District 1
Pavement Sections

Selected Projects Based on 10 Year Life Cycle Cost Analysis
Sorted by Hwy and Ref Post

Selected Candidate Years: 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029
Selected Strategies: All Strategies

HWY NUM	BEGIN REF. POST	END REF. POST	LANE	LENGTH	LOCATION	PRIORITY RANK	CB RANK	STRATEGY	CANDIDATE YEAR	EST. COST	NSI BEFORE STRATEGY	NSI AFTER STRATEGY	PROGRAM YEAR
5228	100.31	101.53	A	1.28	ROSA PARKS WAY LINCOLN	10.64	0.46	RH-PCC	2020	$669,440	91.24	100.00	
5228	100.31	101.53	A	1.28	ROSA PARKS WAY LINCOLN	2.04	1.60	ML1AC	2024	$12,800	90.00	92.50	
5228	100.31	101.53	A	1.28	ROSA PARKS WAY LINCOLN	2.56	2.01	ML2AC	2028	$47,360	82.50	87.50	
5228	100.31	101.53	D	1.28	ROSA PARKS WAY LINCOLN	11.04	0.75	RH-PCC	2021	$669,440	82.00	100.00	
5228	100.31	101.53	D	1.28	ROSA PARKS WAY LINCOLN	2.04	1.60	ML1AC	2025	$12,800	90.00	92.50	
5228	100.31	101.53	D	1.28	ROSA PARKS WAY LINCOLN	2.56	2.01	ML2AC	2029	$47,360	82.50	87.50	
5228	101.53	101.84	A	0.31	ROSA PARKS WAY LINCOLN	10.97	0.84	RH-PCC	2021	$162,130	82.00	100.00	
5228	101.53	101.84	A	0.31	ROSA PARKS WAY LINCOLN	2.00	1.60	ML1AC	2025	$3,100	90.00	92.50	
5228	101.53	101.84	A	0.31	ROSA PARKS WAY LINCOLN	2.51	2.01	ML2AC	2029	$11,470	82.50	87.50	
5228	101.84	102.28	A	0.46	K STREET LINCOLN	12.27	1.77	RH-PCC	2020	$240,580	58.00	100.00	
5228	101.84	102.28	A	0.46	K STREET LINCOLN	2.00	1.60	ML1AC	2024	$4,600	90.00	92.50	
5228	101.84	102.28	A	0.46	K STREET LINCOLN	2.51	2.01	ML2AC	2028	$17,020	82.50	87.50	
5230	101.17	101.87	A	0.70	CAPITAL PARKWAY WEST LINCOLN	10.70	0.65	RH-PCC	2020	$366,100	87.24	100.00	
5230	101.17	101.87	A	0.70	CAPITAL PARKWAY WEST LINCOLN	2.00	1.60	ML1AC	2024	$7,000	90.00	92.50	
5230	101.17	101.87	A	0.70	CAPITAL PARKWAY WEST LINCOLN	2.51	2.01	ML2AC	2028	$25,900	82.50	87.50	
5231	109.78	110.38	A	0.60	27TH STREET INTERCHANGE, LINCOLN	2.34	1.87	ML1PCC	2027	$22,470	88.00	93.00	
5231	109.78	110.38	D	0.60	27TH STREET INTERCHANGE, LINCOLN	2.34	1.87	ML1PCC	2027	$22,470	88.00	93.00	
5248	100.00	101.75	A	1.88	W CORNHUSKER HWY LINCOLN	1.63	1.28	ML2AC	2020	$69,560	78.00	83.00	
5248	100.00	101.75	A	1.88	W CORNHUSKER HWY LINCOLN	3.18	2.23	RS-AC	2024	$658,000	63.00	100.00	
5248	100.00	101.75	A	1.88	W CORNHUSKER HWY LINCOLN	2.04	1.60	ML1AC	2028	$18,800	90.00	92.50	
5248	100.00	101.75	D	1.88	W CORNHUSKER HWY LINCOLN	1.57	1.23	ML2AC	2020	$69,560	78.00	83.00	
5248	100.00	101.75	D	1.88	W CORNHUSKER HWY LINCOLN	3.18	2.23	RS-AC	2024	$658,000	63.00	100.00	
5248	100.00	101.75	D	1.88	W CORNHUSKER HWY LINCOLN	2.04	1.60	ML1AC	2028	$18,800	90.00	92.50	

Figure 17 Example Project Candidate List for MPOs

Chapter 4 Performance Gap Identification

4.1 Overview

A performance gap is defined as the difference between existing and desired performance. Minimizing performance gaps for pavement and bridges at the lowest practicable costs is the goal of asset management and the key to improving mobility, safety and reliability of the system. Best performance at a given funding level can only be achieved when allocations are properly made and project delivery realizes the results of good allocation decisions. Understanding the ways in which existing funding levels will affect future asset management practices is also necessary for developing meaningful performance targets. For example, if effective asset management allocations are not made for preservation projects, future replacement costs will increase. Targets for pavement and bridge performance were addressed in Chapter 3. Every year NDOT evaluates the funding projections and asset conditions to assess funding adequacy. At the time of the TAMP's publication, Nebraska met the pavement and bridge performance targets listed in Chapter 3. By meeting the performance targets, Nebraska Roads and Bridges are in a State of Good Repair (SOGR)[37]. There is currently no gap between performance targets and performance measures.

4.2 Defining Short- and Long-Term Planning Horizons

NDOT has developed, and continues to implement short and long term planning horizons to meet agency goals and communicate with stakeholders as projects develop. Implementation of the TAMP is a continuation of Nebraska's asset management process which has resulted in a SOGR. It is expected that with continued, current funding levels and allocation strategies that are in alignment with practices described in the TAMP, NDOT will be able to maintain a SOGR.

4.2.1 Short-Term Plan

NDOT's short-term planning horizons for asset management results in the Nebraska Surface Transportation Program Book and the Statewide Transportation Improvement Program (STIP).

The Nebraska Surface Transportation Program is developed annually based on cash flow analysis, funding projections, funding allocations, a system wide 10-year project candidate list based on Life Cycle Analysis, and project delivery schedules.

Each year, the pavement condition assessment and the POP application is used to generate a 10-year project candidate list. Each project is given a rank based on condition, benefit/cost, and a priority assessment (see Section 4.3.1 for more details). The project candidate list provides decision makers with the rank of each project, the optimum year of rehabilitation, a recommended rehab strategy, and an estimated cost. The optimum year is the year when the benefit to cost ratio of rehabilitating the pavement is at the maximum.

[37] For a definition of "State of Good Repair", see Appendix B.

Bridges that are confirmed candidates for replacement, but are low-risk and considered to have remaining service of 10 years or less, but do have service life value beyond the timeframe of the Surface Transportation Program are monitored and prioritized annually. Only minimal preservation would be performed on these bridges as needed for short-term safety. Similarly, large-scale preservation work on high asset value bridges, also receives annual review for inclusion in the program. A risk-based approach to both replacement and preservation work is used to rank candidates[38].

Bridges within the limits of proposed Roadway projects are evaluated for maintenance and preservation needs. Roadway projects provide an opportunity for bridge work that keeps bridges in a state of good repair. Strategies for "opportunistic" bridge preservation and repair are evaluated for life cycle cost effectiveness at the typical frequency of roadway projects.

The STIP is the NDOT four-year Highway Improvement Program developed under Title 23 United States Code (USC), Section 135 Statewide Planning, (f) Statewide Transportation Improvement Program. It includes by reference the Transportation Improvement Programs (TIP's) from the Omaha, Lincoln, Grand Island area and South Sioux City metropolitan planning Organizations (MPOs.)

The STIP is a programming tool that receives joint approval from FHWA and the Federal Transit Authority (FTA) annually. Projects included in the STIP are consistent with the Nebraska Long Range Transportation Plan, Freight plan, and the Nebraska Needs Study. Projects included in the MPO TIP's must be consistent with their Long Term Transportation Plans. The STIP includes financial summary tables to demonstrate fiscal constraint. Projects that are funded in the TIP/STIP and constructed, implemented, operated or maintained using Federal dollars must conform to Federal, State or local regulations/statutes that are applicable based on the type of project, type of funding received, scope of work and/or impact to the natural or human environments. The STIP and TIP must be fiscally constrained, which is defined as a "demonstration of sufficient funds (Federal State, local and private) to implement proposed transportation system improvements as well as to operate and maintain the entire system through the comparison of revenues and costs". Cost and revenue estimates for the TIP's and STIP use the inflation rate(s) to reflect "year of expenditure dollars", based on reasonable financial principles and information. If no data is available, a minimum of 4 percent per year is used.

Nebraska STIP Guidelines are available on the NDOT Website[39] and include more detail about NDOT's role in MPO TIP develop and MPOs role in STIP development.

4.2.2 Long-Term Plan

In additional to the short-term planning horizon, NDOT also determines and communicates investment priorities and asset management activities over a 20-year planning horizon. There are many activities that inform long-term priorities and activities

[38] For more information about bridge work candidate selection and ranking see Appendix D.
[39] Nebraska STIP Guidelines available at: https://dot.nebraska.gov/projects/publications/stip/

including stakeholder engagement, study of economic factors, and engineering analysis. In addition, the LRTP is developed for the purpose of providing a vision for transportation development 20 years into the future and defines methods for measuring and monitoring progress toward plan goals and objectives. 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.

The projected funding levels that will be required to maintain agency goals are reported in the 20-year Needs Assessment[40]. A 20-year network capacity analysis for multi-modal transportation is done approximately every five years to assist in the development of needs and is reported in the federally required Long Range Transportation Plan (LRTP). The annual Needs Assessment quantifies the cost to eliminate all of the geometric and capacities needs while meeting agency performance goals for pavement and bridge conditions. Asset needs will never be completely eliminated due to annual deterioration. From Figure 18 below, the 20-year cost to eliminate the highway needs is $18 billion.

In addition to developing the State's LRTP, NDOT is collaborating with the Metropolitan Area Planning Agency (MAPA) to complete the Metro Area Travel Improvement Study (MTIS) for the Omaha area. MTIS is a comprehensive transportation study that will help identify the long-term needs of the community. This multi-modal plan will:

- Develop a plan for the interstate and other major roadways in the region including NHS routes
- Prioritize projects for the short, mid, and long-term
- And consider existing funding sources through 2040

The technical analysis for this study will be used to update future long-range transportation plans for MAPA and the State.

NDOT recognizes the need to invest in preserving the existing system with well-timed maintenance cycles, and new strategies, technologies, and products that yield long-term benefits with less maintenance.

Future growth of demand on the NHS and the State Highway System is monitored and as described in Chapter 6. Project design standards are based on estimates of future traffic needs to maintain the effectiveness of the transportation system.

[40] The Nebraska Needs Assessment can be found at: http://dot.nebraska.gov/business-center/financial-reports/

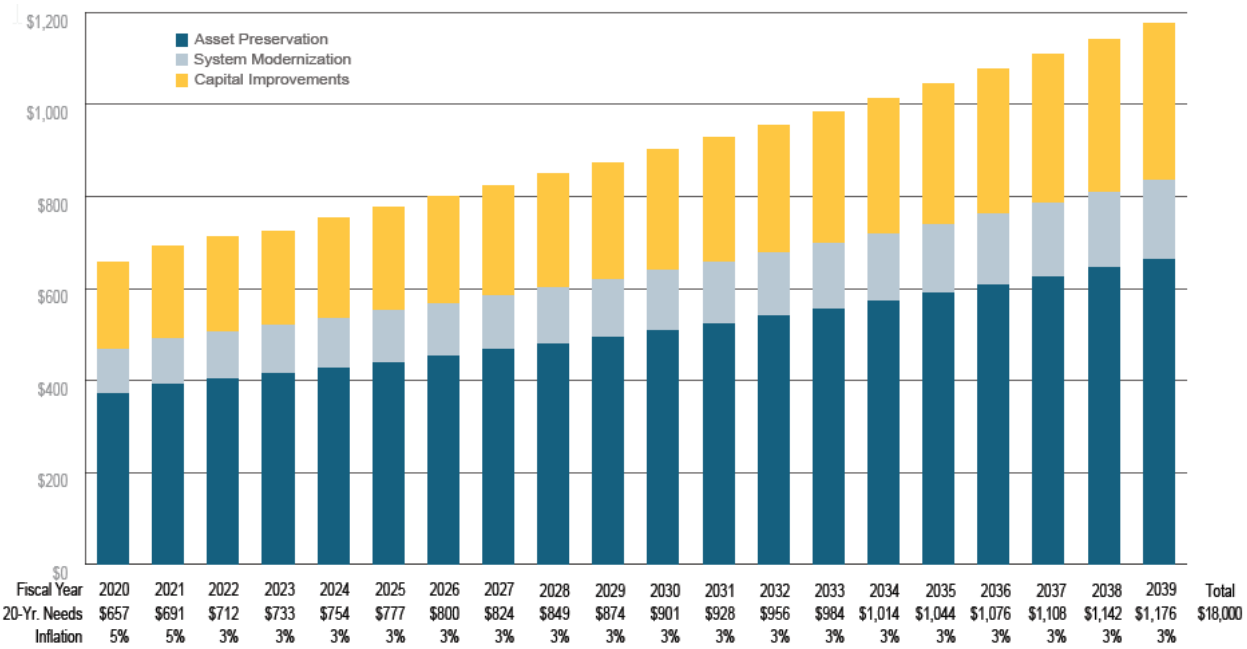

Figure 18 2018 State Highway System Inflated Needs

4.3 Strategies Used to Address Performance Gap

NDOT analyzes and tracks the impact of recent investments, defines, and identifies needs, establishes statewide priorities for projected revenue, and identifies strategies to ensure that resources are used efficiently and effectively.

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. NDOT continues to explore new technology and materials, with the intent to improve bridge and pavement performance and extend the life of those assets.

Historically, NDOT has met performance goals for both pavement and bridges. Should conditions of these assets fall below NDOT targets an increased emphasis would be placed on the following strategies until the performance target is achieved:

- Unmet performance targets are identified, prioritized, and corrected as described in Sections 3.3.2 and 3.4.3
    - Unmet performance targets are identified by monitoring current data as reported in the Annual report
    - The 10-year system wide analysis that creates the project candidate list uses a ranking that prioritizes projects on the higher classified routes: interstates, freeways & expressways, and principal arterials, which make up the NHS. Program adjustments are made to include, prioritized projects and close performance gaps (see Section 4.3.1 below for more details).
    - Higher standards for pavement and bridge designs on high priority routes,

provides lasting performance maintains good conditions longer and reduces performance gaps.
    - Large bridges in high traffic areas are prioritized for preservation with deck protection systems to maintain good condition longer and reduce performance gaps at a lower cost.

- Strategies to close or mitigate gaps may include the following:

    - Increased funding emphasis on assets that are on the NHS
    - Consider advancing projects that have a high impact on performance measures
    - Delay projects with lower life cycle benefit/cost impacts
    - Engage the public and lawmakers, communicate the performance gap and options (i.e.: new revenues and funding increases).
    - Modification of performance targets for some segments or corridors.

NDOT has had recent success securing additional funding at the State level via the Build Nebraska Act and Transportation Innovation Act as described below:

- Build Nebraska Act

  In 2011, Nebraska's legislature passed the Build Nebraska Act (BNA) in response to current surface transportation needs. 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. NDOT will use 85 percent 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 percent to counties and municipalities for road and street purposes.

- Transportation Innovation Act/Transportation Innovation Bank Fund

  In 2016, Nebraska's legislature enacted the Transportation Innovation Act (TIA), which provides new tools to accelerate project delivery such as design-build, which was previously not allowed by law. In addition, this new act provided an initial $450 million to fund the Transportation Infrastructure Bank through June of 2033. These funds will be available for projects that provide increased mobility, freight, and safety benefits.

4.3.1 Pavement Management Project Priority Assessment

NDOT has built a prioritization assessment into the POP Life Cycle Cost Analysis. Through this assessment, project candidates receive rankings based on Functional Classification, Population Density, Strategy Type, and Project Length. As a result, roadways on higher classified routes i.e. interstates, freeways & expressways, and principal arterials receive a higher ranking. These routes primarily make up the NHS; therefore, the NHS receives a higher priority for selection. This proactive process helps deter gaps in performance and reduces the risks related to pavement deterioration.

This priority component was based on NCHRP Report 706. The guidelines from the report and Nebraska's responses are shown in Table 10.

Table 10 Nebraska's Pavement Management Priority Assessment

NCHRP 706 Proposed Guidelines for Risk Assessment	Nebraska's Priority Assessment
Establish Risk Tolerances	Allow lower condition ratings on less traveled routes
Impacts or Consequences	Type of improvement strategy and project length
Strategies or Countermeasures	Decision tree for the right action at the right time
Prioritize/Management Plan	Life Cycle Cost Analysis in POP with the new priority assessed B/C ratio
Measure or Monitor Effectiveness	Compare candidate list to the program list and performance measures

a. Establish Risk Tolerance's – To meet this guideline Nebraska decided to allow lower pavement condition ratings on less traveled routes. Two factors were developed to address this guideline. The first is based on National Functional Classifications, which would assign a higher value to higher classified routes as shown in Table 11. The second is based on the population density of the county the project is located in as shown in Table 12 and Figure 19.

Table 11 System Factors for Classifications

System Factor	National Functional Classification
0.25	Interstate
0.20	Other Freeway/Expressways
0.15	Other Principal Arterials
0.10	Minor Arterials
0.05	Major Collectors
0.01	Minor Collectors/Locals

Table 12 System Factors for Population Density

Population Density Factor	County Density (See Map)
0.1	High
0.05	Moderate
0.025	Low

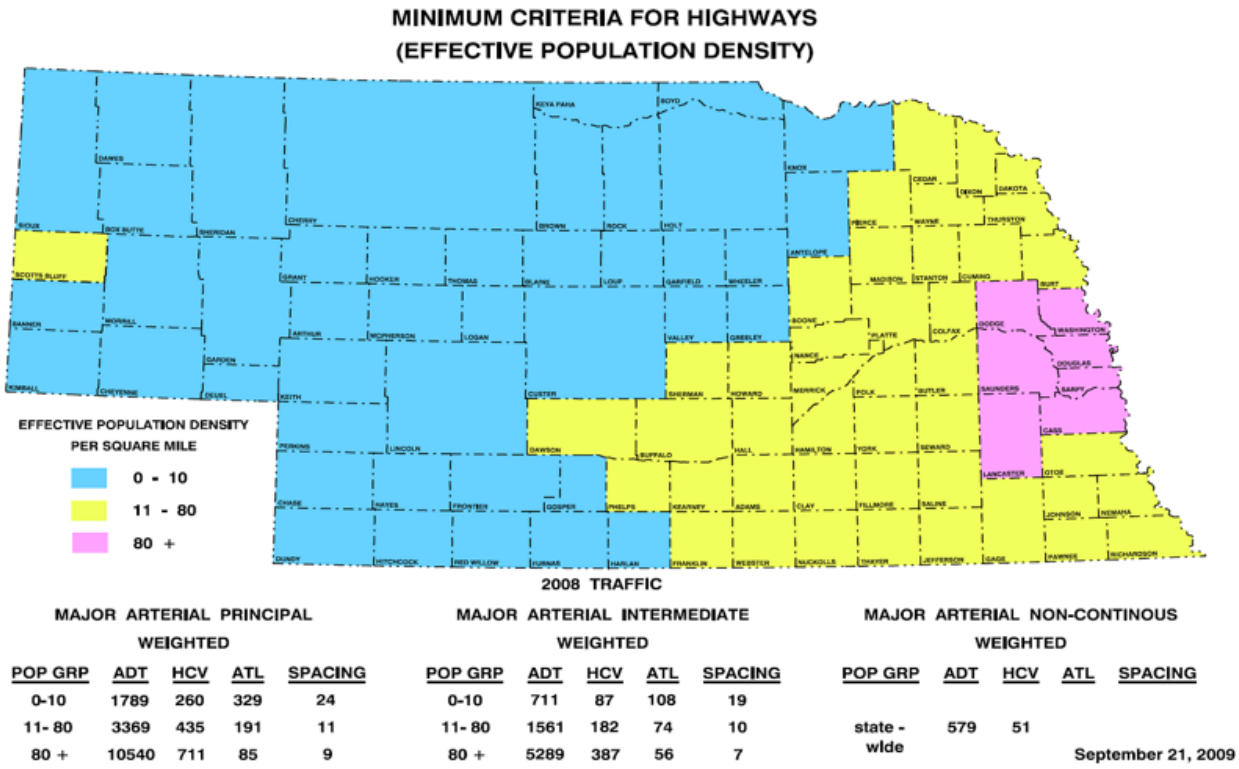

Figure 19 Population Density Map

b. Impacts or Consequences – To meet this guideline Nebraska developed two factors based on the improvement strategy and length of project. Short maintenance projects would have a lower impact then major resurfacing projects that are of significant length. The first factor is based on the improvement strategy as shown in Table 13. The second factor is based on the project length as shown in Table 14.

Table 13 System Factors for Improvement Strategy

Improvement Strategy Factor	Strategy
0.2	Resurfacing/Rehabilitation
0.1	Thin lift overlays
0.05	Maintenance

Table 14 System Factors for Project Length

Project Length Factor	Length
0.1	> 3 miles
0.05	1 – 3 Miles
0.025	< 1 mile

c. Strategies or Countermeasures – For this proposed guideline Nebraska used our existing decision trees, which select the right strategy at the right time. The decision trees shown in Figures 20 & 21 are part of the pavement management program POP. Table 15 shows the decision tree strategies and definitions.

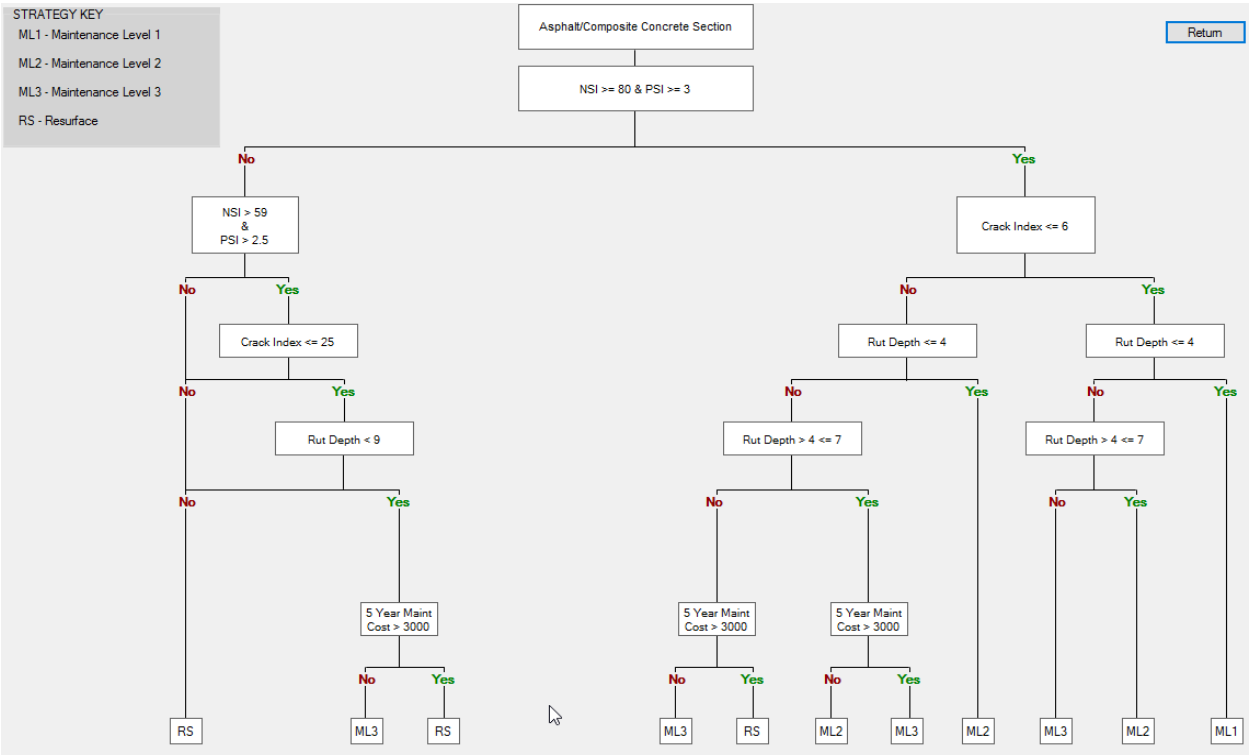

Figure 20 POP Asphalt Decision Tree

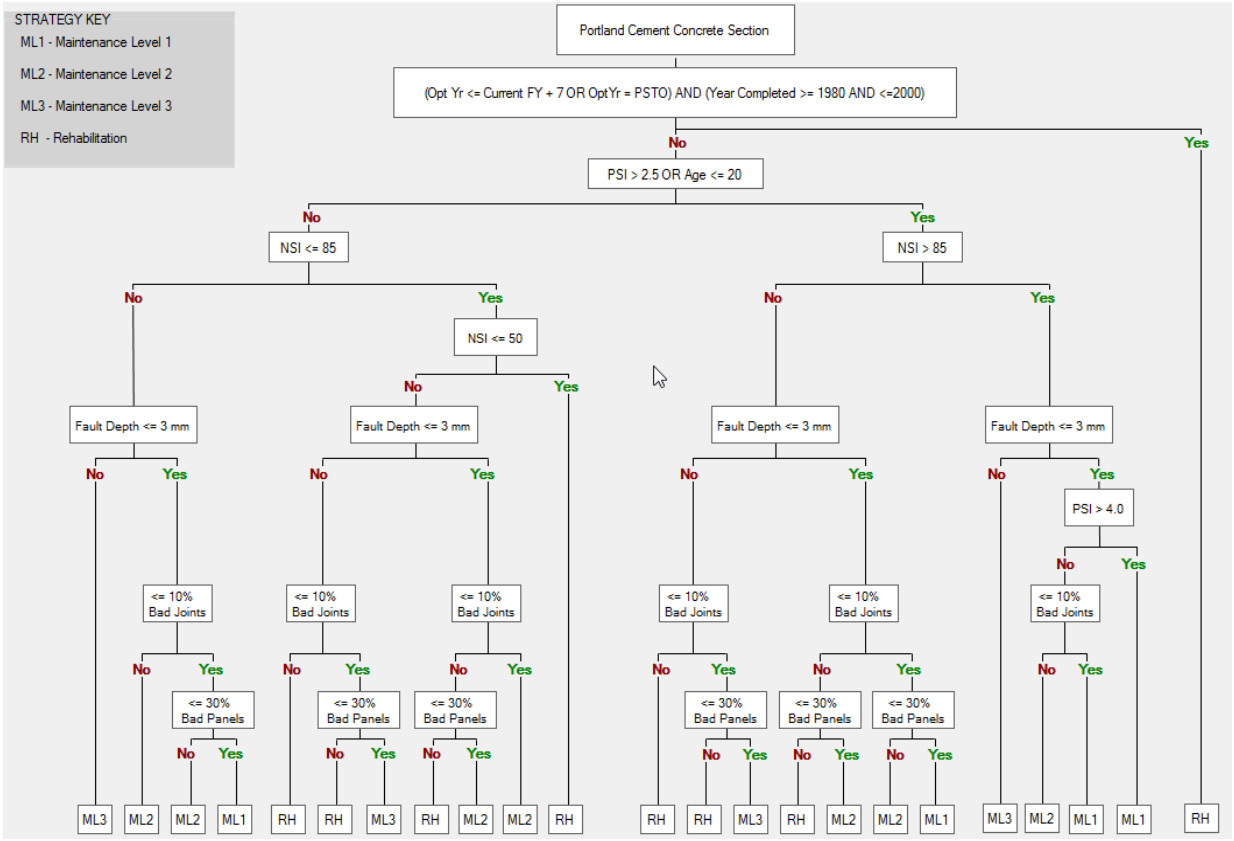

Figure 21 POP Concrete Decision Tree

Table 15 Pavement Strategy Definitions

ML1AC Maintenance Level 1	Example: Crack Sealing, Fog Sealing, Skin Patching
ML2AC Maintenance Level 2	Example: Armor Coats, Chip Sealing, Machine Patch, Mill and Armor Coat
ML3AC Maintenance Level 3	Example: Mill and Overlay, Thin Overlay
RSAC Resurface	Example: Resurfacing
ML1PCC Maintenance Level 1	Example: Joint and Crack Sealing
ML2PCC Maintenance Level 2	Example: Joint and Panel Repair with Sealing
ML3PCC Maintenance Level 3	Example: Diamond Grind, Panel and Joint repair with Sealing
RHPCC Rehabilitation	Example: Repair and Resurfacing Future analysis will be based on ACC

d. Prioritize/Management Plan – For this guideline, Nebraska uses the Life Cycle Cost Analysis in POP combined with priority assessment to rank project candidates for inclusion in the Surface Transportation Program. See Figure 23 for an example of a 10-year project candidate list with priority ranking.

e. Measure or Monitor Effectiveness – To measure and monitor the effectiveness of risk ranking, the candidate lists are compared to the program list. To date approximately 70 percent of the candidate projects are included in the Surface Transportation Program. NDOT also monitors the performance measures for NSI, which currently shows NDOT meeting targets.

4.4 Summary of Performance Gap Identification

The program book shows the 1 & 5-year plan, while the STIP shows a fiscally constrained 4-year plan. For the following years of the analysis, years 6-10, the POP and the Bridge management systems, evaluate the needs based on the 10-year project candidate list. The cost of meeting those needs are reported based on the input described above. Investment strategies to maintain system performance targets are evaluated using POP tools. Using POP and the bridge management tools, NDOT predicts the average condition and distribution of condition over the complete state highway and bridge network at various funding levels.

Chapter 5 Life Cycle Cost Analysis

5.1 Overview

NDOT'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, decision-making, maintenance, rehabilitation, and disposal or replacement. These phases are shown in Figure 22.

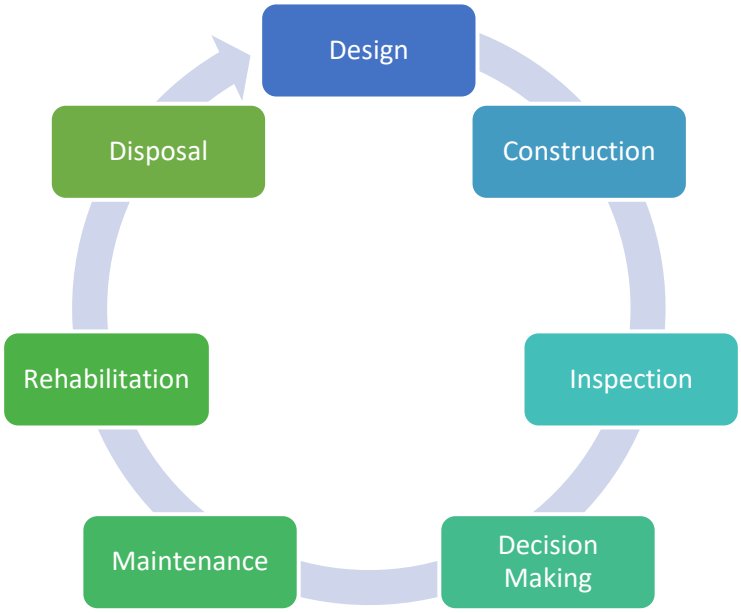

Figure 22 Pavement and Bridge Life Cycle Phases

5.2 Pavement Life Cycle

5.2.1 Pavement Design

Pavements are designed in accordance with the Nebraska Pavement Design Manual[41], AASHTO Guide for Design of Pavement Structures[42], AASHTOWare Pavement ME Design[43], and NDOT policies and practices.

[41] The NDOT Pavement Design Manual can be found at: http://dot.nebraska.gov/business-center/materials/
[42] The AASHTO Guide for Design of Pavement Structures can be found at: https://bookstore.transportation.org/collection_detail.aspx?ID=87
[43] Further information on ME-Design can be found at: http://me-design.com/MEDesign/

5.2.2 Pavement Construction

Highway construction is performed according to the Contract, including the plans and special provisions, the Nebraska Construction Manual, Nebraska Standard Specifications for Highway Construction, and the Nebraska Material Sampling Guide. The plans for highway construction are developed according to the Nebraska Roadway Design Manual and the Nebraska Minimum Design Standards for Highways, Roads and Streets.

5.2.3 Pavement Inspection

Pavements are inspected annually for deterioration and distresses. Condition assessment values are loaded to the mainframe and used by POP for analysis. Refer to Section 2.4 for additional information.

5.2.4 Pavement Decision Making

The Pavement Asset Management section is responsible for providing the Interstate Task Force book, 10-year project candidate lists that have the best benefit/cost ratio for improvement with a limited budget for highway segments, and the condition maps for the highway system. This information is given to Program Management, District Engineers, and their highway commissioners to use for assisting in establishing future construction programs. These reports provide decision makers with supplemental information that assists the decision making process.

These reports are created using POP, which analyzes the projected deterioration of pavement sections for a 10-year period and selects the most efficient strategies based on the best benefit/cost ratios for each year for applied annual budgets. This analysis can be run for various highway systems including the NHS. 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. See Figure 23 for an example 10-year project candidate list provided to Program Management and the District Engineers to help in the selection of the construction program. This same type of report will be provided to local NHS owners to help in their selection of projects.

NDOT uses history graphs in POP to determine deterioration rates for ACC and PCC pavements and track the performance of rehabilitation strategies. NDOT currently incorporates four deterioration rates for ACC pavements: PSI, cracking, rutting, and NSI. Five deterioration rates are used for PCC pavements; PSI, faulting, joint condition, slab cracking, and NSI. These deterioration rates along with the age of the pavement and the current condition values are used to determine the optimum rehabilitation year. This is the year when the benefit to cost ratio of rehabilitation is at a maximum. Details can be found in the Pavement Management Systems Manual[44].

[44] Pavement Management Systems Manual: http://dot.nebraska.gov/business-center/materials/

When ranking and selecting rehabilitation candidates, NDOT 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 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.

District 1
Pavement Sections

Selected Projects Based on 10 Year Life Cycle Cost Analysis
Sorted by Hwy and Ref Post

Selected Candidate Years: 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029
Selected Strategies: All Strategies

HWY NUM	BEGIN REF. POST	END REF. POST	LANE DIR	LENGTH	LOCATION	PRIORITY RANK	CB RANK	STRATEGY	CANDIDATE YEAR	EST. COST	NSI BEFORE STRATEGY	NSI AFTER STRATEGY	PROGRAM YEAR
001	0.00	2.38	B	2.38	JCT US34-ELMWOOD	7.19	2.42	RS-AC	2026	$880,600	58.25	100.00	
001	2.38	7.31	B	4.93	ELMWOOD-MURDOCK	8.26	3.01	RS-AC	2022	$1,725,500	55.00	100.00	
001	7.31	12.91	B	5.60	MURDOCK-JCT N50	8.20	2.97	RS-AC	2023	$1,960,000	55.00	100.00	
002	456.63	456.80	B	0.17	S US77 INTERCHANGE	2.59	2.07	ML1PCC	2021	$9,550	65.00	70.00	2023
002	457.94	462.31	A	4.36	9TH ST-56TH ST LINCOLN	3.17	2.15	RS-AC	2029	$1,526,000	68.03	100.00	2023
002	457.94	462.31	D	4.36	9TH ST-56TH ST LINCOLN	3.17	2.15	RS-AC	2029	$1,526,000	68.29	100.00	2023
002	462.31	464.89	A	2.56	LINCOLN EAST	3.39	2.38	RS-AC	2027	$1,100,800	63.75	100.00	2023
002	462.31	464.89	D	2.56	LINCOLN EAST	3.32	2.33	RS-AC	2027	$1,100,800	63.75	100.00	2023
002	464.89	471.44	A	6.55	LINCOLN-JCT N43	11.86	0.78	RH-PCC	2020	$3,425,650	83.14	100.00	2023
002	464.89	471.44	D	6.55	LINCOLN-JCT N43	12.03	0.89	RH-PCC	2020	$3,425,650	79.44	100.00	2023
002	471.44	476.93	A	5.49	W JCT N43 - JCT S66A	11.99	0.74	RH-PCC	2021	$2,871,270	82.70	100.00	
002	471.44	476.93	D	5.49	W JCT N43 - JCT S66A	11.83	0.63	RH-PCC	2021	$2,871,270	84.99	100.00	
002	476.93	483.89	A	6.95	UNADILLA WEST	12.00	0.74	RH-PCC	2021	$3,634,850	82.22	100.00	
002	476.93	483.89	D	6.95	UNADILLA WEST	11.86	0.65	RH-PCC	2021	$3,634,850	84.46	100.00	
002	483.89	491.92	A	7.89	UNADILLA EAST	11.78	0.60	RH-PCC	2020	$4,126,470	85.90	100.00	
002	483.89	491.92	D	7.89	UNADILLA EAST	11.87	0.66	RH-PCC	2021	$4,126,470	84.67	100.00	
002	491.92	503.76	A	11.84	SYRACUSE-NEBR CITY	11.91	0.69	RH-PCC	2021	$6,192,320	82.70	100.00	2019
002	491.92	503.76	D	11.84	SYRACUSE-NEBR CITY	12.01	0.75	RH-PCC	2022	$6,192,320	82.00	100.00	2019
002	503.76	504.15	B	0.39	JCT US 75	3.23	2.19	RS-AC	2025	$304,200	63.45	100.00	
002	505.74	508.16	A	2.42	NEBRASKA CITY SE	3.03	2.02	RS-AC	2028	$1,040,600	70.63	100.00	
002	505.74	508.16	D	2.42	NEBRASKA CITY SE	3.02	2.01	RS-AC	2028	$1,040,600	70.64	100.00	
004	122.60	126.54	B	3.93	DAYKIN WEST	3.45	2.38	RS-AC	2025	$1,375,500	63.00	100.00	
004	126.54	133.58	B	7.03	DAYKIN EAST	7.64	2.27	RS-AC	2026	$2,601,100	58.00	100.00	
004	133.58	144.03	B	10.45	PLYMOUTH WEST	3.16	2.18	RS-AC	2029	$3,866,500	64.36	100.00	
004	144.03	152.66	B	8.69	PLYMOUTH EAST	3.21	2.22	RS-AC	2028	$3,041,500	68.50	100.00	
004	152.66	156.13	B	3.47	BEATRICE WEST	3.10	2.14	RS-AC	2028	$1,214,500	67.12	100.00	

Figure 23 District Candidate List Example

5.2.5 Pavement Maintenance

District maintenance personnel operate the highway system and are the front line resource. They are responsible for situational awareness, and providing insight into which segments are performing well and which are having difficulty making the expected service life. Through routine inspections, district staff ensure the smooth operation of the system by addressing public concerns, damage control, travel incidents, inclement

weather, emergencies, and providing alternate routes to maintain mobility during blockage. Regular inspections are necessary to monitor actual pavement life and to schedule future maintenance activities to provide cost effective pavement preservation or repair. The type of maintenance, as shown below, depends on the extent of the deterioration, the historical pavement information, previous work performed, and planned future work found in POP. This insures that NDOT does not double program activities and gets the most out of NDOT's dollars to meet the needs and expectations of the travelling public.

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 that preserves the system, slows future deterioration, and maintains or improves the functional condition of the system.

   Examples: crack sealing, dowel bar retrofitting, armor coating/chip sealing, fog sealing, 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 (more than one inch), milling, patching, and crack repair.

3. Emergency maintenance: Performed during an emergency, 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 emergencies.

Preventative maintenance has been shown to be 6 to 10 times more cost-effective than a "do nothing" strategy[45]. The effectiveness of the treatment is directly related to the condition of the pavement. Conservatively speaking, $1 spent for preventive maintenance will provide the same pavement condition that costs $4-5 if rehabilitation is needed. By extending the life of a pavement until it needs rehabilitation, preventative maintenance allows NDOT to even out the budget for both maintenance and construction.

[45] Johnson, A., and Snopl, P. (2000). *Best Practices Handbook on Asphalt Pavement Maintenance*, University of Minnesota, Minneapolis, Minnesota.

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 24.

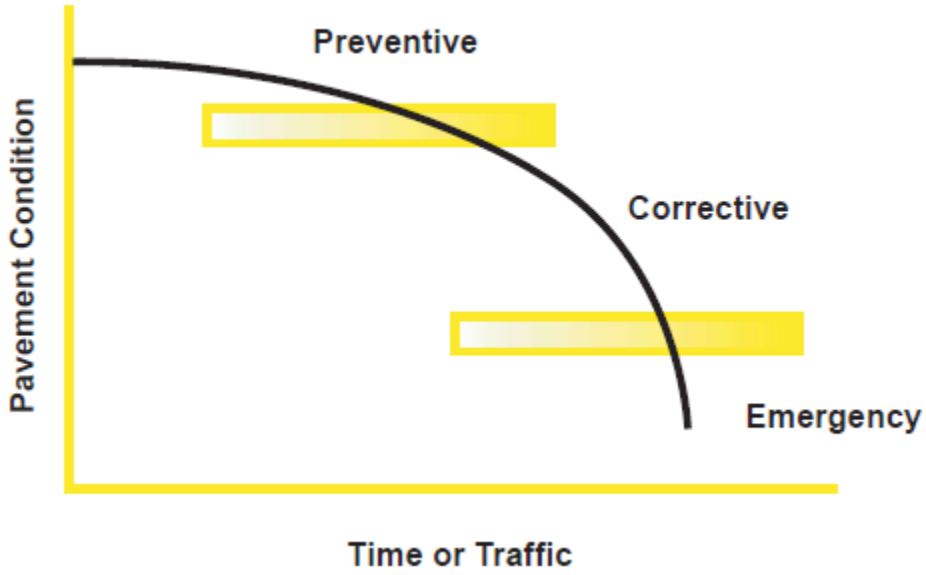

Figure 24 Pavement Maintenance Strategy Overlap

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.

Recommended maintenance treatments for pavement can be found in NDOT's Pavement Maintenance Manual[46]. A brief breakdown of specific treatments, their associated costs, and the number of years these treatments extend the lifetime of the pavement is provided in Tables 16 & 17 below. These strategies and estimated costs per mile are built into the POP Life Cycle Cost Analysis. The average costs were calculated from the previous year's maintenance and construction activities.

[46] The manual can be found online at: http://govdocs.nebraska.gov/epubs/R6000/H048-2002.pdf

Table 16 ACC Pavement Treatment Costs and Expected Life

Treatment	Average Cost[1] (mile)	Expected Life (years)
Crack seal / fill	$1.00/lin.ft[2]	3-5
Fog seal	$6,000	1-4
Chip seal / armor coat	$33,000 – $43,000	3-6
Microsurfacing	$70,000	3-8
Mill (1”)	$18,000	1-4
Cold-in-place recycle	$100,000	8-12
Hot-in-place recycle	$100,000	3-6
Thin hot mix overlay (1”)	$90,000	5-8
(2” overlay)	$146,000	7-9
Thick overlay (4”)	$268,000	8-15
Total reconstruction	$740,000	20+

[1] Costs shown are for a 24’ roadway unless otherwise noted.

Estimates based on 2018 Data

Table 17 PCC Pavement Treatment Costs and Expected Life

Treatment	Average Cost[1] (mile)	Expected Life (years)
Crack & joint seal / fill	$1.15-$3.00/lin.ft[2]	4-7
Partial / full depth slab / joint repair	$95-$110/ sq. yd.	10-15
Thin hot mix overlay (1½")	$120,000	6-10
Diamond grinding	$38,700-$115,400[3]	12-15
Cross stitching	$15-$25/bar	10-15
Thick hot mix overlay (4")	$268,000	8-12

[1] Since some of the treatments are often limited to one-lane, costs shown are per lane-mile unless otherwise noted.

[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.

Estimates based on 2018 Data

5.2.6 Pavement Rehabilitation

Historical evidence shows that pavements have a life ranging from 15 to 40 years, depending on the surface type, area of the state, and how much traffic they carry. Once a highway segment approaches the end of its service life, it becomes a candidate for rehabilitation.

Historically and currently, there are more candidates for major reconstruction or rehabilitation than can be included in the highway construction program. Highway segments may be excluded for various reasons, but these segments are reanalyzed with all other segments based on current condition for inclusion in the next year's 10-year project candidate list.

5.2.7 Pavement Disposal

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, replaced, or reconstructed, resetting the life cycle deterioration process.

5.3 Bridge Life Cycle

NDOT has the goal to extend the service life of bridges and keep them in a state of good repair at a minimum life cycle cost. The life cycle of a bridge begins with design and construction. Life cycle costs of bridge ownership guides bridge design, construction and maintenance decisions.

5.3.1 Bridge Design, Construction, and Service Life

Bridges are designed in accordance with the Nebraska Minimum Design Standards[47], the Bridge Office Policies and Procedures Manual[48] and current AASHTO Design and Construction Guidelines[49]. After construction, bridges are inspected before opening to traffic. While bridges are in service, they are typically inspected every 24 months.

The Information from bridge inspections is reported directly to the SQL server Data Warehouse by inspectors with a web-based installation of AASHTOWare BrM. NDOT uses in-house software to import and flag the recent inspection data for review candidates. The inspection reports are used to develop maintenance and repair strategies and to evaluate the effectiveness of previous design strategies.

Details about the Nebraska Bridge Inspection Program are published on the NDOT website[50].

5.3.2 Bridge Maintenance, Rehabilitation, and Disposal

Like pavement, bridge condition declines 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 extent of repairs required to keep Nebraska's bridges in a state of good repair.

Historically, bridge-length concrete culverts have a lifespan of about 80 years and require minimal maintenance. For these reasons, concrete culverts are used whenever possible. When a larger structure is required, bridges are needed. Nebraska bridges have a similar service life to concrete culverts, but require more maintenance to remain in good repair.

A typical historical maintenance plan for a bridge would involve the following:

- Year 0 - build and open the bridge to traffic
- Year 20 - repair and protect the bridge deck with a concrete overlay
- Year 40 - replace the bridge deck and perform some substructure or superstructure repairs
- Year 60 - repair and protect the second bridge deck with a concrete overlay
- Year 80 - replace the bridge with a new bridge

[47] https://dot.nebraska.gov/business-center/lpa/boards-liaison/training/class-and-standards/2010-class-standards/
[48] http://dot.nebraska.gov/business-center/bridge/
[49] https://bookstore.transportation.org/category_item.aspx?id=DS&gclid=COv_u77DhNUCFRm4wAodsdgJ1g
[50] Nebraska Bridge inspection information: http://dot.nebraska.gov/business-center/bridge/inspection/

In recent years, Nebraska has made changes to bridge preservation strategies. Current preservation methods are coordinated with paving projects and cause less disruption to the travelling public while keeping bridge decks in good condition longer. The two most common deck protection systems are Epoxy Polymer overlays (EPO) and Asphalt Overlays with Waterproofing Membranes (ACC&M). Both of these treatments have been found to be more cost effective than historical practices and perform well when applied at the frequency of roadway projects.

Figure 25 shows the typical cumulative present value costs for an average size Nebraska bridge when managed with historical and current preservation strategies.

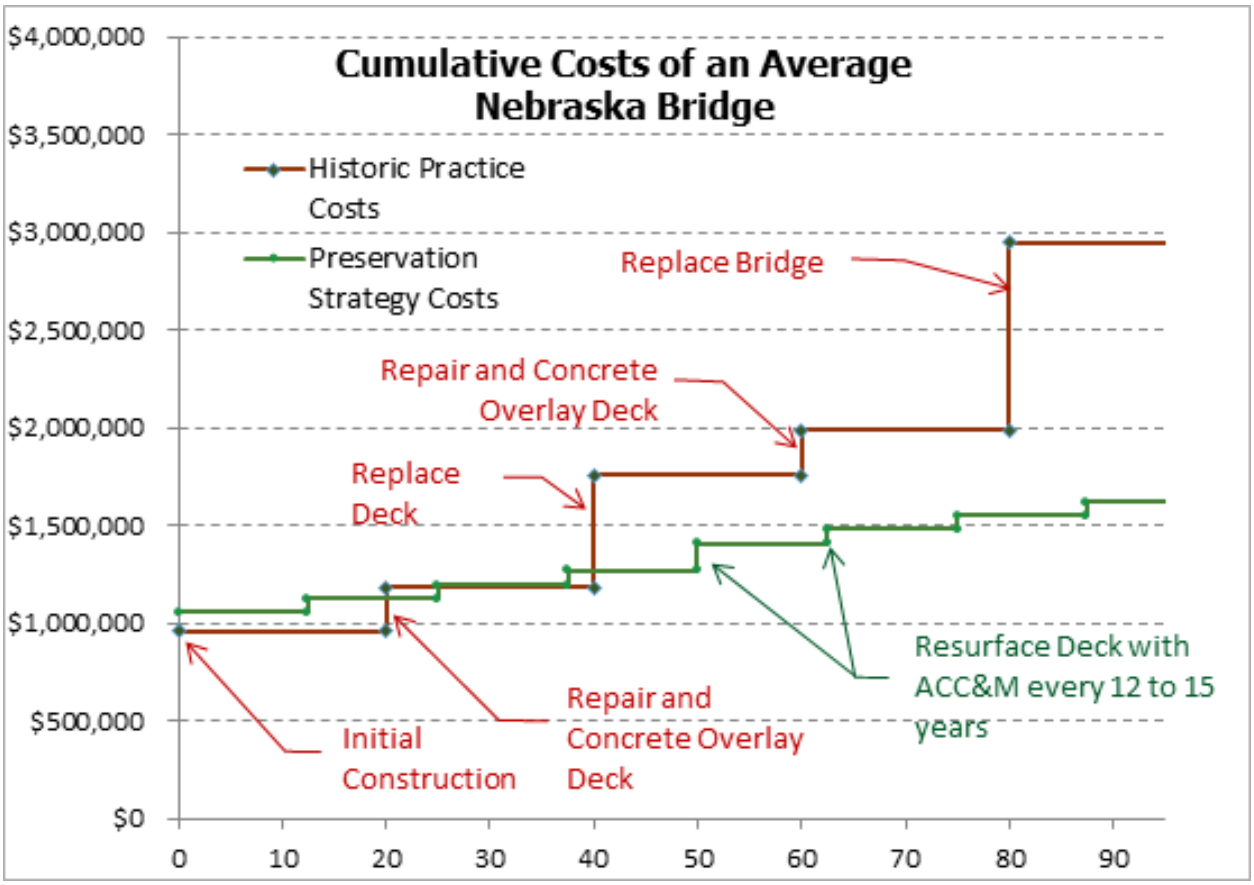

Figure 25 Cumulative Cost of Average Bridge with Historic and Current Preservation Strategies

Larger repairs can sometimes be avoided by periodic maintenance. Bridge inspectors report bridges that may need review for maintenance actions.

Periodic maintenance for bridges includes the following:

- Cleaning 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

5.4 Performance Summary

5.4.1 Pavement Life Cycle Cost Analysis

Within the POP software there is a life cycle benefit/cost analysis tool that is used to determine the most cost effective pavement strategy to meet performance targets. This analysis compares strategy options (see Tables 16 & 17) over a set period of time, the cost of each option, the available funding, predicted improvement in pavement condition, and the proper timing of each strategy to identify the least costly alternative. This analysis is used to develop long-term pavement preservation needs, which are documented in the 20-year NDOT Needs Assessment. For 10-year planning, life cycle benefit/cost analysis with the priority assessment is used to determine which highway segments are candidates to be included in the Surface Transportation Program.

5.4.2 Bridge Life Cycle Cost Analysis

Life Cycle Cost Analysis (LCCA) is used to choose between competing alternative strategies. To address the uncertainty associated with timing, cost, and effectiveness of various strategies, probabilistic analysis is used to check for the most likely outcomes from the combined factors that contribute to uncertainty. NDOT uses RealCost[51], an Excel-based LCCA tool that was developed by the FHWA. On the network level, common repair strategies are compared to find cost-effective categories of repair actions. On specific projects, LCCA is used for complex decisions when there is a large cost difference between competing alternatives. A typical case for project-specific LCCA would be to compare a shorter duration, lower cost repair to a longer duration, higher cost strategy. Bridges for which there is no cost-effective repair strategy become replacement candidates.

[51] Information about RealCost is available at: https://www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm

Chapter 6 Future Growth

6.1 Overview

NDOT employs effective asset management practices that consider how future user demand will affect 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

Eleven of Nebraska's counties are expected to experienced population growth through the year 2040 according to United States Census forecasts. 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 26). The same forecast data indicates Nebraska's total population exceeding two 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 increases in freight traffic volumes.

Commuters in urban areas 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. The City of Lincoln is anticipating an increase in transit ridership of 5-10 percent through 2020 due to changes in the routes and expanded hours. The City of Omaha is anticipating growth above and beyond their current 1 percent growth rate with the addition of their new bus rapid transit system called ORBT.

Additional transit services may need to be provided as Nebraska's population ages. By 2030, it is projected that an average of 20.4 percent of the total Nebraska population will be 65 and over. The usage and demand for paratransit services is likely to grow with the aging population in Nebraska, particularly in rural counties where fewer systems currently exist.

Ultimately, an increase in population means more users on the roadways, more stress on the existing infrastructure, and the construction of new roadways and bridges. The need for expanded transportation system capacity will continue in eastern Nebraska, in urbanized areas, and along the I-80 corridor, as well as the need for improved systems operation, infrastructure renewal, system preservation, mobility, accessibility, and maintenance throughout the state.

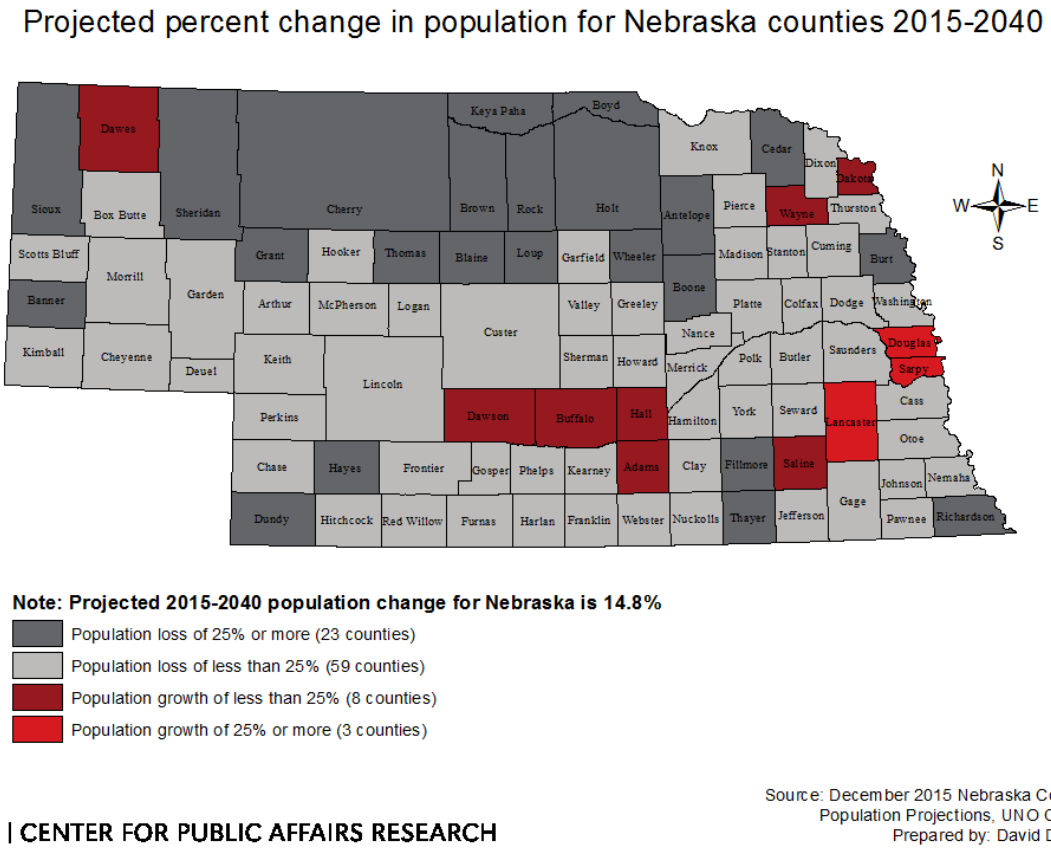

Figure 26 Forecast of Nebraska Population Change 2015-2040

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 254 million tons in 2015 to 331 million tons in 2045, representing a 30 percent increase. NDOT will take into account the increasing freight traffic on Nebraska's highways and the resulting impact on highway infrastructure. Overall, total freight movements for all modes of transport within the state will increase from 882 million tons in 2015 to 933 million tons in 2045. See Figure 27.

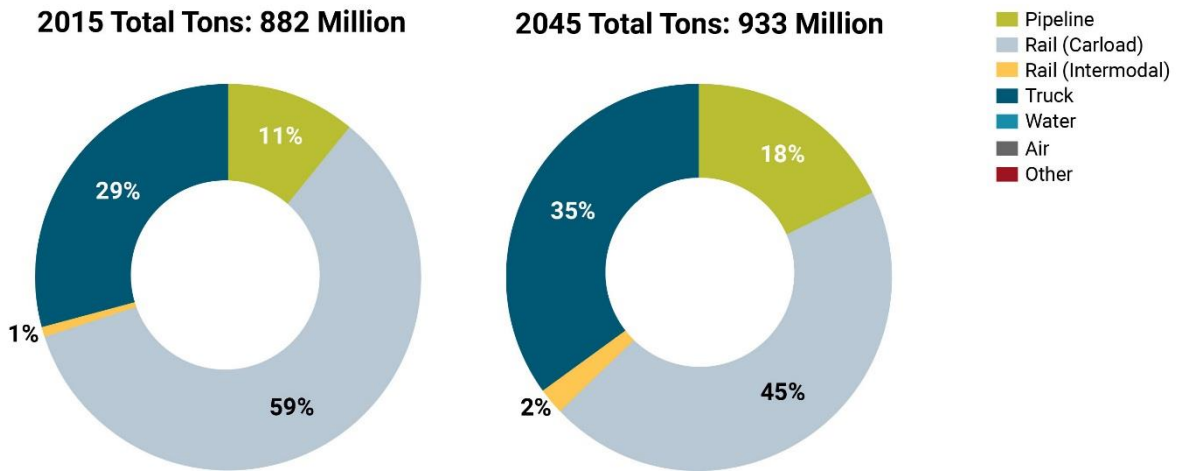

Figure 27 NDOT Target Setting Considerations – Freight Movement

6.2.3 Vehicle Miles of Travel (VMT) Growth

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 projected annual statewide VMT growth is approximately 1.7 percent, in comparison to the projected statewide population growth of just below 1.0 percent per year.

6.2.4 Annual Average Daily Traffic (AADT) Growth

NDOT uses its historic trend traffic data collected on an annual basis to forecast future Annual Average Daily Traffic (AADT) volumes for State and Federal highways within Nebraska. This process uses a 20-year trend of historic traffic data to predict future volumes for specific locations where traffic is collected within a highway project's limits. NDOT uses a linear projection of these observed trends on State and Federal highways and an average of linear and exponential trends on interstate facilities to provide forecasts (see Figure 28).

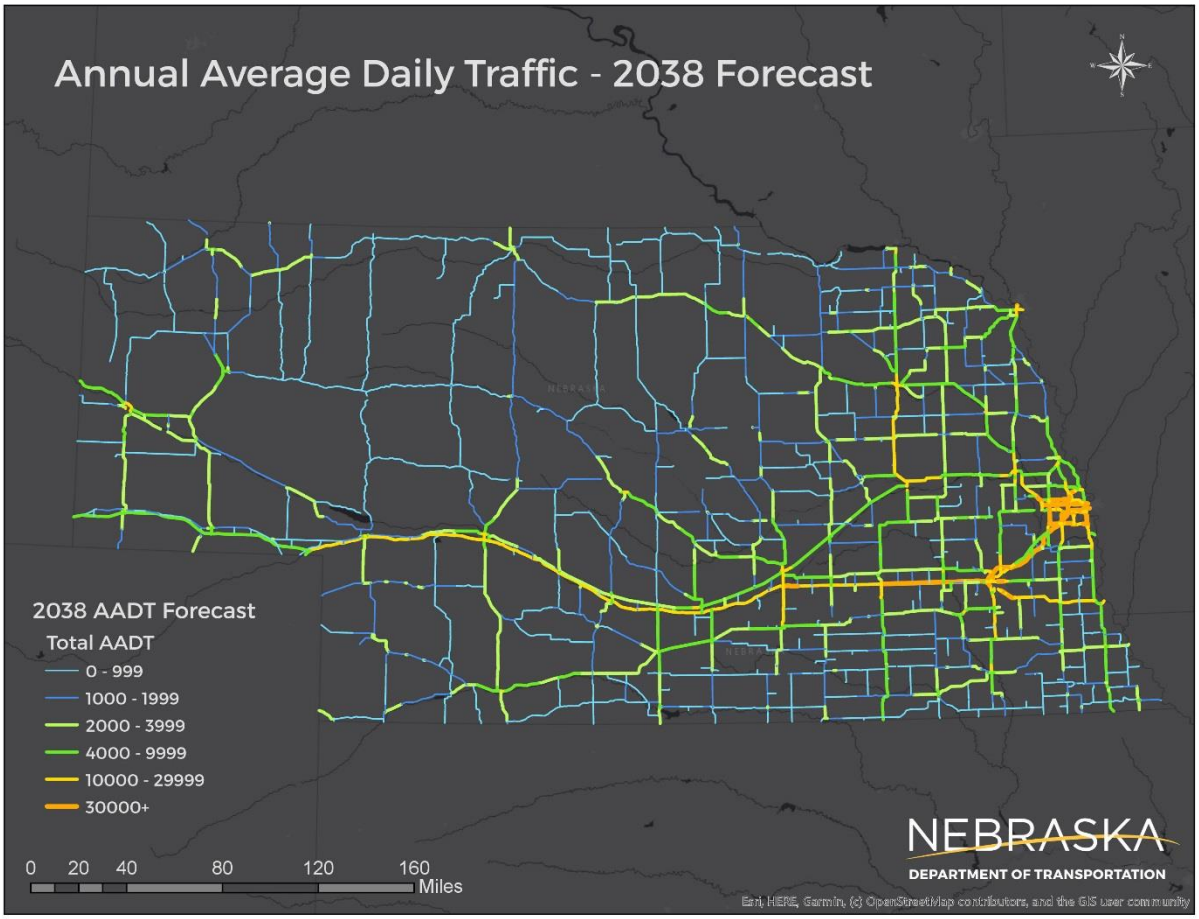

Figure 28 Annual Average Daily Traffic – 2038 Forecast

These projected historic trends do not take into account land use changes or the future addition of major trip generators within a project study area. To assess the impact of these changes on a highway corridor, NDOT uses its Statewide Travel Demand Model to provide AADT forecast volumes for highway projects. This model uses projected population growth to generate trips that are compiled in a trip table, which is organized into traffic analysis zone (TAZ's). The Statewide Travel Demand Model is especially useful for projected traffic for highway projects that involve highway realignments or the presence of new planned urban developments along a highway corridor.

Chapter 7 Risk Management Analysis

7.0 Risk Process

Although not formally defined in terms of risk, likelihood, consequence, and mitigation, NDOT has historically prioritized projects of high impact and consequence as a standard practice. A formal process to identify risks for NDOT began with a funding distribution team in 2010 after the 2008 funding shortfalls. Program strategies were identified to meet budget constraints with the use of a decision tree using If/Then logic. In 2012, NDOT completed its first Asset Management Plan, which identified condition, performance measures, expectations, and funding levels required to maintain the four main assets; Pavement, Bridges, Fleet, and Buildings, in a state of good repair. At this time, priority factors were also built into the Life Cycle/Cost Benefit Analysis for Pavements (see Section 4.3.1).

To verify and expand on risks previously identified, NDOT held a Risk Identification Workshop on January 17 - 18, 2018 with internal stakeholders. The stakeholder group consisted of administration personnel, division heads, district engineers, and district operations personnel. Stakeholders were divided into small groups to identify the potential risks and the consequence to the condition and performance of the highway system. These groups identified 37 potential risks. Next, the entire group came to consensus on the impact and likelihood of these risks to generate a calculated risk. Once the list of risks was sorted based on highest calculated risk, the small groups reformed and were given a set number of points to assign to the risks they saw as the highest priorities. Based on the priority scores, the risks were resorted to create a prioritized list of potential risks. The entire group then came to consensus on eleven high priority risks. These will be reviewed every four years. See the high priority risk registry in Section 7.7.

7.1 Overview

The Federal Highway Administration defines risk as the positive or negative effects of uncertainty or variability upon agency objectives. Natural disasters, economic disruptions, and other unexpected events can reduce a transportation system's level or service as well as the agency's ability to achieve its goals. NDOT'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. Although other potential risks were identified, NDOT has focused on its high priority risks for inclusion in the discussion of this chapter.

7.2 System Risks

NDOT has identified several system risks that could adversely affect infrastructure on the highway system. The potential impacts of each risk is described below.

Increase in Federal funding by 10 percent or more per year for 10 years – Although welcomed, a large increase in available Federal funding would pose challenges for NDOT. Most importantly, the State would need an increase in State funding to provide the required 20 percent match for the Federal funds. Other challenges/risks include, needed staff and

resources to produce the program, needed staff to inspect/build the program, materials availability, and number of qualified contractors. NDOT's Program Management and Government Affairs Divisions will monitor National and State legislative activities to identify potential risk.

Increase in State funding by 10 percent or more for 10 years – Although welcomed, a large increase in available State funding would pose challenges for NDOT. Most importantly, the State would lose buying power if an increase in Federal funds does not accompany the increase in State funding to provide the required 80 percent match for the State funds. Other challenges/risks include, needed staff and resources to produce the program, needed staff to inspect/build the program, materials availability, and number of qualified contractors. NDOT's Program Management and Government Affairs Divisions will monitor National and State legislative activities to identify potential risk.

Deterioration of equipment (age, repair vs replacement cost, mileage/hours) or not having proper equipment – Stagnant funding levels have required the State to keep equipment in service longer than the optimal time. Down time due to repairs, less efficient equipment, and not having the proper equipment can cause delays and affect the quality and cost of maintenance work. NDOT's Districts and Operations divisions will monitor the fleet inventory through the Lucity asset management software.

Lack of qualified personnel (NDOT & Industry) – Nationwide there is a perceived lack of qualified candidates for high-tech jobs in Science, Technology, Engineering, and Math (STEM) fields. This is magnified in Nebraska due to the low unemployment rate and wage differentials between the private sector and government. Being able to hire and retain qualified personnel for both NDOT and the industry is key to maintaining pavement and bridge assets in a state of good repair. NDOT's office of Civil Rights periodically runs reports on the demographics of the current workforce, applicant pools, applicant sources, and new hires to monitor the availability of qualified workers.

Reduction of staff – The NDOT underwent a staff reduction from 2016 thru 2018. Reduction in design and support staff may lead to contracting with more consultants, which may increase costs. A **r**eduction in maintenance staff will reduce the number of miles maintained leading to a decrease in the condition of bridges and pavements. A reduction in the number of construction inspectors may lead to decreased oversight, which could result in errors/change orders increasing the cost of projects. NDOT's Human Resources Division tracks staffing levels.

Capacity and reliability of computer network – As technology advances, the pressure on the computer network infrastructure increases. As NDOT moves toward E-Construction and other applications, the reliability and capacity of the network will be of utmost importance to prevent downtime and delays. Nebraska office of the OCIO will monitor bandwidth usage, security, and suitability of software solutions for NDOT needs.

Regulations that increase loads on pavements – Any legislation or regulation that allows for increase truck axle loads would decrease pavement and bridge service life. Higher axle loads would increase the rate of deterioration, which would result in higher maintenance costs, higher construction cost to accommodate higher loads, and more frequent preservation treatments. NDOT's Government Affairs Division will monitor National and State legislative activities and notify appropriate subject matter experts.

7.3 Programmatic Risks

NDOT has identified several programmatic risks that have the potential to affect the condition of the highway system on a project level as described below.

Decrease in State funding by 10 percent or more for a year – This is a major impact and would cause NDOT to delay projects in the one-year program and possibly subsequent years. These events cause a ripple effect on the program unless an increase in State funding follows. Moving projects back increases maintenance and construction costs due to inflation, decreases the highway and bridge condition, which can take years to recover. It also reduces the available State match, normally 20 percent / 80 percent, for Federal funds which reduces the amount of projects that can be let. NDOT's Program Management and Government Affairs Divisions will monitor National and State legislative activities to identify potential risk.

Decrease in Federal funding by 10 percent or more for a year – Similar to a decrease in State funding, this is a major impact and would cause NDOT to delay projects in the one-year program and possibly subsequent years. Federal funding normally covers 80 percent of project costs and would decrease the spending power of State funds. Unless an increase in Federal funding follows, moving projects back increases maintenance and construction costs due to inflation, decreases the highway and bridge condition, which can take years to recover. NDOT's Program Management and Government Affairs Divisions will monitor National and State legislative activities to identify potential risk.

Extreme weather events (fire, tornados, snow, or floods) - natural disasters can have an impact on the overall condition of an asset.

- Wildfires are isolated events during drought conditions, which can close roads and delay maintenance or construction for a short period of time.
- Tornados are isolated events that traditionally occurring in May or June, but now occur any time of the year. These events can close NDOT facilities or roads and delay maintenance or construction for a short period of time.
- Large snow/ice events can be widespread and cause roads closures for short periods of time. Wintertime events do not normally affect maintenance or construction activities.
- Widespread flooding is the greatest environmental risk to Nebraska's highway system. Flooding can wash out bridges and roadways causing road closures for long periods of time. During this time, highway traffic is detoured causing accelerated deterioration of the detour routes. Maintenance or construction resources may be diverted causing delays to scheduled work.

NDOT operation centers stay alert to potential weather events and wild fire risk ratings.

Premature failure of pavement or accelerated deterioration of bridge - can reduce an asset's level of service and result in higher maintenance costs or an emergency type of project. Due to timing, emergency repairs must be made with State funds. This reduces the amount of funds for matching Federal funds, which could delay projects scheduled elsewhere and lead to increased maintenance/construction costs. District maintenance personnel will monitor and

report on any large scale or sudden pavement or bridge deterioration that occurs between regularly scheduled inspection cycles.

7.4 Pavement Management Priority Ranking

As noted in Section 4.3.1, NDOT has built a priority ranking into the POP Life Cycle Cost Analysis. Through this assessment, project candidates receive rankings based on Functional Classification, Population Density, Strategy Type, and Project Length. As a result, roadways on higher classified routes i.e. interstates, freeways & expressways, and principal arterials receive a higher ranking. These routes primarily make up the NHS; therefore, the NHS receives a higher priority for selection. This proactive process helps prevent gaps in performance and reduces the risks related to pavement deterioration.

7.5 Bridge Management Risk Assessment

For an overview of risk-based bridge project development, please see Section 3.4.2.

These three groups of bridges undergo risk assessment

1. Bridges that have been determined to be candidates for replacement or major rehabilitation are prioritized considering risks associated with scour, condition, load rating, and average daily traffic. Prioritized candidates are assigned a recommended programming year. Annual reviews are conducted to consider new candidates for major work and to confirm the programming year. Decisions about programming year are made with the intent to avoid costly short-term repairs prior to replacement.

2. Roadway projects often present an opportunity to provide both major bridge work as well as bridge preservation without significant additional disruption to traffic as compared to separate projects to provide for bridge needs. Combining bridge work with roadway projects mitigates impacts to the traveling public by reducing time that roads and lanes are closed to traffic. Preservation actions reduce the likelihood and consequences of higher cost repairs in the future.

3. High asset value bridges in good condition are high preservation priorities. High traffic volume bridges impact mobility if they are out of service. Large bridges have higher costs to replace. Large bridges with high traffic volume are considered high asset value bridges. Bridges without deck protection systems are ranked according to ADT x Deck Area and their rank increases as the bridge nears the end of the window of effective preservation opportunity. Some preservation actions, such as installation of deck protection systems have a limited window of effective opportunity. Risk associated with not protecting a bridge increases as the bridges approach the end of the timespan when greatest benefit can be achieved by preservation. See Figure 29.

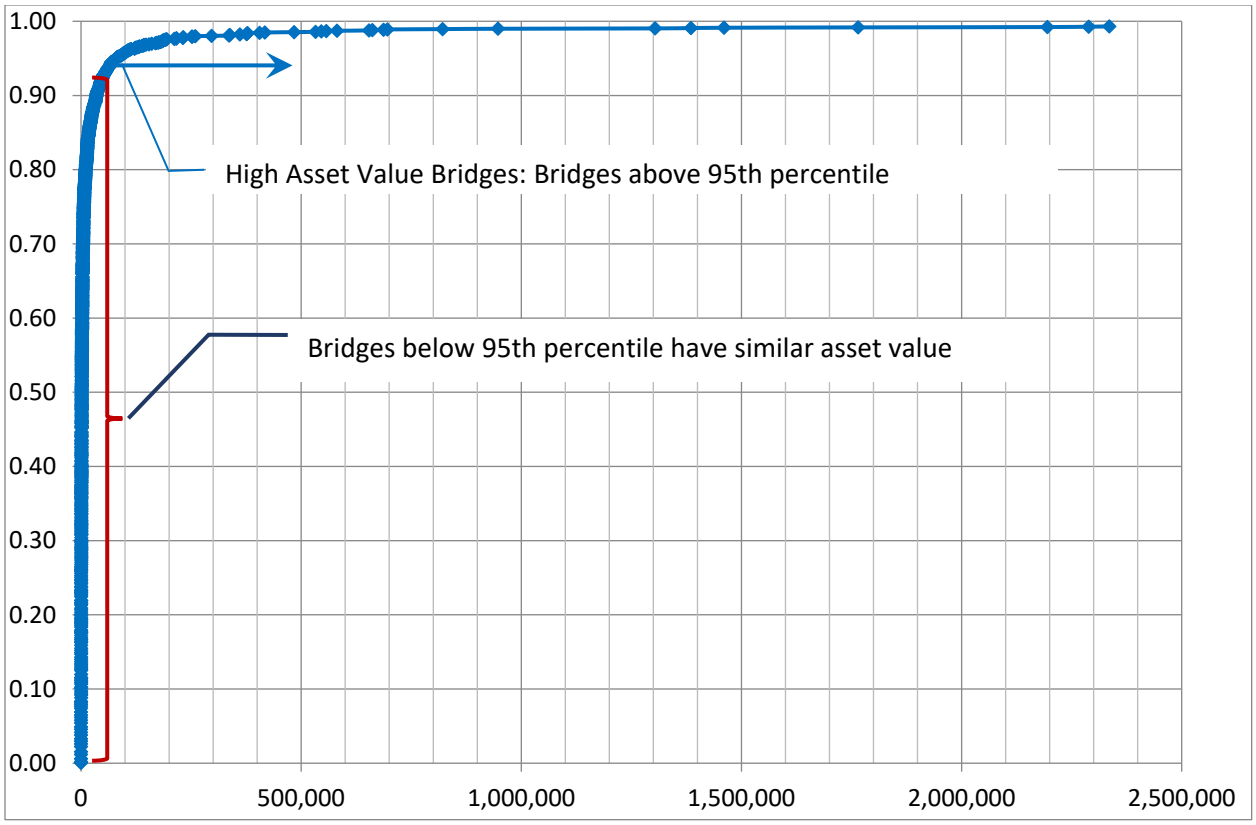

Figure 29 Cumulative Distribution of Asset Value for State Highway Bridges

Bridges that are of high asset value are the big bridges with high traffic.

Asset Value = Bridge Area x Future Traffic

For more information about preservation of high asset value bridges see the Bridge Management Deck Policy[52].

7.6 Evaluation of Facilities Requiring Repair Due to Emergency Events

A review of past projects using Emergency Relief (ER) funding has concluded that no roadway segments or bridges have required repair or reconstruction activities on two or more occasions since 1997 as required by 23 CFR Part 515 Final Rules § 515.7(c)(6) & 23 CFR Part 667 Final Rules § 667.1. This will be reviewed every four years prior to submittal for compliance review.

[52] Bridge Management Deck Policy guidelines can be seen in Appendix C.2.2.

7.7 Priority Risk Registry

The following priority risk register contains the Risk events, the potential consequence, the likelihood of each risk occurring, and mitigation strategies to address the risk. See Table 18

Table 18 Priority Risk Registry

Risk Event		Consequence		Likelihood		Mitigation or Response
Description	**Type**	**Description**	**Appraisal**	**Description**	**Appraisal**	**Description**
Decrease in State funding by 10 percent or more for a year	Program	A reduction in BNA, TIA, or Road ops funds would reduce the amount of federal funds we could match and could cause project delays, maintenance cost increase, pavement and bridge condition drop	major (-4)	Historically State funding has been stable at around 250 million per year	unlikely (2)	Reduce Construction Program. Delay Construction Lettings. Apply for discretionary grants. Convert 100 percent state funded projects to use Federal Aid. Continued communication with lawmakers about the consequences of reduced funding.
Decrease in Federal funding by 10 percent or more for a year	Program	Could cause project delays, maintenance cost increase, pavement and bridge condition drop	major (-4)	Historically Federal funding has been stable at around 250 million per year	unlikely (2)	Reduce Construction Program. Delay Construction Lettings. Apply for discretionary grants. Continued communication with lawmakers about the consequences of reduced funding.
Increase in Federal funding by 10 percent or more per year for 6 years	Program	Would improve pavement and bridge conditions faster than existing funding	significant benefit (2)	FAST Act will be done in 2020, and legislatures are discussing an increase in infrastructure funding.	unlikely (2)	Have projects ready before the planned funding

Risk Event		Consequence		Likelihood		Mitigation or Response
Description	Type	Description	Appraisal	Description	Appraisal	Description
Increase in State funding by 10 percent or more for 6 years	Program	Would improve pavement and bridge conditions faster than existing funding	significant benefit (2)	FAST Act will be done in 2020, and legislatures are discussing an increase in infrastructure funding.	rare (1)	Have projects ready before the planned funding
Deterioration of equipment (age, repair vs replacement cost, mileage/hours) or not having proper equipment	Agency	Unable to perform maintenance in a timely manner which would increase deterioration of pavements and bridges	major (-4)	Stagnant state funding levels have forced us to keep equipment in service longer than optimum	very likely (4)	Communicate consequences with lawmakers. Prioritize maintenance program. Potentially contract out more maintenance work.
Lack of qualified personnel (NDOT & Industry)	Agency	Unable to inspect maintain, develop, and build projects	major (-4)	Lack of interest in transportation (STEM) is leading to a lack of qualified personnel for both NDOT and the industry	very likely (4)	Continue to provide outreach programs to high schools and colleges. Continue to provide paid training and education.
reduction of staff	Agency	Unable to inspect maintain, develop, and build projects	moderate (-3)	NDOT is currently undergoing a reduction in staff	likely (3)	Contract out more work. Streamline process.

Risk Event		Consequence		Likelihood		Mitigation or Response
Description	Type	Description	Appraisal	Description	Appraisal	Description
capacity and reliability of computer network	Other	flow of information shuts down, reduces efficiency and reduces production	major (-4)	As NDOT moves toward e-construction and more technological advances a reliable computer network is paramount	very likely (4)	Continue to invest in equipment and infrastructure.
Regulations that increase loads on pavements	Agency	Pavement & Bridges deteriorate faster	moderate (-3)	Nebraska legislature has proposed bills the last two years to increase the legal load limits	very likely (4)	Continue to educate public and law makers of consequences. Continue to work with AASHTO to provide national perspectives of impacts. Potentially increase design factors to handle higher loads.
Extreme weather events (fire, tornados, snow, or floods)	Agency	Roads are closed or damaged	major (-4)	Nebraska has experienced extreme flooding, localize wild fires, and large snow events in the last ten years	unlikely (2)	Maintain alternative route plans, COOP, Coordination plans with emergency responders, FEAM and NEMA.
Premature failure of pavement or accelerated deterioration of bridge	Project	High Impact to roadway users. State funds are used for these repairs which reduces the amount available for federal fund matching	moderate (-3)	Have experienced premature pavement failures	likely (3)	Continually improve deterioration modeling. Apply necessary funds to fix failure, which may delay other planned projects.

7.8 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, NDOT performs high-quality construction, maintenance, and rehabilitation efforts.

System resiliency requires the mitigation of everyday disruptions. If safe and uncongested alternative routes are not available when routine inconveniences occur, a deficiency in resiliency is indicated. 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 priority.

NDOT employs several strategies to maintain resiliency, improve the operating efficiency of the State's Transportation System, and reduce the duration of incident response and clearance times. NDOT has preassigned alternate routes for key roadways, 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.

Chapter 8 Financial Plan and Investment Strategies

8.1 Overview

NDOT's infrastructure 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. NDOT uses the bulk of its funds to preserve existing roads and bridges. A small percentage of funds are used to expand the transportation system.

8.2 Funding Sources

Nebraska's transportation program is financed by two major funding sources – State and Federal funds. Revenues are initially deposited in the Federal and State Highway Trust funds and distributed to the State through formulas established by law, at both the State and Federal level.

8.2.1 Federal Funds

Federal funds are derived from user revenues paid into the Federal Highway Trust Fund. Ninety percent of the funds are from Federal motor fuel taxes and ten percent from heavy vehicle sales and heavy tire sales. Funding is provided to the states through an annual appropriation process and distributed by means of formula allocations as defined by law.

8.2.2 State Funds

8.2.2.1 State Highway Trust Funds

State funds are derived from user revenues paid into the State Highway Trust Fund. The State Highway Trust Fund is to be used for the maintenance and construction of the State Highway System. State funds are derived from three primary highway user revenue sources: (1) fuel taxes, (2) sales taxes on new and used motor vehicles and trailers, and (3) motor vehicle registration fees. NDOT receives 53 percent of State Highway Trust Funds. The remaining 46 percent is divided among Nebraska's cities and counties.

The annual State Highway Program is based on projected total State Highway Trust Fund revenues.

8.2.2.2 Build Nebraska Act

The Build Nebraska Act (BNA) funding 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. 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. Eighty-five percent is for the State Surface Transportation projects. Fifteen percent is for local roads and streets.

8.2.2.3 Transportation Infrastructure Bank (TIB)

The Transportation Infrastructure Bank (TIB) is to be used for three purposes: (1) accelerate highway construction improvement projects on the State Highway System; (2) promote innovative solutions to accelerate the repair and replacement of deficient bridges on the county road system; and (3) finance transportation improvements to connect new businesses and business expansions to the transportation network. This bank will receive revenue from the fuel taxes generated by LB 610, passed into law in 2015, which increased the motor fuel fixed tax effective January 1, 2016 by 1 1/2 cents each year thru 2019. A ½ cent each to NDOT, cities and counties, and a one-time transfer of $50 million from the State Cash Reserve Fund, which results in a total projection of $450 million over 20 years.

NDOT's monthly and annual financial reports, which identify funding sources and revenue allocation, can be found on NDOT's website[53]. See Figure 30.

[53] NDOT's monthly and annual financial reports are available at: http://dot.nebraska.gov/business-center/financial-reports/

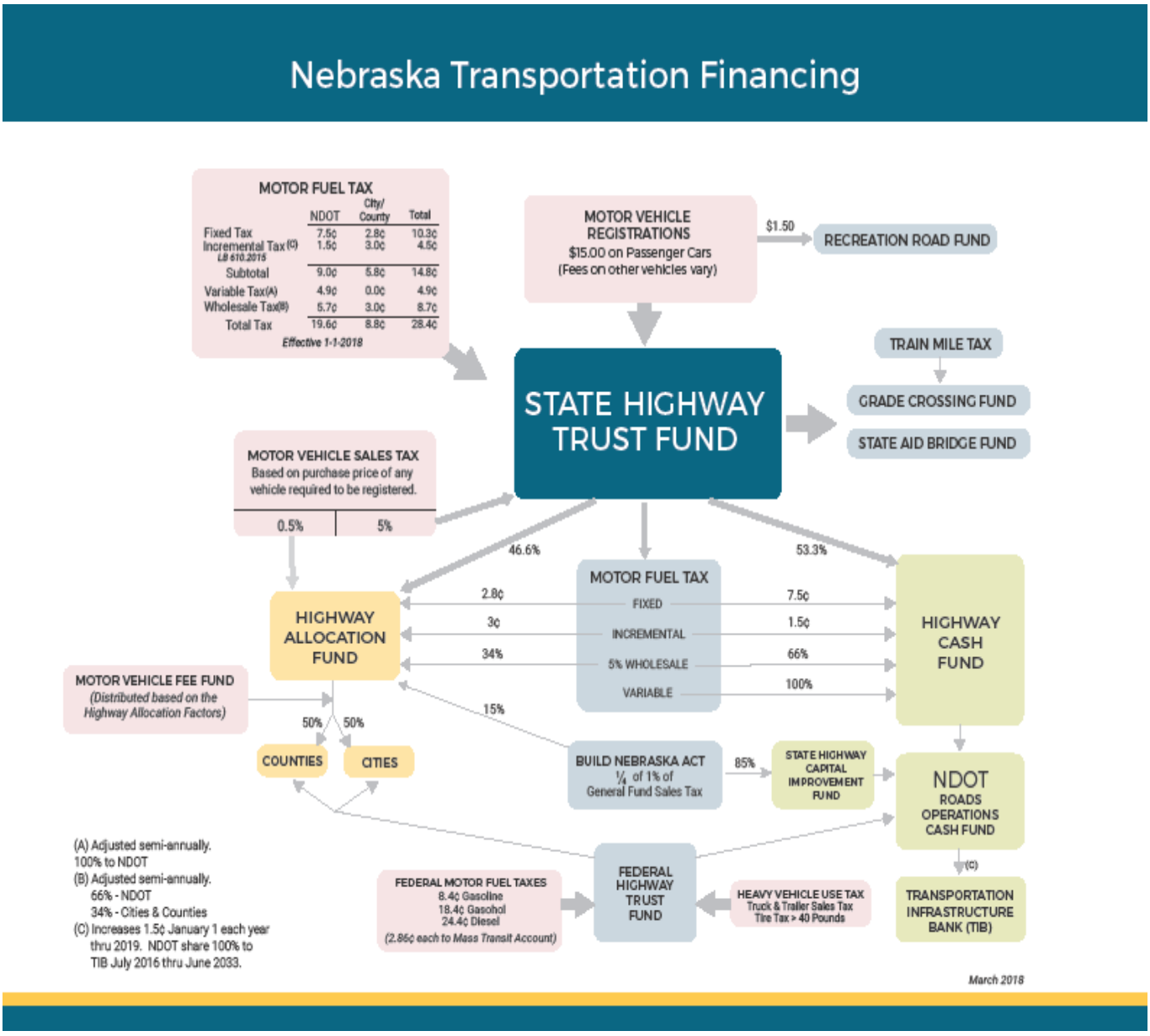

Figure 30 Nebraska Transportation Funding

8.3 Financial Management

Following the creation of the annual needs analysis in 1988, NDOT established a policy to ensure that State Highway Construction funding was distributed based on needs. Each year, NDOT completes an assessment of the highway system comparing roadways and bridges with established criteria. This evaluation is based upon conformance with design standards, 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 statewide. Each of the eight districts receives a construction program size based upon the percentage of the statewide needs located within the district. As a result, majority of revenues received are dedicated to asset preservation.

NDOT's Asset Management Strategic Goal is to operate, maintain, upgrade, and expand physical assets effectively throughout their life cycle. To achieve this goal NDOT uses a general rule of rehabilitating approximately 500 miles of pavement per year or 1/20th of the highway system. Bridges in these locations also receive preservation treatments. This would ensure that roadways and bridges get some type of preservation treatment at least every 20 years, which keeps the system in a SOGR. For pavements, a SOGR is considered to have an NSI between 70 and 100. Setting a goal of 100 is unrealistic and would not be cost effective, so NDOT strives for an average NSI between 75 and 85 for the entire State Highway System.

Revenues used for Capital Improvement are limited to Transportation Innovation Act or Build Nebraska Act funding sources. Capital improvement candidates are prioritized and selected for projected funding, based on engineering and economic impact, stakeholder input, and geographical inclusion.

NDOT annually publishes a Surface Transportation Program Book, which summarizes the construction program financing, projects, NDOT work type, and estimates. Projects are organized by those scheduled for construction within one year and those that are planned for construction in the following five years. The most current program book is posted annually on NDOT's website[54].

The STIP reflects the first four years of federally funded and regionally significant projects included annually in the Nebraska Surface Transportation Program Book.

The Freight Plan also correlates with planned investments on identified corridors. The FAST Act requires that the Freight plan contains a fiscally constrained list of freight projects. In order to qualify for Federal freight funding under National Highway Freight Program (NHFP) Funding, projects must:

- Be located on or improve freight movement on the National Highway Freight network, which includes the interstate system, and the critical urban and rural freight corridors identified in the plan.

[54] NDOT's Program Book is available at: http://dot.nebraska.gov/projects/publications/program-book/

- Be listed in a fiscally constrained Freight Movement Plan including information on other funding sources and matching funds.

8.4 Financial Reporting Requirements

8.4.1 Governmental Accounting Standards Board; Statement 34 (GASB34)

NDOT 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.

8.4.2 Annual State Highway Needs Assessment Report

In 1988, NDOT was assigned the task of annually reporting on the needs of the State Highway System to the Nebraska State Legislature (Neb. Rev. Stat. § 39-1365.02). Since that time, NDOT has made steady progress identifying and addressing the dynamic needs of the State Highway System. To address Nebraska's needs, each year, NDOT determines how much it will cost to eliminate the needs of the highway system. The needs include, removing geometric deficiencies, improving pavements and bridges to meet performance goals, improving mobility, and addressing capacity needs. These costs are computed in today's dollars and are inflated over a 20-year period to determine NDOT's 20-year needs.

8.4.3 Annual BNA/TIA Report

In 2011, with the passing of the Build Nebraska Act (Neb. Stat. § 39-2701) and in 2015, the Transportation Innovation Act (Neb. Stat. § 39-2801), NDOT is required to present the details of the programs contained in these acts to the Nebraska State Legislature. See Sections 8.2.2.2 and 8.2.2.3 above for more details.

8.5 Asset Management Fund Allocation

The NDOT construction program size is approximately $500 million per year. Each fall, NDOT uses a combination of a delivery schedule risk assessment, asset condition, projected revenues, candidate list based on 10-year life cycle, and project estimates to determine how much of the construction program will be dedicated to Asset Preservation, System Modernization, and Capital Improvement. Investment strategies are developed involving trade-offs among assets based on the results of required analyses including performance gaps analysis, life cycle planning, and risk management, as well as a discussion of available revenues. Trade-off tools in POP are used to evaluate the effect of potential funding scenarios to recommend year-by-year distributions that will produce the greatest benefit in highway and bridge network conditions.

8.5.1 Needs Assessment

In 1988, the Nebraska State Legislature assigned the task of annually reporting on the needs of the State Highway System to the Nebraska Department of Transportation (NDOT) (Neb. Rev. Stat. § 39-1365.02). Since that time, the NDOT has made steady progress identifying and addressing the dynamic needs of the State Highway System. To address Nebraska's needs, each year, NDOT determines how much of the construction program will be dedicated to asset preservation, system modernization, or capital improvement. These decisions are made based on condition of our existing system, project deliverability, revenue, and allocation projections. Costs are computed in today's dollars and are inflated over a 20-year period to determine NDOT's 20-year needs.

The 20-year needs of the State Highway System are divided into three categories. See Figure 31:

- Asset Preservation – Maintenance of the system.
- System Modernization – Safety, geometric, or mobility improvements that do not add capacity to the roadway.
- Capital Improvements – Improvements that add capacity or support economic growth.

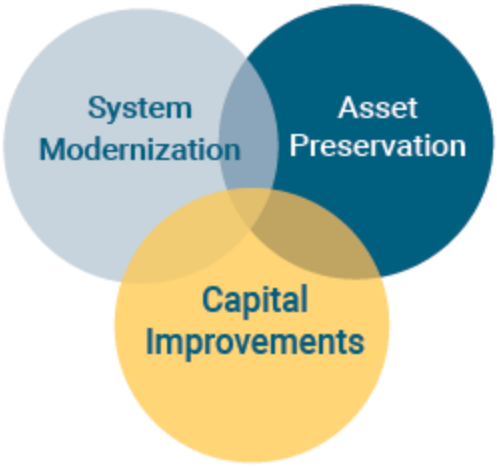

Figure 31 Needs Categories

Some highway projects may have aspects that fall into more than one category or all three; however, no costs are double counted in this report. What follows is a brief description of how the needs are determined for each category.

A 2017 Summary of the 20-year Needs Assessment suggests 59 percent of the needs represent Asset Preservation, 15 percent represent System Modernization and 26 percent represent Capital Improvement.

8.5.2 Asset Preservation

Many different factors affect pavement and bridge preservation needs, including the previous year's work, extreme environmental conditions, traffic volumes, traffic loads, and yearly maintenance. NDOT continues to explore new technology and materials that may lead to improved pavement and bridge performance and may extend the life of pavements and bridges. The projected 20-year asset preservation needs, in 2017 dollars, are estimated at 59 percent of the budget and include Pavement and Bridge Preservation:

8.5.2.1 Pavement Preservation

The entire State Highway System is rated each year in order to evaluate its overall pavement condition. Distress factors such as cracking, faulting, rutting, and ride quality are inserted into formulas that have been developed to calculate the overall condition of the roadway, called the Nebraska Serviceability Index (NSI). This NSI rating is then used in a benefit/cost analysis tool to identify the right preservation treatment at the right time to maintain the highway system at a specified pavement condition level. Preservation treatments include, but are not limited to, crack/joint sealing, armor coats, milling, resurfacing, and replacements.

8.5.2.2 Bridge Preservation

Similar to pavements, bridges are inspected for safety and condition. Every bridge in Nebraska is typically inspected every two years. NDOT 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 at the proper times. Preservation includes preventative maintenance, repair, re-decking, rehabilitation, and replacement of bridges that meet the required width. Bridges continually deteriorate so bridge needs are not static but change yearly. NDOT is doing more systematic preservation such as asphalt overlays with waterproof membranes, expansion joint replacements, and thin epoxy/polymer overlays to keep our good bridges in good condition for longer periods of time. The timing of solutions for bridge needs varies, but efforts are made to plan bridge construction at the same time as the adjacent pavement and road construction.

8.5.3 System Modernization

System modernization is associated with roadway improvements that do not increase capacity. These needs are associated with deficiencies such as pavement width, shoulder width, vertical curves, and bridge width. Interstate roadway or bridge deficiencies, as defined by Nebraska's minimum design standards, are included in the needs assessment. The non-interstate rural system modernization needs are defined using the standards shown in Figure 32. The projected 20-year system modernization needs, in 2017 dollars, for the interstate, rural, and municipal highways are estimated at 15 percent of the budget and include the following:

8.5.3.1 Roadway Modernization

Roadway modernization describes changes made to existing roadways to correct certain deficiencies based on set criteria, see Figure 32. Such changes as widening lanes and shoulders, straightening curves, and cutting down hills make roadways safer to travel. All highway plans are reviewed to ensure that NDOT's database contains the most current geometric information. The roadway system modernization needs are compiled by calculating the construction costs, including resurfacing and right-of-way costs, required to correct the deficiency. These costs are updated annually. The State currently operates and maintains approximately 39 miles of gravel highways. The costs to surface and bring these roadways up to current standards are based on annual construction costs. Modernization needs for rural intersections are determined by the need to improve intersections due to high traffic volumes and a documented crash history. The costs associated with these needs are based on the average cost per intersection improvement times the number of intersections that would either meet the 20-year traffic volume or crash history criteria. In addition to the costs to remove deficiencies, costs for other roadway improvements, such as lighting and traffic signal needs, are determined based on an average of previous years' costs.

Criteria to identify non-interstate roadway geometric deficiencies are grouped into six Average Daily Traffic (ADT) categories.

Future ADT

36,000 & greater
(six or more lanes warranted)

10,000 - 35,999
(four lanes warranted)

- 12' surfaced lane width
- Outside shoulder
  8' of the 10' shoulder will be paved
- Inside shoulder
  3' of the 5' shoulder will be paved

4,000 - 9,999

- 12' surfaced lane width
- 8' shoulder width w/6' paved shoulder
- Stopping sight distance
  - No vertical crest curve more than 20 mph below the posted speed limit
  - No vertical sag curve more than 25 mph below the posted speed limit

2,000 - 3,999

- 12' surfaced lane width
- 6' shoulder width w/2' paved shoulder
- Stopping sight distance
  - No vertical crest curve more than 20 mph below the posted speed limit
  - No vertical sag curve more than 25 mph below the posted speed limit

750 - 1,999

- 12' surfaced lane width
- 3' shoulder width
- Stopping sight distance
  - No vertical crest curve more than 20 mph below the posted speed limit
  - Existing vertical sag curve condition allowed

Under 750

- 11' surfaced lane width
- 2' shoulder width
- Stopping sight distance
  - No vertical crest curve more than 20 mph below the posted speed limit
  - Existing vertical sag curve condition allowed

Figure 32 Criteria to Identify Geometric Deficiencies

8.5.3.2 Bridge Modernization

Modernization needs for bridges are determined by the need to widen bridges and remodel bridge rails to meet current standards. The costs associated with these needs are based on the bridge's condition at the time of improvement and can include remodeling bridge railings, widening an existing bridge, or replacing a bridge with a wider bridge.

8.5.4 Capital Improvements

Capital improvement needs are associated with those projects that add vehicle capacity or provide infrastructure for economic development. The projected 20-year capital improvements needs, in 2017 dollars, are estimated at 26 percent of the budget, and include the following:

8.5.4.1 Roadway Expansion

Roadway expansion is a broad category, which includes costs for future bypasses, new roads, interchanges, additional lanes, upgrading freeways, and the completion of the expressway system. The needs associated with roadway expansion are determined as follows:

- The costs for projects selected for design and construction under Build Nebraska Act (BNA) and Transportation Innovation Act (TIA) between 2018 and 2033 are determined using historical material and project costs, planned length and scope.

- The costs for expanding the interstate to six lanes between Lincoln and Grand Island includes all pavement, interchanges, and bridge work. The six-lane interstate needs are determined by projecting when the traffic density will reach level-of-service (LOS) D, as defined in the Highway Capacity Manual.

- The costs for the widening or reconstruction of urban state highways are based on historical cost per mile values, which are then used to calculate the needs. The urban capacity needs, for cities with a population greater than 5,000, are determined by identifying those roads with a fair to poor pavement condition and Average Daily Traffic (ADT) that requires additional lanes. The urban bridge needs are extracted from the bridge needs program output and are included in this category.

- The costs for planning and research to investigate new strategies and to develop the projects mentioned above are also included.

- The costs for grade separations, which include all on-system, at-grade railroad 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.

8.6 Asset Value

The current value for state-owned NHS pavements is approximately $5.6 billion. The annual investment required to maintain the interstate system at its current condition is approximately $80.0 million and the investment needed to maintain the non-interstate, state-owned NHS in its current condition is approximately $115.7 million. The current value of the NHS bridges is approximately $2.5 billion, which requires an annual investment of approximately $20 million to maintain in the current condition.

8.7 Annual Asset Allocation Development

The Asset Allocation process is a cyclical process conducted annually to determine investments strategies by work type for future years.

Table 19 Annual Asset Allocation Development

Season	Activity
Summer	Conduct Risk Assessment Gather Data for Condition Assessments of Highways and Bridges

Fall	Update Revenue Projections
	Generate Asset Candidates Based on 10-Year Life Cycle
	Set Preliminary Construction Program Size
	Set Preliminary Allocations for the following work types*:
	• Highway Preservation and Modernization
	  ○ e.g. 1”-6” Resurfacing
	• Bridge Preservation and Modernization
	  ○ e.g. 2-3” Resurfacing, Deck Repair, Remodel Bridge Rail
	• Interstate Preservation and Modernization
	  ○ e.g. 1”-4” Resurfacing
	• Capital Improvement
	  ○ New alignment or added capacity
	• Routine Surface Maintenance
	  ○ Crack Seal, Chip Seal, Patching

Winter	Refine project estimates, schedules and revenue projections Conduct Annual 20-Year Needs Assessment and Gap Analysis
Spring	Finalize Project Estimates, Construction Program Size and Allocations Refine project schedules based on new priorities
Summer	Update Planning and Program Documents to reflect new decisions

* Table 20 shows a correlation between NDOT’s work types and the FHWA work types

Work types used by NDOT as shown in Table 20 differ from the work types defined by the FHWA shown below:

- Initial Construction
- Maintenance
- Preservation
- Rehabilitation
- Reconstruction

A correlation between these two sets of work types can be seen in Table 20. NDOT classifies most projects as preservation, which is the department’s main priority, see Section 8.5.2. Preservation projects along with the Districts routine surface maintenance are intended to

maintain the highway system in a SOGR. Preservation projects are programmed bases on pavement condition and are reviewed during the project development process to address any other deficiencies according to the Board of Public Roads Classifications and Standards, Minimum Design Standards[55], see Section 8.5.3. If deficiencies (e.g. lane width, shoulder width, bridge width) are identified, this work may be included in the project. If so, the preservation project may include segments of other work types (i.e. rehabilitation, reconstruction) within the project. Ultimately, the main focus of these projects is to preserve the pavement. NDOT's three types of Preservation and Modernization work would incompass the FHWA work types Preservation, Rehabilitation, and Reconstruction.

NDOT projects classified as Capital Improvement are those projects that add vehicle capacity or provide infrastructure for economic development, see Section 8.5.4. These projects would align with the FHWA work type Initial Construction.

Routine Surface Maintenance projects are usually performed by the district maintenance forces but may be let to contract. This work would align with the FHWA work type Maintenance.

Table 20 Work type correlation

NDOT Work Types	Description (Typical)	FHWA Work Types	Description
Highway Preservation and Modernization	Pavement repair with 1" to 6" resurfacing	Preservation/ Rehabilitation/ Reconstruction	Undefined
Bridge Preservation and Modernization	Deck Repair, Remodel Bridge Rail, 2-3" Resurfacing	Preservation/ Rehabilitation/ Reconstruction	Undefined
Interstate Preservation and Modernization	Pavement repair with 1" to 6" resurfacing	Preservation/ Rehabilitation/ Reconstruction	Undefined
Capital Improvement	Highways on new alignment, Addition of lanes, Urban reconstruction	Initial Construction	Undefined
Routine Surface Maintenance	Crack seal, Chip seal, patching	Maintenance	Undefined

Between 2015 and 2018, NDOT annually allocated these average funding levels.

- $50-55 million for routine surface maintenance of highways and bridges
- $200-250 million for Highway preservation and modernization
- $40-65 million for Bridge preservation and Modernization
- $75-100 million for Interstate Preservation and Modernization
- $60-70 million for Capital Improvement or expansion of Highways and Bridges

[55] Board of Public Roads Classification and Standards, Minimum Design Standards can be found at: https://dot.nebraska.gov/business-center/lpa/boards-liaison/nbcs/downloads/

Pavement and Bridge Management tools mentioned in chapter 4 and life cycle cost analysis mentioned in chapter 5 is used to minimize life cycle cost and increase the percentage of pavements and bridges in good condition. This allows NDOT to achieve the best pavement and bridge conditions in the future, thereby supporting progress toward achieving the national goals in accordance with 23 U.S.C. 150 (b). These investments have proven to support our asset performance goals, and satisfy the investments levels summarized in Section 8.6 needed to keep NHS assets in their current condition.

8.8 Summary of Financial Plan Development and Investment Strategies

NDOT's financial plan projects revenues and prioritizes investments over a 10-year period to meet bridge and highway performance targets. NDOT annually conducts a gap analysis through the Needs Assessment and performs a risk-based life-cycle planning analysis to predict costs to maintain assets in a state of good repair.

Historically, NDOT's strategy has been to invest more in asset preservation than any other work type. This approach has cost effectively maintained pavements and bridges in a state of good repair as shown by state performance measures and targets in the NDOT Annual Report[56]. NDOT anticipates this investment strategy will also continue to achieve national performance goals provided that the public commitment to roadway infrastructure is maintained.

The 10-year projected investment plan by work type (see Figure 34) is based on revenue projections displayed in Figure 33. The investment plan for FY2020-FY2028 is based on the assumption that the State will experience stable revenues and that construction inflation rates remain consistent between 3-5 percent per year. These projections support NDOT goals to meet performance measure targets and maintain the system in a state of good repair (SOGR). NDOT's historical investment strategies have emphasized preservation and maintaining a SOGR.

[56] NDOT's Annual Report can be found at: https://dot.nebraska.gov/news-media/publications/

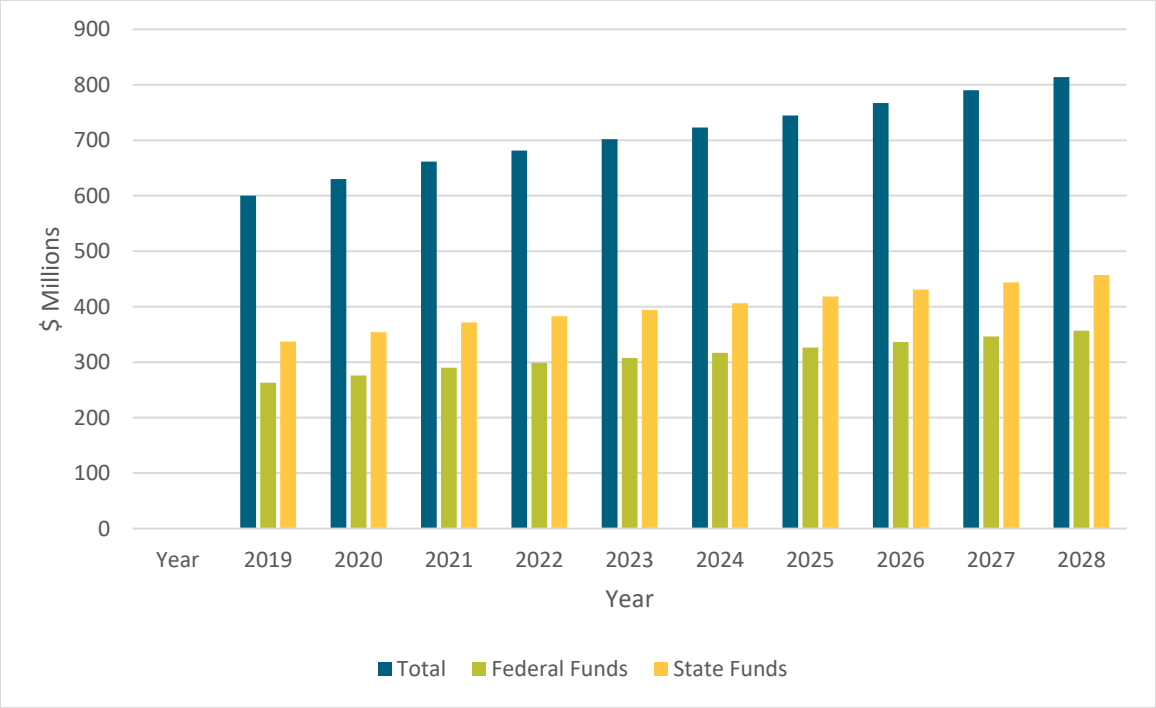

Figure 33 10-Year Projected Revenue for Construction

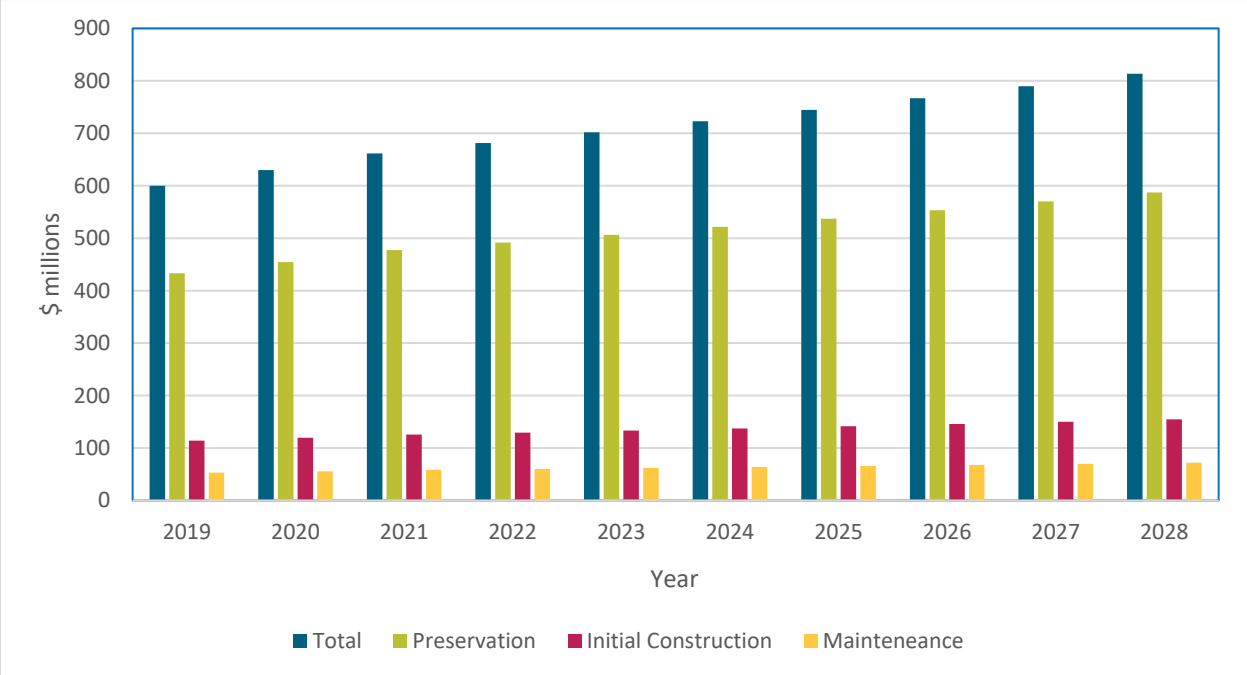

Figure 34 10-Year Investment Plan for FHWA Work Types based on Projected Revenue

Appendix A References

1. "Annual Report." Nebraska Department of Transportation. https://dot.nebraska.gov/news-media/publications/

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10. "NCHRP Report 632: An Asset-Management Framework for the Interstate Highway System." 2009. National Cooperative Highway Research Program. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_632.pdf.

11. "Transportation Innovation Act & Build Nebraska Act Report." Nebraska Department of Transportation. https://dot.nebraska.gov/business-center/financial-reports/

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 undercoping 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.

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.

Remaining Service Life: The projected time it will take a pavement to deteriorate from its current condition to a threshold value. Used to calculate optimum year for rehabilitation.

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.

State of Good Repair (for Bridges): A bridge is considered to be in a state of good repair if it is in good or fair condition as determined by 23 CFR Part 490 § 490.409

- Good Bridges – when the major bridge components are all in good condition or better.
- Poor Bridges – when one or more of the major bridge components are in poor condition or worse.
- Fair Bridges – all other bridges
- Major Bridge Components – Bridge Deck, Superstructure, Substructure

State of Good Repair (for Pavements): Pavement is considered to be in a state of good repair if the Nebraska Serviceability Index value is between 70 and 100 with 100 being new pavement and 70 having several years of service life remaining.

System Modernization: Safety, geometric, or mobility improvements that do not add capacity to the roadway.

Appendix C Bridge Management Documentation

C.1 Overview

NDOT Bridge Division's Bridge Management section was created in January of 2015. Prior to that time, bridge management decisions were made by a committee that did periodic review of bridge work candidates. The Bridge Management section is tasked with developing the bridge work program for bridges that will be included on projects as described in Sections 3.4 and 5.3.

The Bridge Management section monitors and maintains bridge inventory and condition data, construction scheduling information and a record of bridge construction programming decisions in the Record of Decision (ROD). The ROD is an Excel spreadsheet that has been customized with macros to facilitate bridge management processes. Inspection and construction scheduling data changes as new inspections occur and as project programming progresses toward project delivery. Data is kept current by scheduled data updates that import data from a SQL server database. The ROD also contains hyperlinks to bridge plans and inspection photos.

This appendix contains some of the primary documentation and guidance that is used for Bridge Management decisions and policies.

C.2 Strategy Selection

C.2.1 Major Work: Replacement, Rehabilitation and Re-decking

Before bridge inspection data is imported into the ROD, it is analyzed by a decision tree that does an automated review of the data for major work candidates. A schematic of the automated review decision tree is shown in Figure 34. Bridges that are not flagged for Replacement, Rehabilitation or Re-decking may be repair candidates.

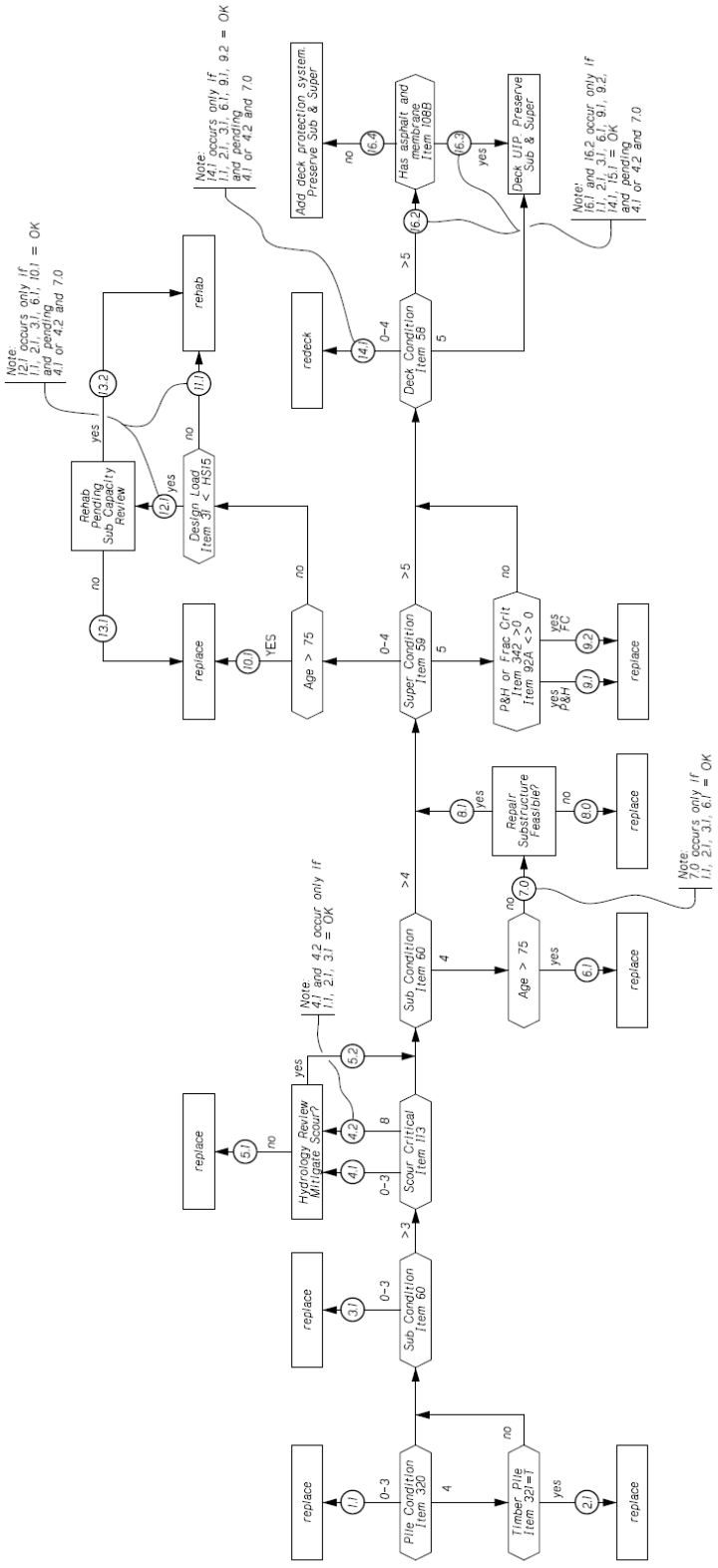

Figure 35 Decision Tree for Major Bridge Work

C.2.2 Bridge Deck Policy

As described in Section 5.3.2, NDOT recognizes the cost effectiveness of deck protection systems. By far, the preferred deck protection system is a rubberized asphaltic membrane under an asphalt overlay. This treatment has been found to greatly reduce the deterioration rate of the concrete bridge deck underneath the membrane.

Background: A bridge preservation success

Between 1973 and 1975, there were 24 bridges that are known to have received asphalt and waterproofing membrane prior to opening for traffic. They are known as AMODs – Asphalt and Membrane on Original Deck.

- Two have since been removed due to poor condition of timber piling
- 22 remain in service with their original 1970's concrete deck under the overlay
- Membranes have remained in place on 21 of them
- One had the asphalt overlay replaced with a concrete overlay

It is not known why this method of deck preservation was employed or why the practice was discontinued.

There has been no reason to do repairs on the AMOD bridge decks, so they have remained in-service without attracting much attention.

Original construction documents have been found for some, but not all of the AMODs.

All appear to have used pre-formed fabric backed membranes.

- Some called for two layers of fabric to be placed, one longitudinally and one transversely
- All were applied on steel-troweled concrete bridge decks
- This sets them apart from other known pre-formed membrane placement
- The smooth surface is thought to provide a better opportunity for uniform membrane thickness

A control group of comparable bridges was sought to compare to the AMOD performance.

- similar in age
- original deck concrete still in place
- without protective overlay of any kind
- similar deck thickness
- similar ADT
- ideally built on the same project with same concrete mixes
- geographically proximal
- Chloride tests were done but mostly found to be inconclusive

    - AMODs were uniformly low, but many of the unprotected decks had low chlorides too

- Inventory data shows that Nebraska bridge decks typically transition from NBI Condition 9 to 4 in about 25 years
- The control group has and average deck condition of six.

    - Are these average bridges?
    - The ideal control group had already been replaced or reconstructed

- Excluding the AMODs, 252 bridges were built between 1970 and 1976

    - 42 still have their original decks
    - 40-year survival rate for non-AMOD deck is about 17 percent

- The 40-year survival rate for AMODs is 100 percent
- Field visits to the AMODs and the control group bridges have been highly persuasive
- Inspection photos usually capture problems

    - Inspection photos of the bottom of AMOD bridge decks were rare or nonexistent

The specifications for Asphalt overlays with waterproofing membrane are under ongoing review. The intent to provide a cost effective deck protection system that performs as well as the historical precedent.

Figure 35 describes the various types of bridge deck overlays and the criteria and costs for their use.

NDOT Bridge Deck Overlay Policy

(11/1/17) in progress

Type	Applicability	Lifespan (years)	Cost ($/SF)	Criteria	Commentary
Epoxy Polymer Overlay	0 -20 years (Deck Age)	10 to 15	$4.00	Deck condition 7 or better (NBI). ≤ 5% defective deck. Cannot be placed on concrete or cementitious patch material less than 28 days old. Can be used on decks that have extensive cracks whether or not the cracks have been sealed with HMWM.	Avoid EPO's when movement related cracks are present. Some early EPO's were implemented as a strategy to extend the life of decks with concrete overlays experiencing cracking or some delamination. Bridges with concrete overlays are no longer candidates for EPO based on cost effectiveness and budget cap. Not intended to perform as a healer/sealer flood coat treatment.
Asphalt Overlay (fabric membrane)	Anytime	10± (asphalt) 20+ (membrane)	$5.00 (3.50 + 1.50)	Use on New Decks is now current practice. Only cost effective strategy if joints are in need of replacement also. Not for use on bridges that exceed 4.5% superelevation. Not ideal for horizontally curved bridges.	Strategy involves life cycle that leaves membrane in place thru one milling of asphalt, replace membrane on subsequent milling project. Cost includes primer, membrane and deck preparation (smoothness req.) Deck preparation not required on new decks. Cost of deck repairs not included. Cost of asphalt, tack coat not included.
Asphalt Overlay (hot bituminous membrane) UNDER DEVELOPMENT	Anytime	10± (asphalt) 20+ (membrane)	? ?	Same as (fabric membrane) Same as (fabric membrane) After Provision is developed, it will be offered as an alternative to the fabric membrane system.	Strategy involves life cycle that leaves membrane in place thru one milling of asphalt, replace membrane on subsequent milling project. Cost includes membrane placement. This method does not require deck preparation for smoothness. Cost of deck repairs not included. Cost of asphalt, tack coat not included.
Asphalt Overlay (cold liquid membrane)	Anytime	10± (asphalt) Indefinite (membrane)	$7.00	Primarily used on high asset value bridges. Used on Interstate bridges, to prolong the future traffic interruption associated with membrane replacement. It is believed that the cold liquid membrane could have a service life of well beyond 50 years if not indefinite.	Lifespan might be indefinite if 3" overlay used. Successive overlays would require milling 2" of original 3" and placement of 2" of new asphalt without interference with the membrane. Cost includes primer, base coat and top coat membrane layers. Cost of deck repairs not included. Cost of asphalt, tack coat not included.
Silica Fume Overlay	Rarely	15 to 20 (ridability) 0-5 (protection)	$30.00	Use ONLY when Asphalt is not available on project of interest. Not cost effective, especially if the superstructure is expected to have a significantly longer service life than the overlay. < 2.0 lbs./CY chloride content in bridge deck.	A large number of bridges in NE that received a concrete overlay, exhibited early cracking of the overlay. The worst overlay for cracking has been SFO. In general, SFO's are not recognized to provide long-term protection from chloride intrusion. Cost includes up to 20% partial depth repairs (deck area).

Figure 36 NDOT Bridge Deck Overlay Policy

C.3 Bridge Project Timing

C.3.1 Un-Programmed Work

Bridge replacement candidates are ranked successively by the following criteria:

1. Substructure Condition
2. Superstructure Condition
3. Deck Condition
4. Scour
5. Load Rating
6. ADT

Additionally, an engineering review is conducted using inspection photos, inspection notes, condition data history and load rating. The goal of the review is to suggest a programming year that will avoid the need for costly end-of-service-life repairs but keep the bridge in service as long as possible. The result of the review is a suggested programming year for a replacement project. District Engineers, in coordination with NDOT Project Programming staff, review project scheduling and incorporate the new replacement work suggestions. When feasible, bridge work is done in coordination with roadway work to minimize inconvenience to the travelling public. NDOT Bridge Management section monitors the cost to the bridge program and appeals for additional funding or suggests trade-offs when needed to meet budget and performance target constraints.

C.3.2 Programmed Work

Bridge Candidates for major work and preservation are prioritized and a programming priority group is determined by engineering review. Figure 36 shows guidance for prioritizing bridge work candidates.

BRIDGE PRIORITIZATION					
GROUP A - High Priority		GROUP B - Medium Priority		GROUP C - Low Priority	
A0.	Special Consideration as noted.	B0.	Special Consideration as noted.	C0.	Special Consideration as noted.
A1.	Replacements, Rehabs, Redecks of Girder Bridges with Deck 3 *(or weak 4)* .	B1.	Replacements, Rehabs, Redecks of Girder Bridges with Deck 4.	C1.	Replacements, Rehabs, Redecks of Girder Bridges with Deck 5 or higher.
A2.	Preservation of bridges ≤ 15 years old (at the time of construction). Overall condition 7 or better.	B2.	Preservation of bridges between 15 and 20 years old (at the time of construction). Overall condition 7 or better. Year Built 2002 to 2007.	C2.	Bridge Replacements - pile condition is predominant defect if pile condition is poor to severe and iterim pile repairs are performed.
A3.	Bridges with pile preservation as predominant need.	B3.	Bridge Replacements - pile condition is predominant defect and pile condition is poor to severe (example: approx. 50% in Condtion State 3 or 4 or concerns about adjacent no-value pile).	C3.	Bridge Replacements - pile condition is predominant defect and pile condition is fair to poor (example: approx. 50% in Condtion State 2 or 3).
A4.	Bridge Replacements with ≥ 12 in. Grade Raise, that can't be delayed ≥ 10 years that are part of roadway projects with pavement reconstrucion.	B4.	Approaches with turndown construction proposed of mid-life bridges.	C4.	Bridge Replacements with ≥ 12 in Grade Raise, that could be delayed ≥ 10 years that are part of roadway projects could have the scope changed to UIP and create a Bridge-Only project.
A5.	Bridge Replacements - pile condition is predominant defect and pile condition is severe.	B5.	Bridge Replacements, Scour Critical that are not candidates for mitigation.	C5.	Bridge Replacements, Scour Critical that could be delayed with mitigation.
				C6.	Approaches on short bridges. Consider omitting this strategy on future projects due to cost effectiveness.
				C7.	Acc+M, FAIR bridges.
				C8.	Acc+M, decks older than 20 years regardless of condition. Year Built 2002 or earlier.

Figure 37 Prioritization of Bridge Work Candidates