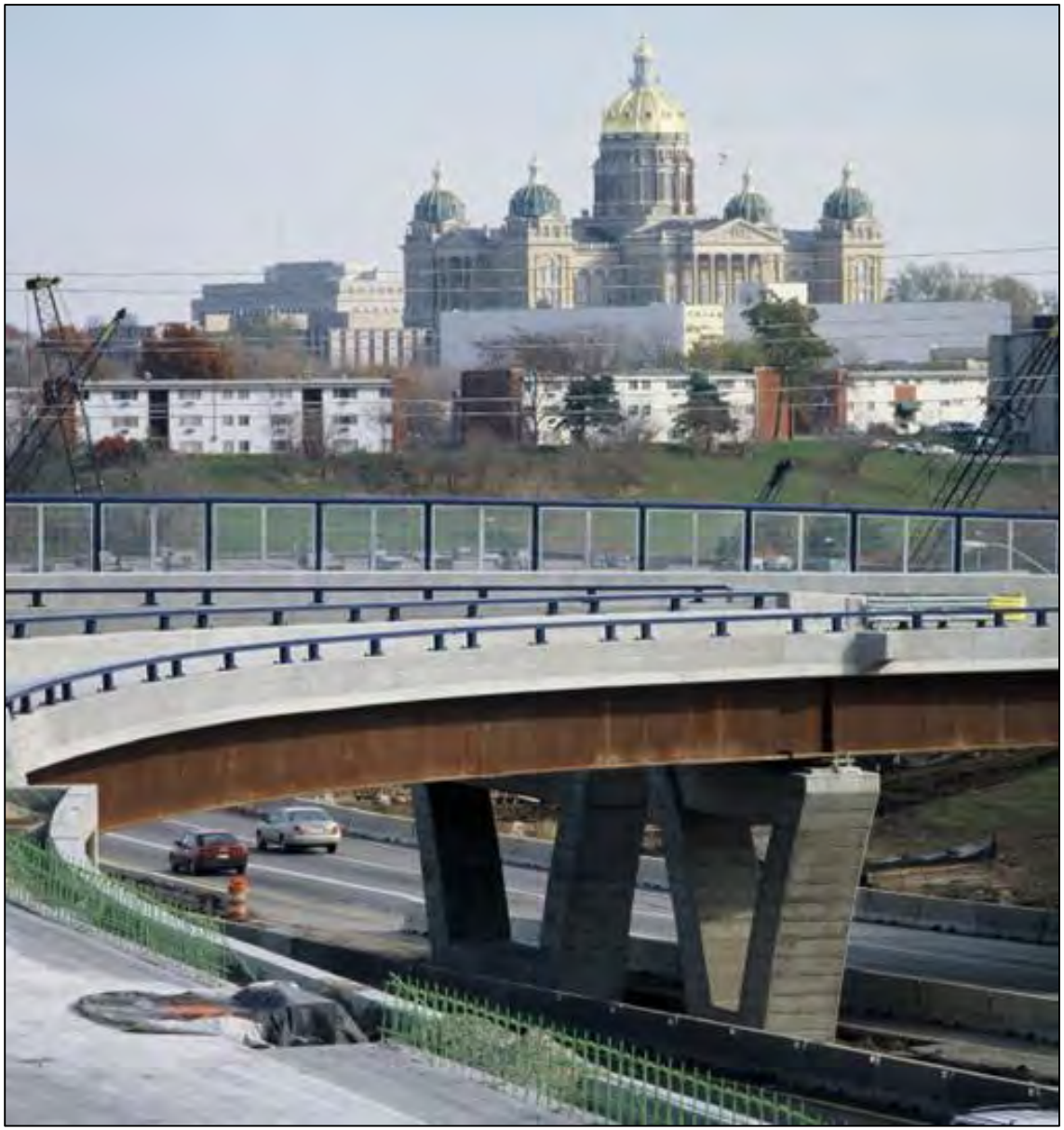
Iowa Department of Transportation

Transportation Asset Management Plan



April 2018

IOWA DOT

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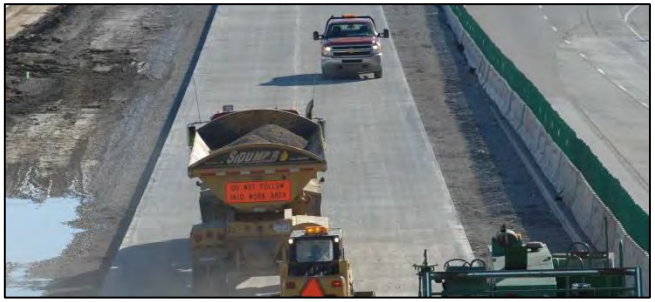

Images on cover: left, view of Iowa State Capitol Building, December 2004 | top right, US 34 bridge damage, June 2015 | bottom right, I-80 at Altoona

Image on inside cover: I-35 Raccoon River bridge, 2013

Image at right: US 34 bridge, 2015

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1 Introduction

What is Transportation Asset Management?

Transportation asset management is a strategic approach to managing transportation infrastructure. It embodies a philosophy that is comprehensive, proactive, and long term. The overall goals of asset management are to minimize long-term costs, extend the life of the transportation system, and improve the transportation system's performance.

The Iowa Department of Transportation's (DOT's) guiding principles for transportation asset management are the following:

- **Asset management is policy driven.** Funding decisions reflect Iowa DOT's vision for how the transportation system should look in the future.
- **Asset management is performance based.** Iowa DOT understands the condition of its assets, defines performance targets, and makes decisions that support these targets.
- **Asset management involves making trade-offs.** Iowa DOT has options for how to allocate transportation funding. It evaluates these options and makes informed decisions regarding the best path forward.
- **Asset management relies on quality information.** Iowa DOT uses data and analytical tools to support its decisions.
- **Asset management requires transparency and accountability.** Iowa DOT documents how funding decisions are made. It monitors performance, tracks progress towards performance targets, and reports on results.

Why choose Transportation Asset Management?

Iowa DOT began its move toward transportation asset management in the spring of 2011. Previously, Iowa DOT had used a combination of preventive maintenance and "worst-first" approaches to manage its bridges and roads. In a worst-first approach, agencies rank their assets from worst to best condition and then work down the list repairing assets until they exhaust available funds. Often, the assets in the worst condition require expensive reconstruction. This approach is costly and leaves limited resources for preserving and maintaining other parts of the network.

Asset management provides an alternative approach in which agencies strike a balance between reconstructing poor assets and preserving good assets so that they do not become poor. Over the past decade, transportation agencies throughout the United States have found that this balanced approach extends the useful lives of their assets and is more cost-effective in the long run.

In 2011, faced with budgetary constraints and an overwhelming need for investment in infrastructure, Iowa DOT's executive leadership determined that transportation asset management was necessary for the successful long-term operation of Iowa's transportation system. Since then, Iowa DOT has been committed to transportation asset management.

Consistent with best practices nationally, Iowa DOT's asset management goals are to:

- Build, preserve, operate, maintain, upgrade, and enhance the transportation system more cost-effectively throughout its whole life
- Improve performance of the transportation system
- Deliver to Iowa DOT's customers the best value for every dollar spent
- Enhance Iowa DOT's credibility and accountability in its stewardship of transportation assets

1 Introduction

What is the purpose of this Transportation Asset Management Plan?

In July 2012, the U.S. Congress passed a transportation bill referred to as Moving Ahead for Progress in the 21st Century (MAP-21). This legislation requires every state DOT to develop a risk-based transportation asset management plan (TAMP). This document meets these requirements.

This document, Iowa DOT's initial TAMP, describes how Iowa DOT manages its bridges and pavements throughout their lives. It also provides a framework that will guide funding decisions across Iowa DOT districts, divisions, bureaus, and offices.

In addition to meeting the requirements of MAP-21, Iowa DOT's TAMP meets the following objectives:

- Defines clear links among agency goals, objectives, and decisions
- Defines the relationship between proposed funding levels and expected results
- Develops a long-term outlook for asset performance
- Documents how decisions are supported by sound information
- Develops a feedback loop from observed performance to subsequent planning and programming decisions
- Improves accountability for decision making
- Unifies existing data, business practices, and divisions to achieve Iowa DOT's asset management goals

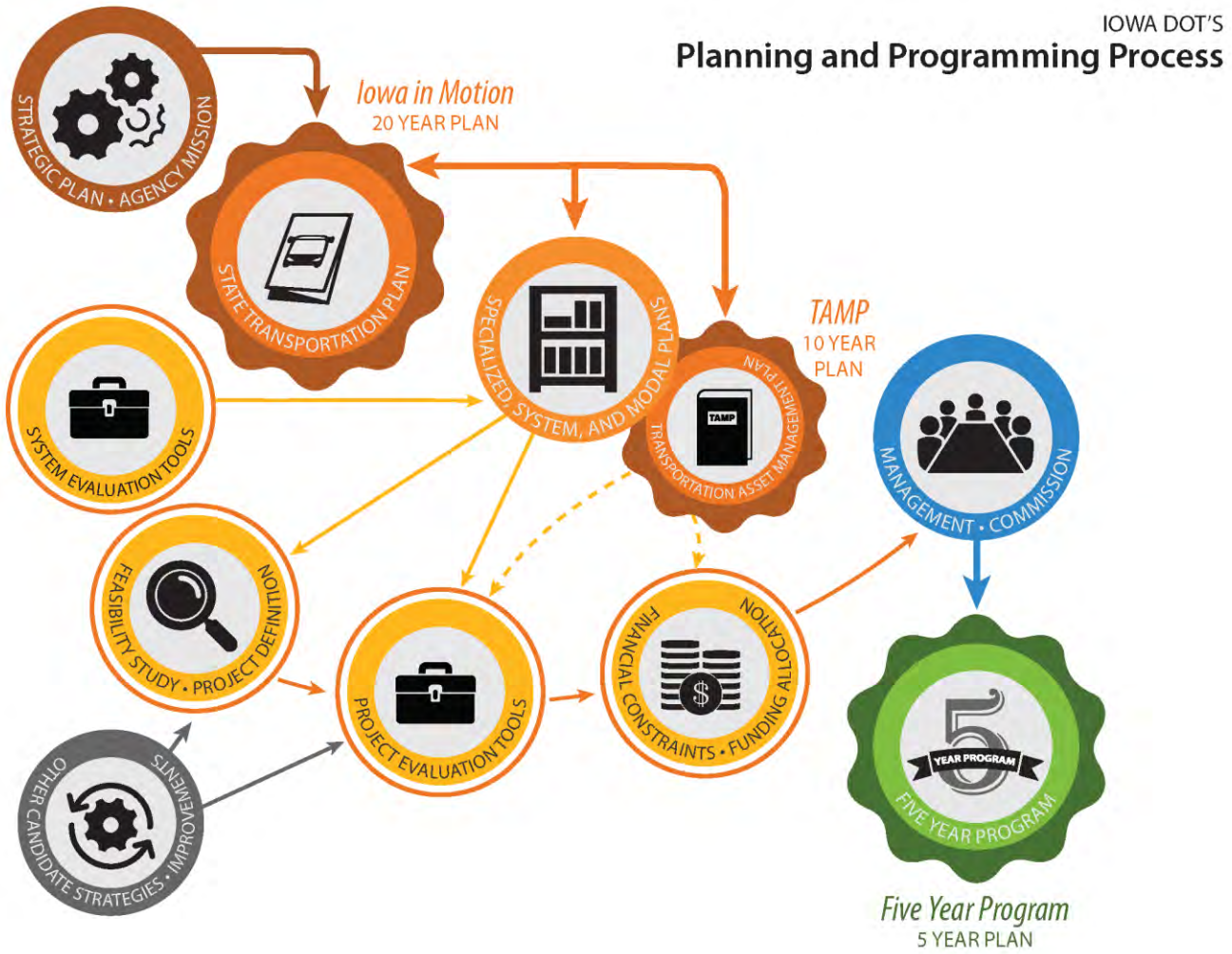
The TAMP is organized as follows:

- Section 2 describes how Iowa DOT manages its bridges.
- Section 3 describes how Iowa DOT manages its pavements.
- Section 4 provides a financial plan for funding Iowa DOT's bridge and pavement programs over the next 10 years.
- Section 5 addresses the risks associated with asset management.
- Section 6 presents a series of investment strategies that will help Iowa DOT achieve its asset management objectives.
- Section 7 describes how Iowa DOT will further improve its asset management practices.

Iowa DOT's TAMP is not a fix for an emergency. It represents a way of doing business. When used effectively, the TAMP will assist Iowa DOT in preventing major problems by prolonging the life of Iowa's most critical assets and by planning for future replacements.

How does the TAMP relate to Iowa DOT's other planning documents?

Iowa DOT's statewide transportation plan, called *Iowa in Motion*, established a vision for Iowa DOT: "A safe and efficient multimodal transportation system that enables the social and economic wellbeing of all Iowans, provides enhanced access and mobility for people and freight, and accommodates the unique needs of urban and rural areas in an environmentally conscious manner." The plan focuses on four investment areas, with a heavy emphasis on stewardship:



-**Stewardship** through maintaining a state of good repair

-**Modification** through rightsizing the system

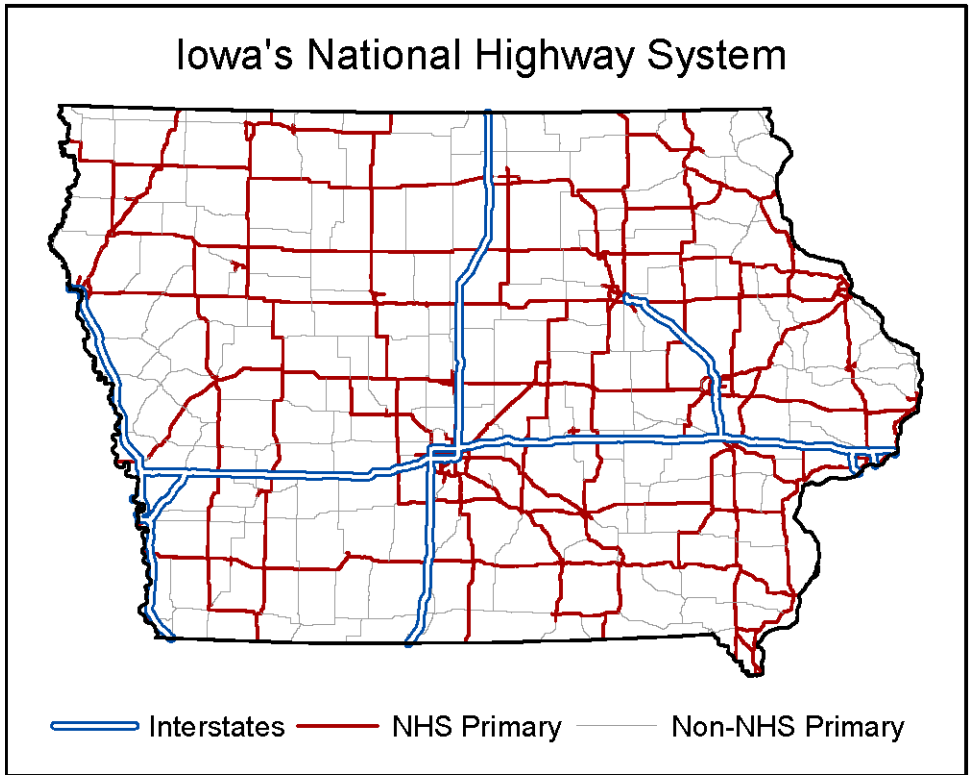
-**Optimization** through improving operational efficiency and resiliency

-**Transformation** through increasing mobility and travel choices

This TAMP describes how Iowa DOT manages the existing highway system. Preserving and improving this system is critical for achieving the system vision. The TAMP also connects *Iowa in Motion* and system/modal plans to Iowa DOT's Five-Year Transportation Improvement Program (Five-Year Program). *Iowa in Motion* defines a vision for the transportation system over the next 20 years, while the Five-Year Program identifies specific investments over the next five years. The TAMP has a 10 year planning horizon and helps ensure that investments in the Five-Year Program are consistent with Iowa DOT's longer-term vision.

How does the Iowa DOT coordinate with local agencies to manage assets?

Iowa DOT recognizes that most people using the highway system are more concerned with their trip than with who manages each road section. The DOT works with local agencies in Iowa to coordinate asset management efforts to help everyone get the most value from public roads. Although the primary focus of this document relates to the management of Iowa's primary road network managed by Iowa DOT, there are places where the plan also references the condition of local National Highway System (NHS) assets, and how we work with local governments in Iowa to coordinate management of the system. Such references are intended to be responsive to federal requirements related to the content of this plan, in particular with respect to the NHS. Neither the Iowa DOT nor the Iowa Transportation Commission direct local agency investment decisions, and the inclusion of information concerning these assets should not be considered to substitute for local agency decision-making processes.



As detailed later in the document, the Iowa DOT works with other agencies in Iowa to manage the transportation network, including the National Highway System (NHS). Other NHS owners in Iowa are:

Planning Agency	Local Agency	Miles of Pavement	Bridge Deck Area (sq. ft.)
AAMPO	AMES	5.9	14,060
Bi-State	BETTENDORF	0.2	
Bi-State	DAVENPORT	1.7	2,986
CMPO	CEDAR RAPIDS	21.8	93,514
CMPO	MARION	5.5	18,726
DMAMPO	CLIVE	1.5	9,497
DMAMPO	DES MOINES	31.9	287,512
DMAMPO	PLEASANT HILL	0.6	6,462
DMAMPO	URBANDALE	10.6	8,026
DMAMPO	WEST DES MOINES	10.8	3,122
DMATS	DUBUQUE	2.9	20,843
INRCOG	CEDAR FALLS	4.0	
INRCOG	ELK RUN HEIGHTS	2.7	
INRCOG	EVANSDALE	3.6	12,682
INRCOG	RAYMOND	1.1	1,702
INRCOG	WATERLOO	11.9	108,799
MAPA	COUNCIL BLUFFS	7.5	130,842
MPOJC	IOWA CITY		16,938
RPA 1	MCGREGOR	0.2	
RPA 10	LINN COUNTY		16,100
RPA 13	SHENANDOAH	0.1	
RPA 16	MOUNT PLEASANT	0.2	
RPA 16	WEST BURLINGTON	2.5	
RPA 5	FORT DODGE	9.4	4,441
RPA 5	MASON CITY	1.0	
RPA 8	CAMANCHE	0.2	
SIMPCO	SIOUX CITY	8.8	34,184

1 Introduction

Federal regulations require the State, MPOs, and providers of public transportation to establish agreements related to performance management elements, including the target setting and reporting process and the collection of data for the State asset management plan for the NHS. Iowa DOT has established agreements between the State and MPOs in each MPO's annual unified planning work program (UPWP), and with transit providers through their annual consolidated funding applications. The agreements provide for coordination with MPOs during the Iowa DOT's target-setting process, and for MPOs to coordinate with the Iowa DOT during their target setting processes. The agreements also provide for the Iowa DOT to take the lead in providing performance-related data, and focus on sharing existing data rather than creating new data collection responsibilities.

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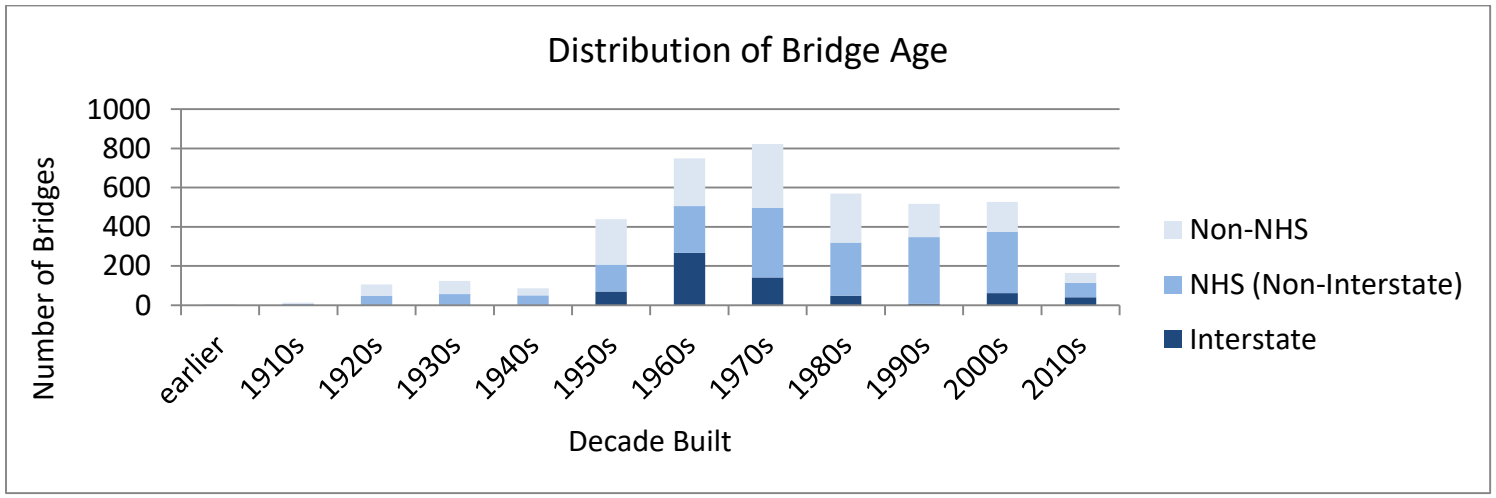
2 Managing Bridges

How many bridges does Iowa DOT own and maintain?

Iowa has 24,179 bridges. Iowa DOT is responsible for maintaining 4,141 of these bridges, including bridges on interstates, the National Highway System (NHS), and state highways. Local governments throughout the state maintain the remaining bridges. Some bridges owned by local governments are on the NHS system and these counts are included in the summary table below.

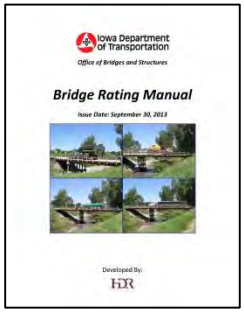
Highway System	# of Bridges	Deck Area (Sq. Feet)
Interstate	715	10,673,237
NHS (Non-Interstate)	1,826	21,441,731
Non-NHS	1,600	11,960,489
Total DOT	4,141	44,075,457
Local NHS	39	733,003
Total DOT + local NHS	**4,180**	**44,808,460**

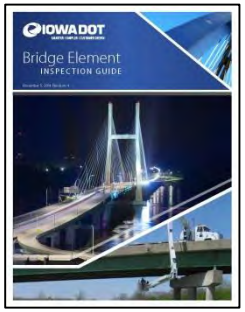
The average age of Iowa DOT's bridges is 38 years. About 25 percent of the bridges are over 50 years old, and the average age of bridge structures is going up. In 10 years, almost half of the bridges on the state highway system will be over 50 years old. In comparison, a typical bridge lasts about 75 years.



How does Iowa DOT assess the condition of its bridges?

Iowa DOT inspects its bridges using practices consistent with national standards





Bridge data is collected at least biennially for every bridge in the inventory. This data has been maintained for almost 40 years. There are 116 data items required to be collected for the National Bridge Inventory (NBI).

Every inspection is documented in our SIIMS database. The documentation for an inspection includes: photos, sketches, inspector's notes, condition ratings for specific elements, National Bridge Inventory (NBI) data, and recommendations for maintenance. The inspection documents are reviewed by the Quality Control (QC) Team in the Bridge Office. Once the QC team has reviewed the inspection, they make recommendations for maintenance or forward the report to a staff engineer for further review. The staff engineer will make repair, rehabilitation, or replacement recommendations for programming as needed.

Along with the required NBI data, additional information has been collected to enhance and support bridge management. Many individual bridge items and their corresponding conditions and configurations are documented during the biennial inspections. These elements include the National Bridge Elements (NBE), Bridge Management Elements (BME), and Agency Developed Elements (ADE). The state also has many items not included in the aforementioned elements that are also collected during every inspection.

Data is collected in an on-line inspection software system. This system is used by all bridge owners in Iowa. The NBE and NBI data collected in this system is transferred to the AASHTOWare Bridge Management (BrM) program for use in creating deterioration and funding models.

Several inspection cycles of data collection will be needed before the NBE can be utilized effectively for deterioration modeling and forecasting. Between now and then, existing NBI data will be used to

produce modeling and forecasting. Efforts are underway to develop these processes.

In January 2014, the Bridge Office began collecting new NBE data. In 2015, the FHWA required the submittal of NBE data as part of the NBI. FHWA requires NBE data be submitted to them annually. All state-owned bridges have one cycle of NBE data collected.

Iowa DOT uses this data to assess the condition of its bridges using the following performance measures.

The Federal Highway Administration (FHWA) has developed condition terminology used to describe the overall condition of bridges and culverts nationally. Ratings of Good, Fair, and Poor are used as classifications for bridge condition. A bridge in Good condition is adequate for today's traffic and vehicle loads. A bridge with a Poor condition rating is not unsafe, but should be considered for repair, replacement, restriction posting, weight limits, or monitoring on a more frequent basis.

Bridge Condition Index (BCI). Iowa DOT developed the BCI to aid in the prioritization of bridges for replacement and maintenance. The BCI is based on data collected as part of the National Bridge Inventory (NBI) inspections. The index combines a bridge's condition, its ability to provide adequate service, and how essential it is for the traveling public into a single index. The BCI is reported on a 100-point scale.

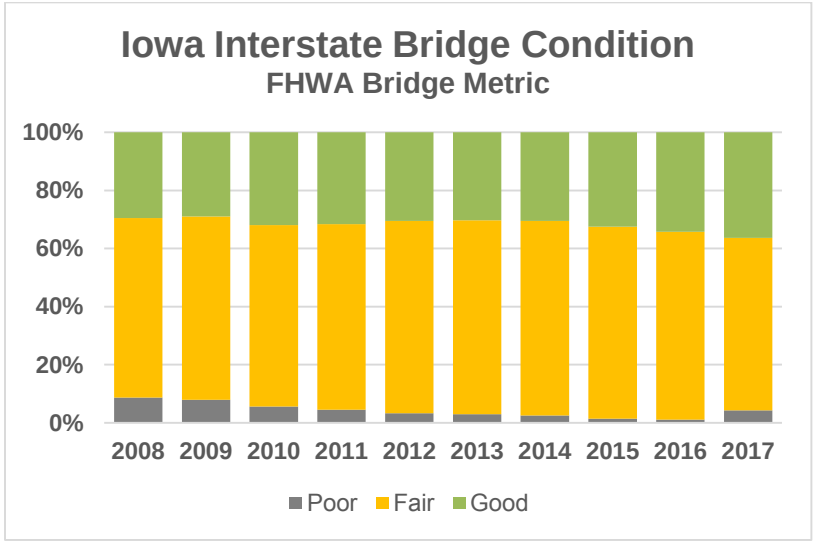
The BCI reflects the overall condition of the bridge, considering; structural condition, load carrying capacity, horizontal and vertical clearances, width, traffic levels, type of roadway it serves, and the length of out-of-distance travel if the bridge were closed.

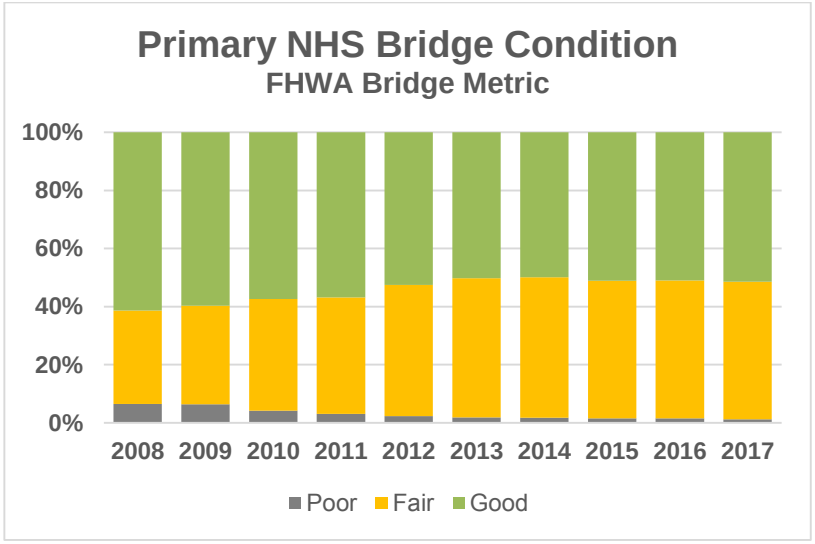
The BCI is used to help make decisions for scheduling bridges for replacement or rehabilitation. When funds are limited, not all needed bridge work can be scheduled in the same year and BCI is one factor used in the prioritization of bridge work.

What is the condition of Iowa DOT's bridges?

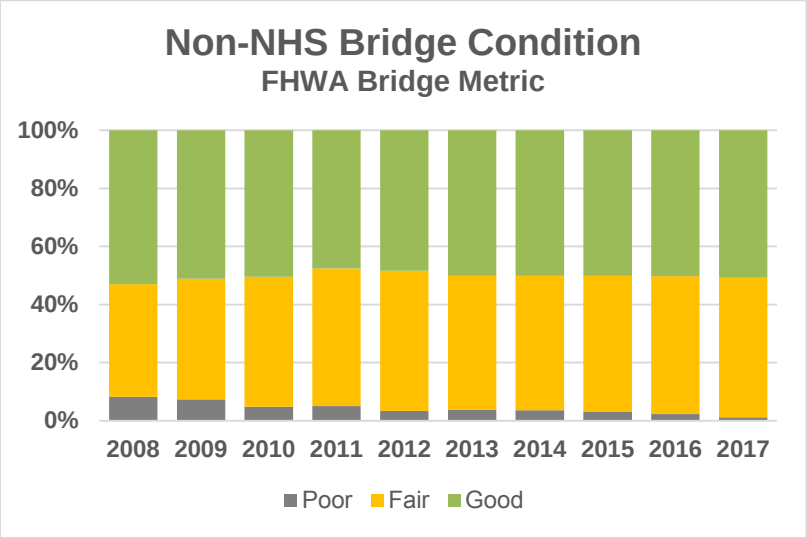
Iowa DOT's bridges are in relatively good condition overall, and recent trends show that condition overall appears to be improving. Although the number of poor bridges has been going down over the past decade, the number of Poor bridges is expected to begin to grow again due to funding limitations to address bridges in Fair condition. In addition, many structures are coming to the end of their designed service life. This means that they will need major rehabilitation or even replacement at some point in the near to mid-term future.

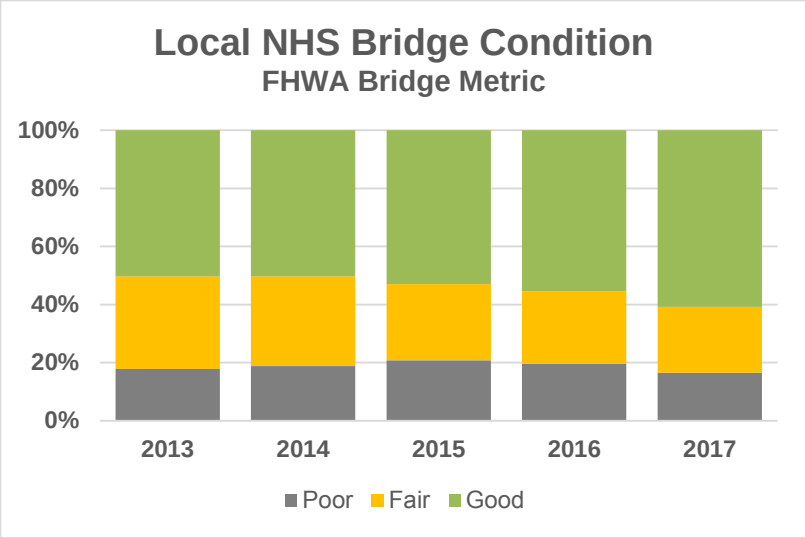
The following charts show the percentage of Good, Fair, and Poor bridges, as defined by the FHWA bridge measure. Trends show that conditions have been fairly stable, although they do fluctuate from year to year. Overall, interstate bridges have been trending behind bridges on other parts of the roadway system. This is partially because Iowa DOT is working to develop a few large interstate reconstruction projects. Although these projects are focused primarily on addressing capacity and safety needs, they will also address existing condition needs.





2 Managing Bridges





Performance gaps are identified by examining the following information: 1) Number of bridge replaced per year versus the number that should be replaced, 2) Maintenance work performed versus maintenance needs identified, 3) Bridge decks identified for overlay versus actual decks overlaid, 4) Change in the number of Embargoed bridges on the National Highway System (NHS), 5) Change in the number of Poor bridges from one year to the next on the NHS, 6) Change in the number of Good bridges from one year to the next on the NHS.

The work needed will be identified by querying the data from the Structure Inventory and Inspection Management System (SIIMS). Work needs are entered annually into SIIMS for review and approval by the Bridge Office and Districts at an annual meeting. Approved projects will be prioritized and recommended to the 5-year program as the budget will allow. The projects not included in the program will be considered the performance gap for that program year.

Performance gaps for a 10-year outlook are identified by using the output from the Bridge Management System (BMS). The BMS predicts the funding needed to meet a given performance target. The difference in actual funding available and the funding needs predicted by the BMS will be used to determine the performance gap.

Performance gaps for the federal targets will be identified by using the annual NBI submittal. The target change in Good and Poor bridges on the NHS will be compared to the previous year's submittal to determine if the change is within the target range. If the performance targets are not met, strategies will be identified to close the gap or new performance targets will be set.

2 Managing Bridges

What does Iowa DOT want to accomplish with its bridge program?

The Iowa DOT strives to maintain the bridge inventory in a condition that provides safe and efficient movement of people and freight. Bridges are managed by using a bridge management process with forecasting capabilities to better identify future needs across the entire inventory. The ability to predict bridge needs beyond a short-term time horizon improves our ability to make better decisions today and predict what funding needs are necessary for a stable bridge inventory.

The Iowa DOT defines a State-of-Good-Repair (SoGR) as a Bridge Condition Index (BCI) for all bridges on National Highway System (NHS) to be 50 or higher.

Iowa DOT has established the following desired bridge program outcomes:

- Replacement of at least 40 bridges per year.
- Replace all interstate bridges that have thin decks in the next 10 years.
- Place the first overlay on all bridges when they reach 20 years of age.
- Maintain the deck area of bridges in Poor condition below the 10% threshold on the NHS.
- Maintain the average Bridge Condition Index above 50 for all bridges on the NHS.
- Maintain the deck area of bridges in Good condition above 40% on the NHS.
- Reduce risk associated with roadway overtopping by implementing a Riverine Infrastructure Data Base (RIDB) to integrate hydraulic and infrastructure information to provide real-time monitoring and alert notifications to enhance public safety.

What types of activities does Iowa DOT perform in order to meet these outcomes?

Asset management focuses on prolonging the service life of Iowa's bridges. This approach is the most cost-effective way to achieve desired outcomes. To this end, Iowa DOT performs the following types of activities to maintain the bridge inventory:

Work Type	Treatment Family	Project Treatment	Typical Cost
Preservation	Paint Steel	Routine painting of steel girders	$10/sq. ft.
Preservation	Wash Weathering Steel	Wash weathering steel girders on a regular basis	$4,000/bridge
Maintenance	Strip seal joint repair	Replace glands	$100/ft.
Maintenance	Expansion joint replacement	Install new expansion joints	$2000/ft.
Rehabilitation	Deck overlay	Dense concrete overlay	$50/sq.ft.
Rehabilitation	Deck overlay	Epoxy Polymer overlay	$30/sq. ft.
Preservation	Epoxy Injection	Inject epoxy into delaminated areas under deck overlays.	$12/sq. ft.
Maintenance	Deck Patching	Repair delaminated and spalled areas of a deck	$100/sq. ft.
Maintenance	Prestressed girder repair	Repair girder ends under joints	$1500/beam end
Rehabilitation	Deck Replacement	Replace bridge deck	$75/sq. ft.

Work Type	Treatment Family	Project Treatment	Typical Cost
Reconstruction	Bridge Replacement	Replace bridge	$325/sq. ft. of existing bridge deck area
Reconstruction	Culvert Replacement	Replace culvert	$650/CY/ft.
Construction	New bridge	New bridge	$118/sq. ft.
Construction	New culvert	New culvert	$650/CY/ft.

How does Iowa DOT determine what work to conduct on a bridge?

Iowa DOT's Bridge Maintenance and Inspection Unit recommends bridge maintenance activities based on the results of the bridge inspections described previously. This information is then forwarded to a bridge engineer, who is responsible for making rehabilitation and reconstruction recommendations and developing cost estimates.

The Office of Bridges and Structures (OBS) compiles the rehabilitation and reconstruction recommendations and prioritizes them based on their urgency. Urgency is evaluated on a scale of one to four, where one means "implement a project as soon as practical," and four means "hold as a future candidate for the Five-Year Program."

Each year, OBS discusses the priorities with each District. At this annual meeting, OBS reviews all newly recommended projects from the past year to determine if they should be candidates for the Five-Year Program. If more than one work type is proposed for a given structure, each recommendation is given an importance rating of high, medium, or low.

After meetings with Districts, OBS reviews all priority one candidates to determine if the current Five-Year Program needs to be adjusted to accommodate them earlier in the program. OBS also determines which projects can be developed for construction in the final year of the upcoming Five-Year Program.

If costs of priority one candidates exceed available budgets, OBS prioritizes them using a process that considers bridge condition index (BCI), project cost, development time, and public needs. If all priority one candidates are programmed, priority two and three candidates are then considered. This process continues until funding is exhausted.

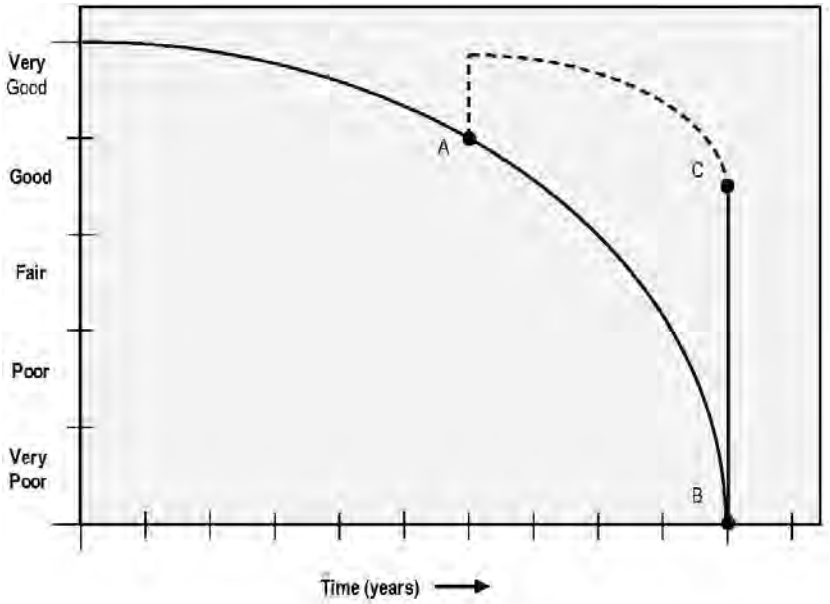
The process described above focuses on the condition of Iowa's bridges. In addition, Iowa DOT replaces a few bridges each year to accommodate capacity needs, and major urban interstate reconstruction projects often include replacing bridges that might not have been candidates otherwise.

Iowa DOT typically allocates 70 to 74 percent of bridge funding for replacements, nine to 23 percent for rehabilitation, and seven to 17 percent for maintenance.

How does this approach help to minimize whole life costs?

Whole life costs represent the costs of managing an asset from inception through disposal. Historically, many agencies have used a "worst-first" approach to bridge management. This approach focuses on replacing the poorest bridges. A more cost-effective approach considers treatments that slow down deterioration and prolong bridge life. This strategy is typically cheaper than letting a bridge deteriorate to the point of needing replacement.

This figure illustrates the two approaches. The solid line represents an asset that is built and deteriorates to point B before any work is performed. Once work is performed, the condition improves to point C. The dashed line shows work being done at point A. The asset's condition improves, and then eventually deteriorates to point C. The cost of performing work at point A can be significantly lower than waiting until point B. However, the final condition of both assets is the same.



At the network level, the idea of considering whole life costs is sometimes called Life Cycle Planning (LCP). According to the Federal Highway Administration, LCP is "a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based on 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 practical cost"[i].

Minimizing the cost to extend the life of bridges is a major goal of LCP. Unlike traditional lifecycle cost analysis, which is carried out at a bridge level, LCP is performed on a system level. It includes the development of life cycle treatment scenarios and economic analysis. To do this the following information will be used:

1) Bridge condition information and deterioration models
2) Treatment rules (when and where a treatment should be used) and how the general rules would be affected due to extreme events (e.g. flooding) and/or expected changes in system demand (e.g. increasing vehicular load)
3) Treatment costs
4) Expected condition improvements or service life extension, new deterioration rates
5) Budget levels, inflation and discount rates
6) State bridge performance goal

The department has utilized many maintenance and preservation treatment tools to improve the condition of bridges. A sophisticated analysis will be developed over time to: 1) obtain more accurate treatment cost data, 2) set up treatment rules in a systematical way, and 3) determine the expected condition improvements or service life extension. Economic analysis will be performed to compare the LCP scenarios and identify the optimal LCP.

One tool in use by the Department, called NBI Optimizer, has been used to perform LCP by evaluating scenarios altering the percentages of the budget used for different project types. The difference in the scenarios that were analyzed showed how each budget allocation would impact the projected future condition of the bridge inventory. These scenarios look 10 years or more into the future.

The NBI Optimizer tool uses historic NBI data to create deterioration models for approximately 3200 bridge structures on the state highway system. This system does not model culvert deterioration or "big bridges" due to their unique sizes and design characteristics. A twenty-year program is developed with this software based on funding limits and target condition values. With this information, we can better understand future funding needs and expected bridge conditions under various funding scenarios.

2 Managing Bridges

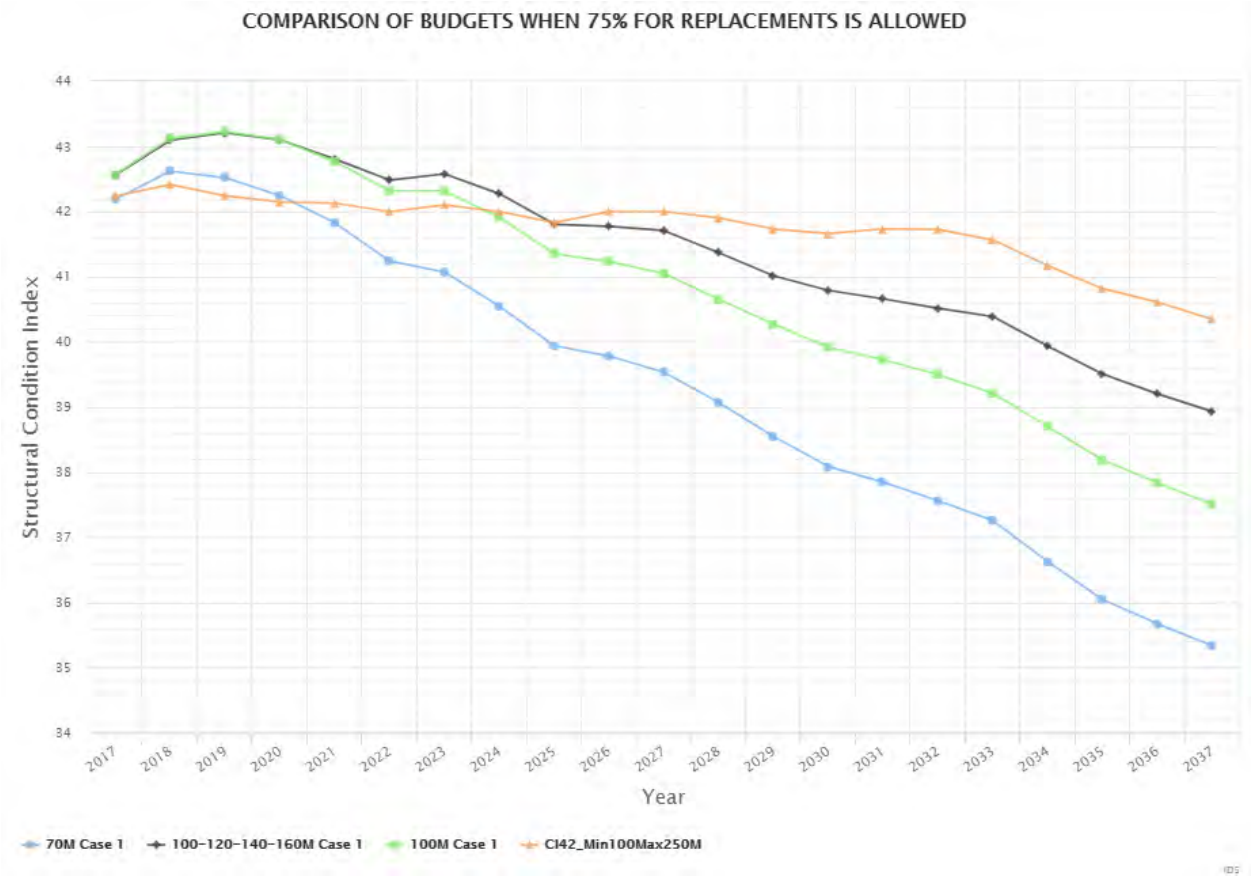
In the future, Iowa DOT expects to be able to utilize a tool jointly developed by DOTs across the country known as AASHTOWare BrM. Once the BrM program is fully functional, deterioration modeling and life-cycle planning will be done using that tool. The Iowa DOT is partnering with the Bridge Engineering Center at Iowa State University to develop and implement BrM.

Iowa DOT is also part of a Michigan-led pooled fund study on "Big Bridges." This project has developed new elements for the BrM to use with big bridges. These new elements may be incorporated into our major bridge inspections in the future.

The charts below show the change in condition of the bridge inventory at different budget levels and when the budget is limited on the amount spent on replacements. The first chart shows the change in condition when the budget allows 75 % to be spent on replacements. In the second chart, only 60% of the budget can be spent on replacements. The second budget scenario shows that there may be network-level advantages to focus 40% of the budget on repairs and rehabilitation versus 25% when the total budget is constrained to lower levels.

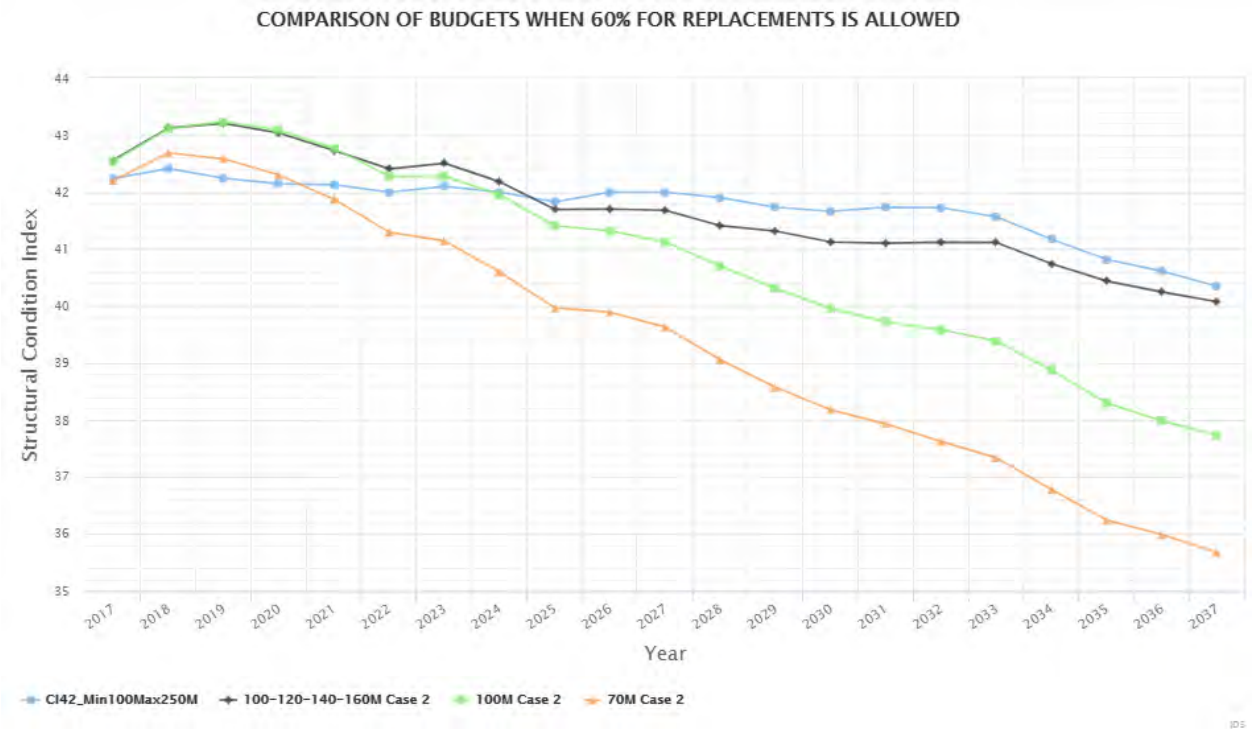
Funding Allocation Scenario 1:

1. 70M Case 1 - $70 million annual budget for 20 years. A 3.5 % annual inflation rate for the cost estimates was used. A maximum of 75% of the annual budget could be used for replacements.
2. 100-120-140-160M Case 1 - $100 million annually for the first five years with a $20 million increase every five years. A 3.5 % annual inflation rate for the cost estimates was used. A maximum of 75% of the annual budget could be used for replacements.
3. 100M Case 1 - $100 million annual budget for 20 years. A 3.5 % annual inflation rate for the cost estimates was used. A maximum of 75% of the annual budget could be used for replacements.
4. CI42_Min100Max250M – The budget is variable with a minimum of $100 million spend per year up to $250 million annually as required to maintain a specified condition level for the bridge inventory.



Funding Allocation Scenario 2:

1. 70M Case 2 = $70 million annual budget for 20 years. A 3.5 % annual inflation rate for the cost estimates was used. A maximum of 60% of the annual budget could be used for replacements.
2. 100M Case 2 - $100 million annual budget for 20 years. A 3.5 % annual inflation rate for the cost estimates was used. A maximum of 60% of the annual budget could be used for replacements.
3. 100-120-140-160M Case 1 - $100 million annually for the first five years with a $20 million increase every five years. A 3.5 % annual inflation rate for the cost estimates was used. A maximum of 60% of the annual budget could be used for replacements.
4. CI42_Min100Max250M – The budget is variable with a minimum of $100 million spend per year up to $250 million annually as required to maintain a specified condition level for the bridge inventory.



What does Iowa DOT expect its bridges to look like in the future?

Understanding the impact of funding levels and potential work strategies on future conditions is an important aspect of asset management planning. An analysis using the NBI Optimizer tool indicates that the short and long-term budget needs are both greater than the current forecast bridge funding available. The proposed 5-Year Program funding levels will keep the bridge inventory in compliance with the target condition of less than 10% of the NHS deck area being rated as Poor per the FHWA bridge performance metric, however the average condition is projected to decline during the current 5-year program. Beyond the 5-year program, the needs will increase rapidly. Between 2025 and 2030, the deck area rated as "Poor" on the National Highway System (NHS) could exceed the 10% threshold set by federal law. The current federal funding levels will not be adequate to reduce the Poor deck area below the federal performance requirement in the long-term.

In addition to the NBI data, Iowa DOT also collects more detailed, element-level data during its biennial bridge inspections. With these data, Iowa DOT will have the option to use a bridge management software program being developed by the American Association of State Highway and Transportation Officials (AASHTO). Once this system is completed, Iowa DOT plans to use it to evaluate its bridges, predict future conditions, and support project selection. Using the AASHTO option is a longer term solution because Iowa DOT expects it will need several cycles of inspection data before this program can accurately predict conditions and needs.

How does the Iowa DOT work with Local Agencies on bridge management?

The Iowa DOT works in partnership with local agencies to promote good bridge management practices. The Iowa DOT provides the Structural Inventory and Inspection Management System (SIIMS) software to local agencies as a tool to help manage local bridges. This software is used to capture the inspection data local agencies are required to provide as part of the annual National Bridge Inventory submittal to FHWA, as well as providing document storage, dash boards, and reports to help local agencies manage their bridges. The Iowa DOT also provides other tools and resources to local agencies through support of the Iowa Highway Research Board and Iowa State University's Institute for Transportation Bridge Engineering Center.

The Iowa DOT provides manuals and instructional memorandums to assist local agencies in bridge inspection, maintenance, and load rating. These manuals and memorandums provide the necessary information all local agencies need to manage their bridge inventories.

The Iowa DOT is working with MPOs and local agencies to establish performance targets for non-interstate NHS system bridges that are managed by local jurisdictions. Target setting for NHS bridges is a requirement of the FHWA.

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How much pavement does Iowa DOT own and maintain?

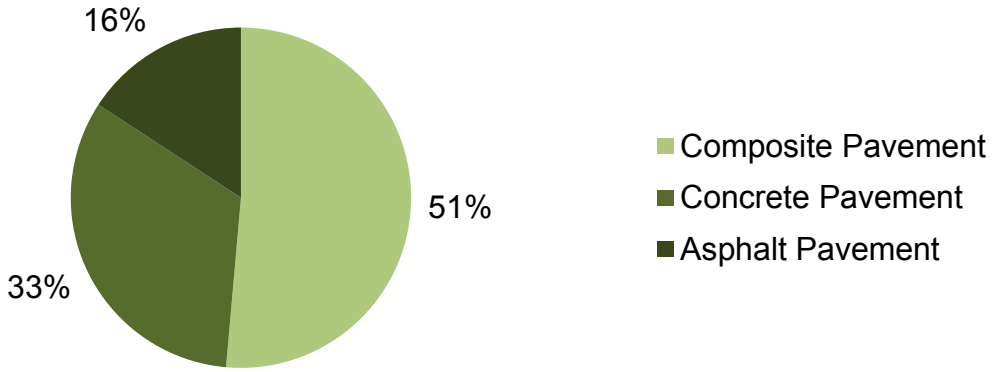
Iowa's pavements include the Interstate System, National Highway System (NHS), non-NHS state highways, county roads and city streets. Overall, Iowa's roadway system includes over 240,000 lane miles of roadway. Iowa DOT is responsible for 22,805 of these lane miles with an estimated replacement value of over $14 billion. The Iowa DOT owned highways are known as the primary highway system. The primary highway pavement inventory is expected to grow strategically over the next decade as targeted corridors may be expanded to improve mobility and address existing and projected capacity concerns.

Highway Mileage Summary

Highway System	Lane Miles
Interstate	3,305
Non-Interstate NHS	12,368
Non-NHS	7,131
Local NHS[1]	288
Total	22,950

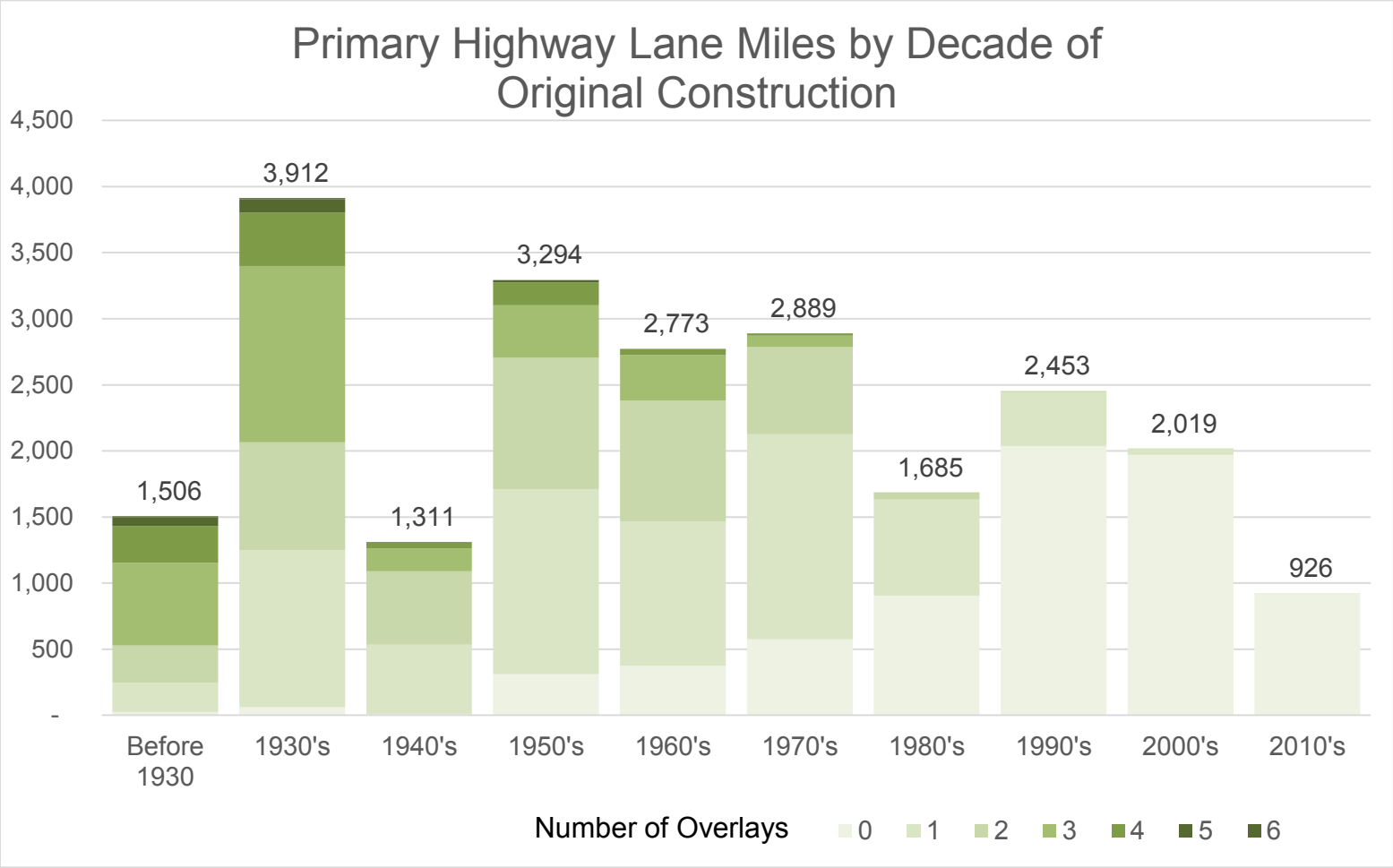
[1] *Note Iowa DOT is not the owner of the local NHS miles, but does coordinate with the local agencies on NHS routes.*

Iowa DOT's pavements represent a mixture of asphalt pavement, concrete pavement, and composite (asphalt over concrete). Just over half of the network is composite pavement.[2]



The primary highway pavement system is aging. Over half of the primary pavements are more than 55 years old, substantially exceeding their design service life. Nearly a third of the pavements are over 80 years old. In addition, thousands of miles of the primary system have had significant rehabilitation to keep them in serviceable condition.

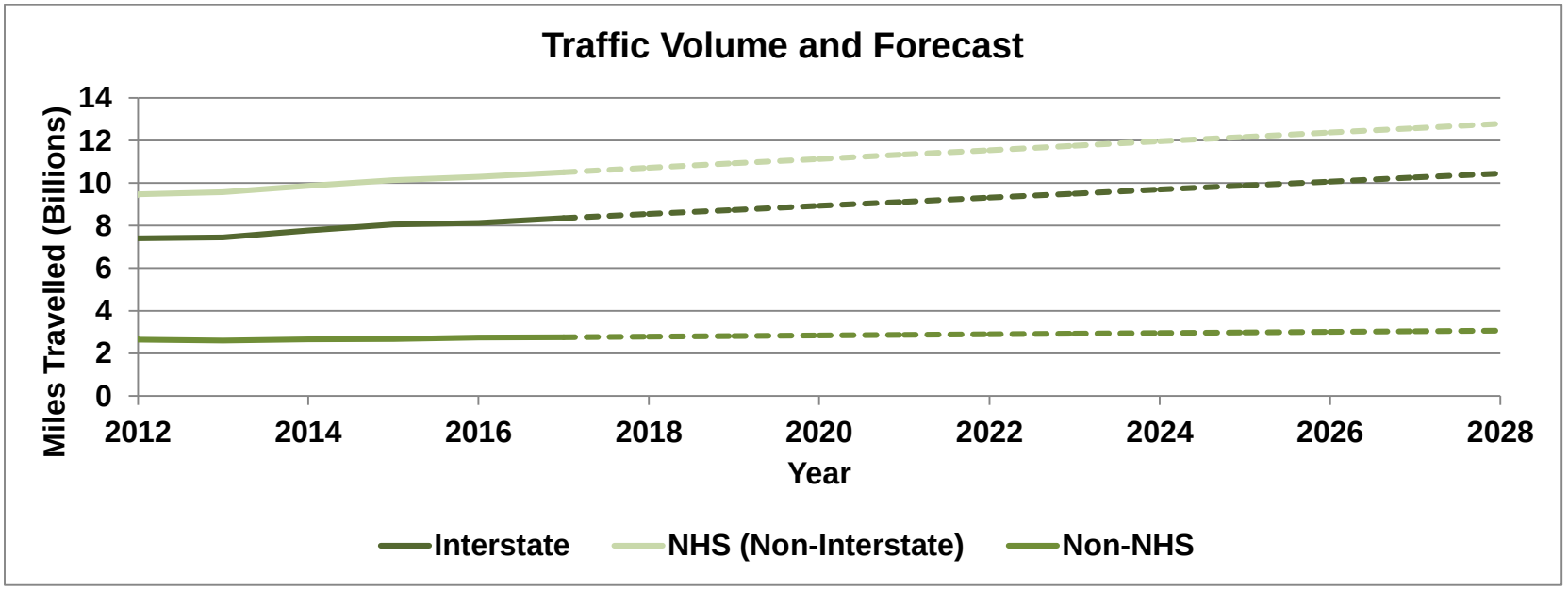
[2] The Iowa DOT also has a small amount (less than 12 lane miles) of Continuously Reinforced Concrete pavement. Since this represents less than 0.1% of the system lane miles and would therefore not impact network-level pavement management analysis, we have chosen to disregard it as a separate category.


Primary Highway Lane Miles by Decade of Original Construction
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
-
1,506
3,912
1,311
3,294
2,773
2,889
1,685
2,453
2,019
926
Before 1930
1930's
1940's
1950's
1960's
1970's
1980's
1990's
2000's
2010's
Number of Overlays
0
1
2
3
4
5
6

How much traffic uses Iowa DOT's roads?

An important consideration in the asset management planning process is the amount of traffic that Iowa's roadways serve. The figure above shows actual traffic volumes in Iowa from 2012 through 2015, and projected volumes from 2016 through 2025.

Truck traffic, in particular, is hard on pavements. Iowa DOT projects a 66 percent growth in truck traffic over the next 20 years. This level of projected traffic growth is an indication of increased economic activity. As traffic volumes increase, the importance of maintaining existing roadways increases. At the same time, wear and tear on roadways increases, and there is more pressure to allocate money to capacity expansion projects. These trends further strengthen the need for Iowa DOT to implement asset management.



3 Managing Pavements

What is Pavement Management?

Pavement management is a process that utilizes data about the current condition of pavements, estimated benefits from pavement treatments, computer modeling to forecast future pavement conditions, and budget constraints to assist in determining how to best manage pavement assets over time. Pavement management is using data to assist in determining the right treatment at the right time on the right pavement so that the most value is received from the funds invested in the road network.

A pavement management system (PMS) has been developed for primary highways. The PMS collects and analyzes data for use in managing interstate and primary highway pavements and assists in the selection of projects.

The goal of the PMS is to assist in developing pavement selections and treatments based on data that will allow the Iowa DOT to manage pavements over their whole life.

How does Iowa DOT assess the condition of its pavements?

Pavement condition data is collected on the interstate system each year. The rest of the primary highway network has data collection on a biannual cycle with data on half of the system being collected each year. Inspection vehicles equipped with sensors collect data on pavement smoothness and pavement defects. These defects include items like cracking, faulting, rutting, spalling and patching.[3]

In addition, Iowa DOT periodically conducts the following more detailed condition assessments:

- Assessment of structural capacity using a falling weight deflectometer: five-year cycle and upon request
- Assessment of pavement subsurface using ground-penetrating radar: five-year cycle and upon request
- Assessment of pavement friction: five-year cycle

[3] Iowa DOT periodically updates its inspection process to take advantage of new data collection technologies.

The collected data is reviewed according to a Pavement Management Data Quality Plan to ensure accuracy. After this review the data is included in the pavement management information system (PMIS), which is the database for pavement data. Past years of pavement data are also saved in PMIS so pavement conditions can be tracked over time. Additional data about the history of the pavement and traffic are also stored in the system. The pavement history includes the construction date, pavement thickness, pavement width and quality of aggregate used in the pavement. The data is assigned to individual pavement management sections that are referenced by mile posts and can be located by a linear referencing system. This allows the data to be used by geographic information systems (GIS).

Iowa DOT reports pavement condition using a Pavement Condition Index (PCI).PCI is a metric developed by Iowa DOT that accounts for a pavement's ride quality and the amount of cracking, faulting, and rutting on it. Iowa DOT uses PCI thresholds for Good, Fair, and Poor that differ by roadway type.

Iowa DOT uses the Good, Fair, and Poor categories to track and communicate the overall condition of its pavements. It uses the more detailed, underlying condition data when evaluating and prioritizing specific pavement projects.

Category	PCI Thresholds		
	Interstate	NHS (Non-Interstate)	Non-NHS
Good	76–100	71–100	71–100
Fair	51–75	46–70	41–70
Poor	0–50	0–45	0–40

FHWA Pavement Metric

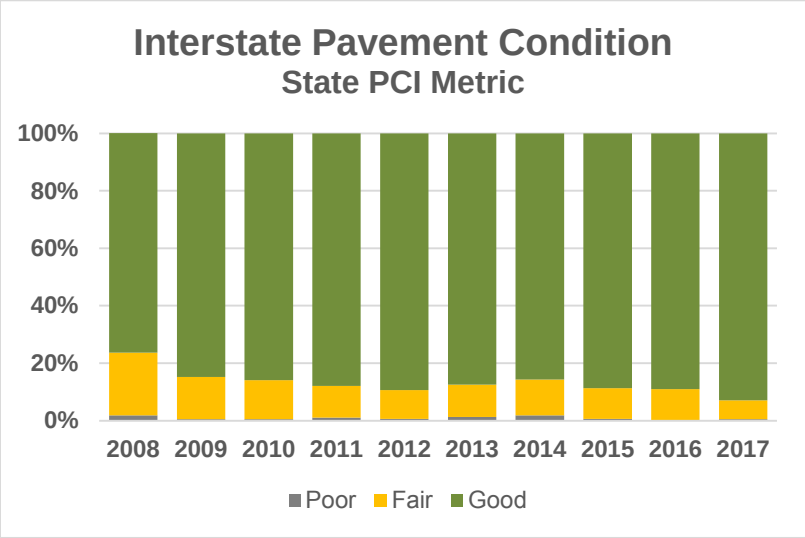
The Federal Highway Administration (FHWA) has also initiated a good, fair and poor metric. The FHWA metric is defined in the Title 23 of the Code of Federal Regulation Part 490 (23 CFR 490). The requirement to use this metric in asset management is covered in 23 CFR 515. In this plan there will be references to both the Iowa DOT PCI and FHWA pavement metric. The FHWA regulations requires reporting of all pavements on the Interstate System and the Non-Interstate NHS System, starting with data collected in calendar year 2018.

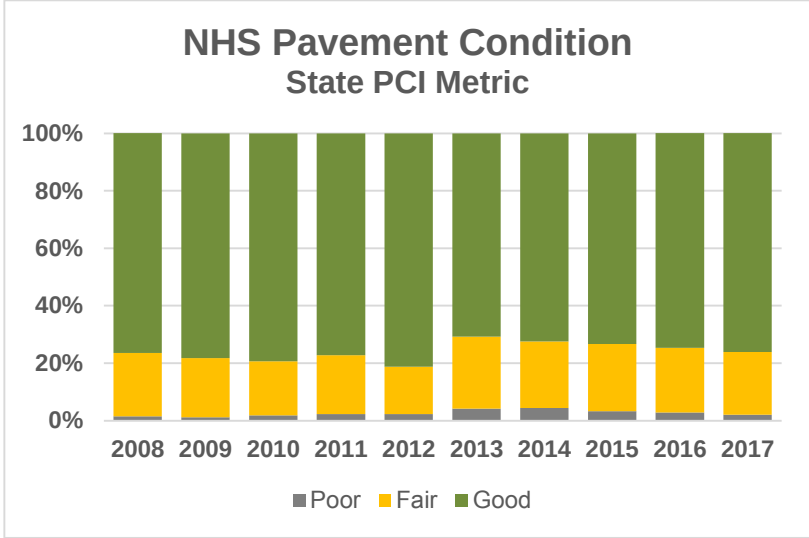
The FHWA metric is non-numerical and will give a good, fair or poor rating based on 0.1 mile segments. Similar to the Iowa DOT PCI, the FHWA metric uses IRI (smoothness), cracking, rutting (PCC) or faulting (HMA) to define a segments good, fair or poor rating. The jointed PCC pavements metric uses IRI, cracking and faulting. The HMA pavement metric uses IRI, cracking and rutting. For a segment of pavement to be considered good, all three metrics must be rated as good. If two of the three metrics rate poor, then the section is considered poor. All other rating combinations are considered a fair rating.

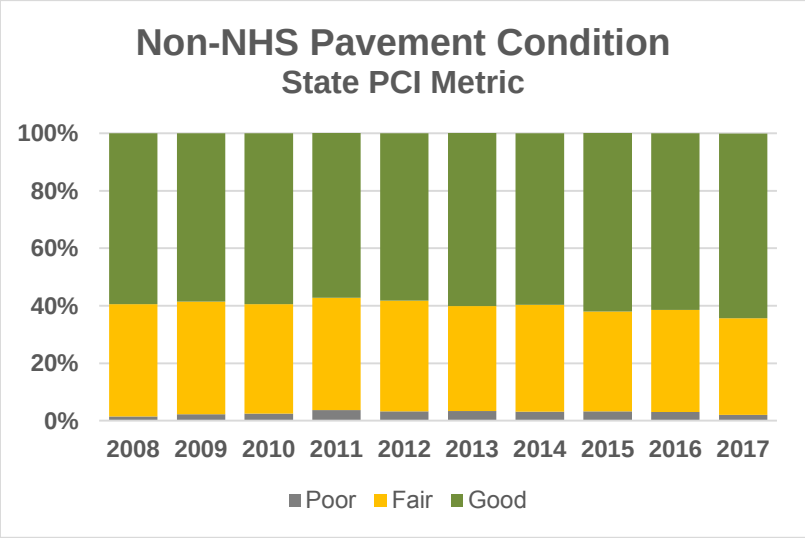
The FHWA metric is used for uniform reporting by states to the FHWA. This allows the FHWA to look at pavement conditions across the United States with a uniform measuring system. The Iowa DOT primarily uses the PCI method of measuring pavements since it gives a numerical value for comparing pavement conditions that can be tracked over time. This aids in the decision making process for managing pavements.

What is the condition of Iowa DOT's pavements?

The following charts show the distribution of Good, Fair, and Poor pavements based on the Iowa DOT PCI over the past decade. The condition of the Interstate Highway System has improved significantly over that time. Conditions on the other parts of the network have fluctuated from year to year, but have remained relatively stable overall.







The table below presents the pavement condition as of 2017 based on the FHWA performance metric. Note that although the local-government managed NHS miles show a higher percentage in poor condition, this represents only about 2.5% of the Non-Interstate NHS mileage in Iowa. Overall only 4.0% of NHS pavements in Iowa are rated in poor condition based on the FHWA metric.

System		Percent Good	Percent Poor
Interstate Highway System		57.7%	1.8%
National Highway System (non-Interstate)		37.5%	4.0%
	NHS – DOT managed	38.3%	3.7%
	NHS – managed by local government	8.0%	15.2%
Non-NHS Primary Highways		32.0%	6.3%
All non-Interstate Primary Routes		35.7%	4.7%

3 Managing Pavements

What does Iowa DOT want to achieve with its pavement program?

The Iowa DOT works to provide a safe, serviceable, and sustainable roadway system through the use of the pavement management system. The pavement management system will assist program administrators in the selection of economical options for pavement decisions for the construction, reconstruction, rehabilitation, preservation, and maintenance of pavements.

The pavement management system will be used to model and predict future pavements conditions based on various funding levels. This analysis will determine the level of funding to maintain the pavement system in a state of good repair. A desired state of good repair is defined as at least 97% of Interstate system lane miles and 97% of the non-Interstate NHS lane miles being in a good or fair pavement condition. Good and fair pavement condition are defined by the Iowa DOT PCI metric that was previously discussed in the Pavement Management Section. The Iowa DOT continues to evaluate other metrics that may more robustly define a state of good repair and provide better measurements of a complex system.

The DOT is in the process of developing short and long term performance targets for the pavement system by utilizing the data in the pavement management system. In addition, the State of Good repair will be used in setting targets for DOT funding for the 10-year analysis period required by Chapter 23 CFR 515.

What types of activities does Iowa DOT perform in order to meet these objectives?

Consistent with the principles of asset management, a wide range of work types are used to maintain primary pavements. These work types differ based on the pavement condition. Generally, this work is divided into five categories: construction, reconstruction, rehabilitation, preservation, and maintenance.

Construction involves building a new roadway section or a significant reconfiguration of an existing roadway. Construction projects are identified in long range planning documents, the 5-Year Program and the Statewide Transportation Improvement Program (STIP). These projects involve issues that extend beyond the pavement condition. These larger issues include economic, capacity, and safety considerations. Since these projects

involve many different configurations and environments, there is not a standard per mile cost for construction. Each project will have an individual scoping and planning document prepared by the Department to determine its economic cost and benefits.

Treatments for the other work types are indicated in the following table. The table does not cover all possible treatments for each work type, but it does cover those most commonly used and their approximate cost per lane mile. The treatment family is a grouping used in the pavement management software that helps identify the work type. The project treatment(s) are the alternatives that may be selected from a treatment family. The typical costs reflect the average project costs for each lane mile of the treatment. Actual costs of an individual project will differ from those shown in the table, but these costs are considered typical and used in the benefit cost analysis of the pavement management software.

Work Type	Treatment Family	Project Treatment(s)	Typical Cost/Lane Mile
Construction	Construction	New HMA or PCC Pavement	Project Specific
Reconstruction	Reconstruction	New HMA or PCC Pavement	$750,000 Interstate $600,000 Primary
Rehabilitation	Major Structural Rehabilitation (More than 4.5 inches of structure needed)	Crack and Seat with HMA Overlay, HMA Overlay or PCC Overlay	$500,000 Interstate $400,000 Primary
Rehabilitation	Minor Structural Rehabilitation (3.0 to 4.5 inches of structure needed)	HMA Overlay or PCC Overlay	$380,000 Interstate $240,000 Primary
Rehabilitation	Functional Rehabilitation (Less than 3.0 inches of structure needed)	HMA Overlay	$220,000
Rehabilitation	Cold in Place Recycling	Cold-In-Place Recycling	$247,500
Preservation	Diamond Grinding I & II	Diamond Grinding I or II	$25,000 Diamond Grinding I Primary $50,000 Diamond Grinding II Primary $50,000 Diamond Grinding I & 2 Interstate
Preservation	Thin Surface Treatments	Thin Lift HMA, Microsurfacing and Chip Seal	$30,000

Maintenance	Maintenance	Patching, Crack Filling and Sealing, Slurry Leveling and Joint Repair	Variable – Based on project quantity and density

How does Iowa DOT determine what type of work to perform on a pavement?

Good pavement management is all about selecting the right treatment at the right time on the right pavement section. The Pavement Management System allows for a system wide identification of treatment options to help determine the right time for each treatment on each pavement section based on a given funding scenario.

Interstate projects are prioritized by the DOT's central office. This allows all interstate projects to compete against each other for funding, regardless of location. The rest of the primary system is managed collaboratively by the central office and the district offices. Generally, construction and reconstruction projects are identified by districts and prioritized by a team from the central office and districts. Rehabilitation, preservation, and maintenance projects are managed by the district offices.

The pavement management system is used to assist in determining which projects should be developed. Algorithms, developed by Iowa DOT pavement engineers, create performance models based on the condition data collected for each pavement section. These performance models predict the anticipated future condition of each pavement section. Using trigger criteria, treatment strategies are generated for each pavement section by the pavement software, and the benefits and costs of potential pavement treatments are estimated. This information is used to determine a benefit cost ratio for each potential treatment on each pavement section. For a given budget scenario, the pavement management software selects project treatments for pavement sections by prioritizing the greatest incremental benefit/cost ratio, seeking to optimize the benefits at any given budget level. The Iowa DOT has separate budgets and budget scenarios for Interstate and non-interstate pavements. The system uses a 10-year period for predicting the future condition of pavements and potential project treatments.

More than just pavement condition data is considered when selecting a project. The DOT also uses information on the condition of bridges and other structures, safety, traffic volume, capacity, and economic benefit when making these decisions. Construction and reconstruction projects are accounted for in the Iowa DOT pavement management system, which allows the pavement management software to estimate these projects' impact on the overall statewide pavement condition.

3 Managing Pavements

The recommendations of pavement management software are used by program administrators when developing reconstruction, rehabilitation, and preservation programs. For the Interstate System, the recommendations of the pavement management software are part of the annual Interstate review where potential pavement replacement and rehabilitation projects are evaluated. In addition, the Districts use the pavement management software recommendation as a resource in the development of the interstate preservation and maintenance programs.

The Districts also use the pavement management recommendations and data in conjunction with site visits, pavement investigations, and local knowledge about roadways to develop the district pavement rehabilitation and preservation programs. The pavement management recommendations do not provide specific maintenance treatments, but the pavement management system does provide data to the district about current condition and history that is used to prioritize maintenance treatments. These maintenance treatments address specific events or pavement defects in order to maintain a pavement's condition in order to maintain a functional state of operation.

The projects developed from these procedures become part of the recommendations given to the Iowa Transportation Commission for funding consideration. If they are approved and are federally funded, the projects are placed in the STIP. As part of the process the Iowa Transportation Commission is updated on the current condition and estimated future condition of the Iowa DOTs pavements based on various funding scenarios.

Pavement management systems and the modeling software are an evolving process. The modeling efforts have limitations: there are time lags between data collection and data availability; the models do not perfectly predict future conditions, treatment costs are estimates, treatment selection lengths may not be practical or economical, and local knowledge of pavements is not represented in the model. In addition, the Iowa DOT considers other factors such as traffic, system classification, and a need for funding flexibility when making project selections. Because of these issues, engineering judgement is needed when reviewing the pavement management output and developing projects. The Iowa DOT strives to have a practical low cost approach to pavement management and continues to work to improve its pavement management system with better models and better aligned project recommendations.

As Iowa DOT continues to enhance its pavement management system, it will be able to estimate the remaining service life of its pavements and incrementally improve pavement strategies to maximize pavement investment. Iowa DOT also is working to institutionalize a Transportation Asset Management Governance Structure. One aspect of TAM Governance is the development of Pavement Management Team, a group of engineers and subject matter experts from the Districts and central office, as well as external partners such as FHWA and Iowa State University charged with continual improvement of Iowa DOT's pavement management system. This team has been chartered and is actively working on developing and improving pavement management practices.

What does Iowa DOT expect its pavement to look like in the future?

As discussed above, Iowa DOT is working to customize its pavement management software program so that it can better understand the relationship between funding and future conditions. Until this tool is available for use, Iowa DOT is using an interim pavement model for planning purposes. Iowa DOT has used this model to assess generalized impacts of various funding scenarios. Based on this analysis, Iowa DOT expects that with current funding levels, 30 percent of non-Interstate pavements will be in Poor condition in 20 years. This is a significant increase in percent Poor compared to the current value of less than 10 percent. Iowa DOT will review and update these projections once its pavement management software program becomes available.

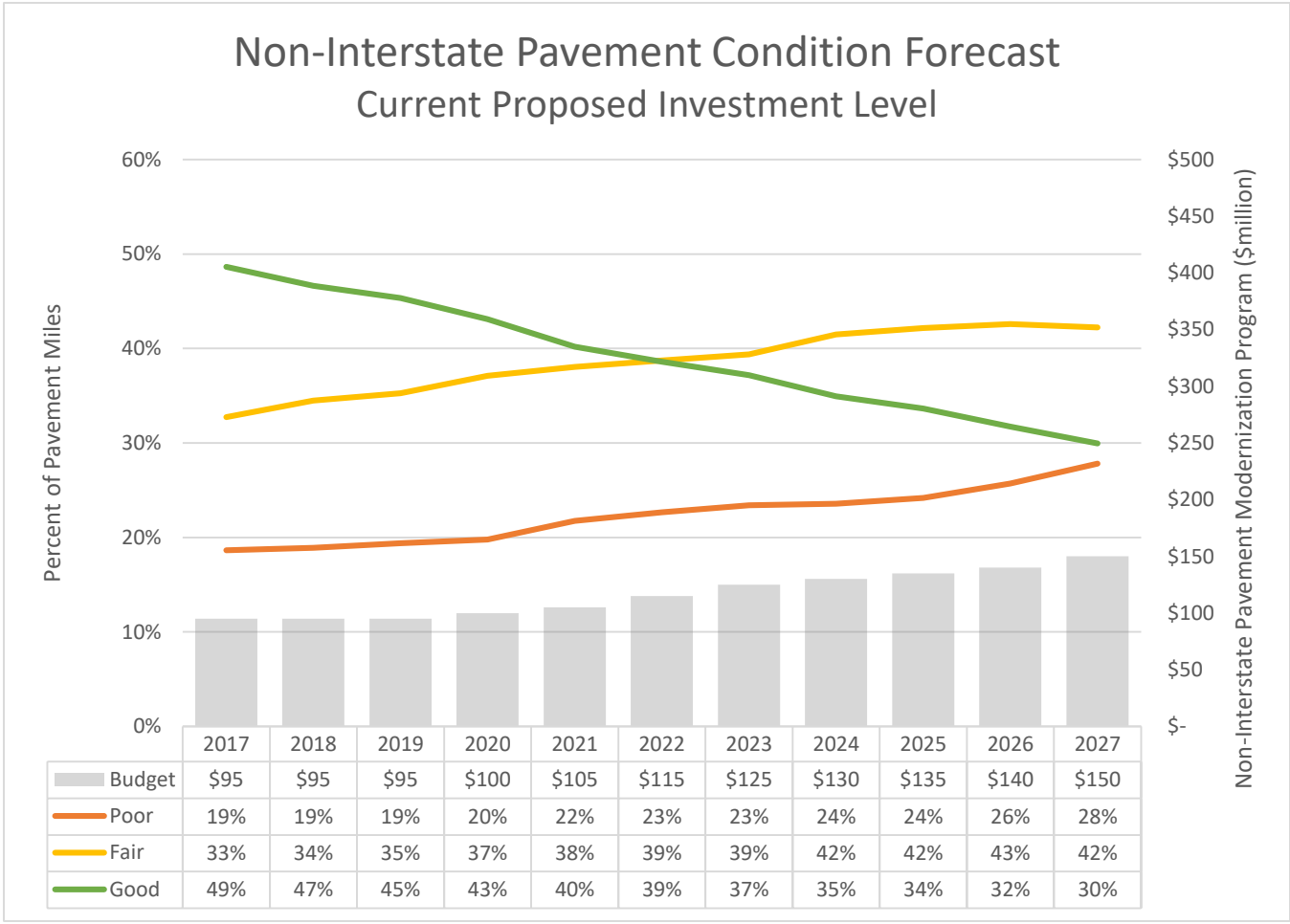
The chart below illustrates the types of graphs Iowa DOT is working to develop for bridges and pavements. This graph is based on Iowa DOT's interim pavement model. It shows the relationship between annual funding and the condition of non-interstate pavements in 2026. As Iowa DOT implements its pavement and bridge management software programs it will develop refined versions of this graph, and use the information to inform the target setting process.

Pavement management data and the pavement management software are used to determine the future condition of the pavement system based on funding scenarios. Highway project funding for the next five years is listed in the 5-year Program, as well as a "target funding level" for the subsequent five year period. Programmed pavement projects and funding levels from the 5-year Program are used in the pavement management software as one budget scenario. This scenario includes funding for interstate stewardship, interstate capacity/system enhancement, non-interstate capacity/system enhancement and non-interstate pavement modernization. Analysts use the pavement management software to examine other funding scenarios to forecast the future conditions of primary system pavements. These funding scenarios might include:

- Seeking an annual budget level that would allow us to maintain current conditions (% pavements in G/F/P condition)
- Examining budget scenarios from "do nothing" up to 300% of current proposed funding levels

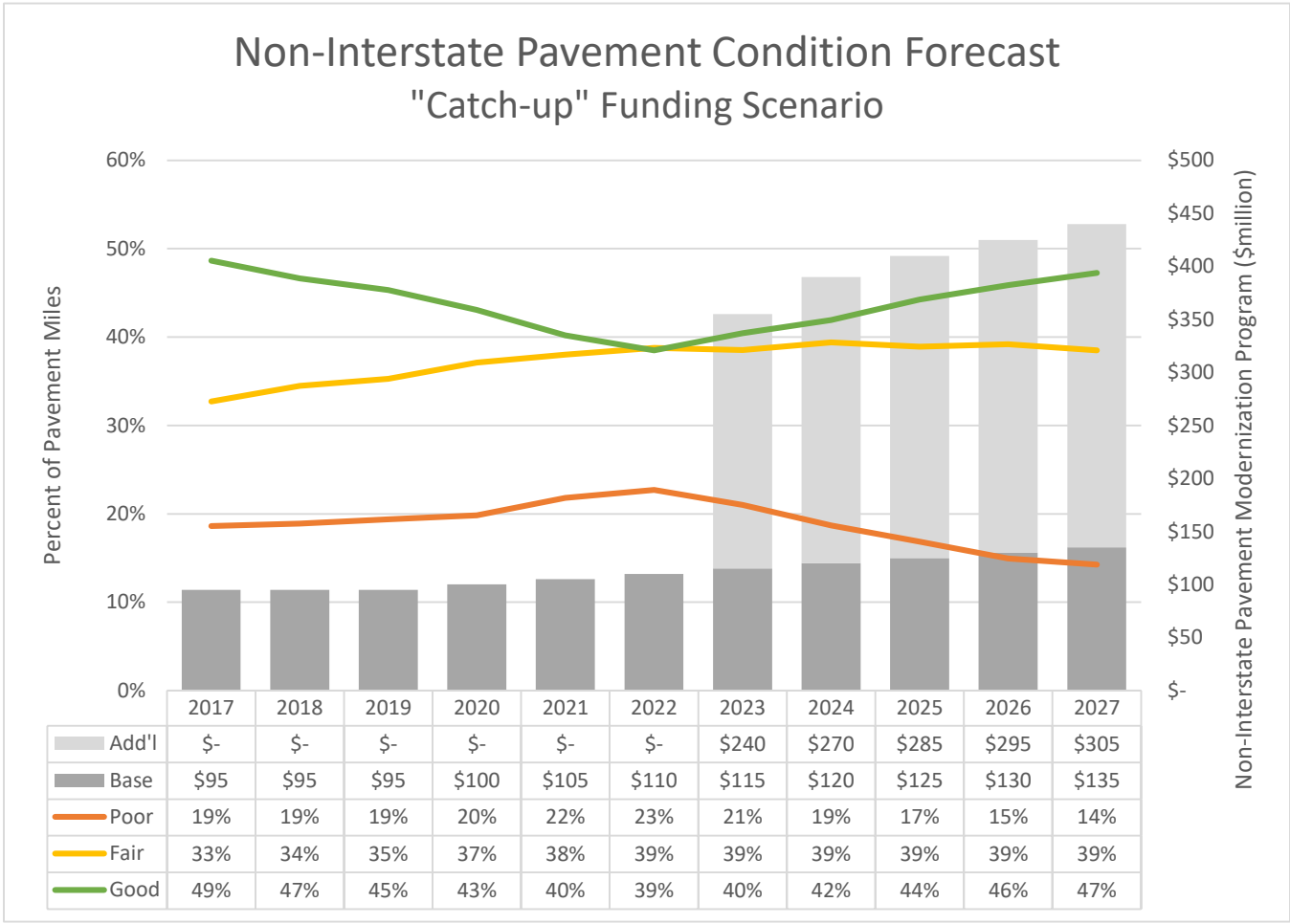
- Understand the resources required to "catch up" pavement condition when resources are diverted to other priorities.

These budget scenarios allow pavement management experts and other stakeholders to understand the range of future pavement conditions that can reasonably achieved at various funding levels, and to understand the impact of trade-offs to either additional or reduced funding. The following chart is an illustrative example presented to the Transportation Commission during the 2017-2022 Program development process to help demonstrate the anticipated non-Interstate pavement condition under different funding scenarios.



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Budget	$95	$95	$95	$100	$105	$115	$125	$130	$135	$140	$150
Poor	19%	19%	19%	20%	22%	23%	23%	24%	24%	26%	28%
Fair	33%	34%	35%	37%	38%	39%	39%	42%	42%	43%	42%
Good	49%	47%	45%	43%	40%	39%	37%	35%	34%	32%	30%

Based on the current funding forecast the non-interstate primary highway system is predicted to gradually decline in overall condition. Over the next ten years more pavements are expected to be in the fair and poor category. The percent of lane miles in poor condition will in increase from 19% to 28%. In addition, the amount of pavement in the good category will decrease from 49% to 30%. Information provided by the pavement management system will help message and manage the rate of decline for the non-interstate pavement system. PMS information will help the Iowa DOT to compare alternative project selection strategies to determine which strategies best maintain the overall pavement system condition.



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Add'l	$-	$-	$-	$-	$-	$-	$240	$270	$285	$295	$305
Base	$95	$95	$95	$100	$105	$110	$115	$120	$125	$130	$135
Poor	19%	19%	19%	20%	22%	23%	21%	19%	17%	15%	14%
Fair	33%	34%	35%	37%	38%	39%	39%	39%	39%	39%	39%
Good	49%	47%	45%	43%	40%	39%	40%	42%	44%	46%	47%

The Iowa DOT is continuing to develop and refine this analysis to include additional scenarios and pavement networks. The example above is an illustration, using information shared with the Transportation Commission.

How does the Iowa DOT work with Local Agencies on pavement management?

The Iowa DOT works in partnership with local agencies to promote good pavement management practices. The Iowa DOT participates in and is the primary funding source for the Iowa Pavement Management Program (IPMP) at Iowa State University's Center for Transportation Research and Education. IPMP has been supported by Iowa DOT since 1996, and its role is to support local agencies in the collection and management of pavement data, as well as with modeling and analysis tools. IPMP focuses on local agency needs and is a technical resource for pavement management. Since 2013, the Iowa DOT has expanded pavement data collection efforts to collect pavement condition data on all paved roads in Iowa. Data is shared, free of charge, with counties, cities and planning agencies through IPMP and is available for their use.

The Iowa DOT will also be working with MPOs and local agencies to establish performance targets for non-interstate NHS system segments of roadways that are in local jurisdictions. The target setting for these pavement sections is a requirement of the FHWA.

What improvements are being made to the pavement management process?

The Iowa DOT is continuously improving the pavement management process. Current process improvement efforts include developing a scoping and project prioritization application. This application will include pavement management software recommendations and a pavement score. It will also include scores for bridges, safety, economics, and traffic volume that will be used to prioritize projects. The application will users to access pavement data to assist in project decision-making. In addition, a straight line diagramming tool is being implemented. This data visualization tool will display pavement information in conjunction with other highway system data, leveraging Iowa DOT's robust linear referencing system. These efforts will more readily place pavement data in the hands of decision makers.

A technical group is reviewing the pavement management software in order to improve the software prediction models. This group seeks to improve deterioration curves as well as condition and other measurements in order to better model and forecast pavement conditions. This group includes members from all six districts as well as central office staff in order to have a shared understanding of the pavement management system and broad involvement in enhancements.

Work is also being performed to track the pavement management software recommendations and final project treatment selection. This will allow for feedback on project selection and decision making. The feedback can be used to improve performance models and project selection. The goal is to improve the correlation between the recommendations from the pavement management software and the projects selected for programming.

What is the value of Iowa DOT's bridges and pavements?

Iowa DOT estimates that it would cost over $26 billion to replace its bridges and pavements.[4] This cost is significant and reinforces the need for Iowa DOT to maintain its existing assets effectively in order to minimize expensive reconstruction activities.

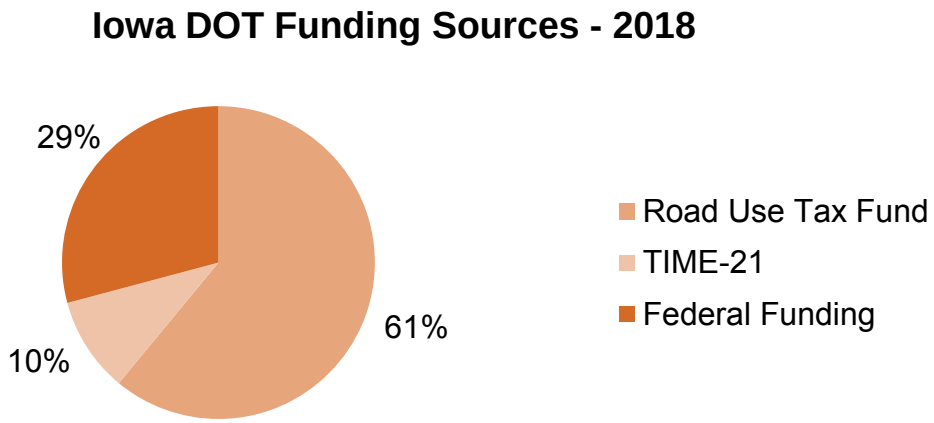
	Basis for Unit Costs	Average Unit Cost to Reconstruct			Replacement Costs
		Interstate	NHS (Non-Interstate)	Non-NHS	
Bridge	Each bridge	$3,067,000	$1,642,000	$2,120,000	$11,990,000,000
Pavement	Lane mile	$750,000	$600,000	$600,000	$14,178,750,000
				Total	**$26,168,750,000**

[4] These costs reflect the costs of rebuilding Iowa DOT's bridges and pavements as they are today, without making any improvements to them, such as widening them. These costs do not include the cost to replace other roadside assets such as signs, guardrails, and sidewalks.

Where does Iowa DOT's funding come from?

Iowa DOT's budget comes from three primary sources of funding:

- **Road Use Tax Fund.** A significant portion of Iowa DOT's funding is provided through the Iowa Road Use Tax Fund (RUTF). The RUTF consists mostly of revenue from state fuel taxes and motor vehicle registration fees. These funds are allocated by law to Iowa DOT and Iowa's cities and counties. In 2018, Iowa DOT anticipates receiving $730 million in funding from the RUTF.
- **TIME-21.** In 2008, the Iowa Legislature increased transportation funding by increasing registration fees for motor vehicles and trailers. These funds are also allocated to Iowa DOT and Iowa's cities and counties. In 2018, Iowa DOT anticipates receiving $118 million in TIME-21 funding.
- **Federal Funding.** The Federal Government collects transportation funding and disperses it to the states through its Highway Trust Fund. The Highway Trust Fund is funded primarily by a motor fuel tax, and fees charged to heavy vehicles. In 2018, Iowa DOT anticipates receiving $349 million in federal highway funding.



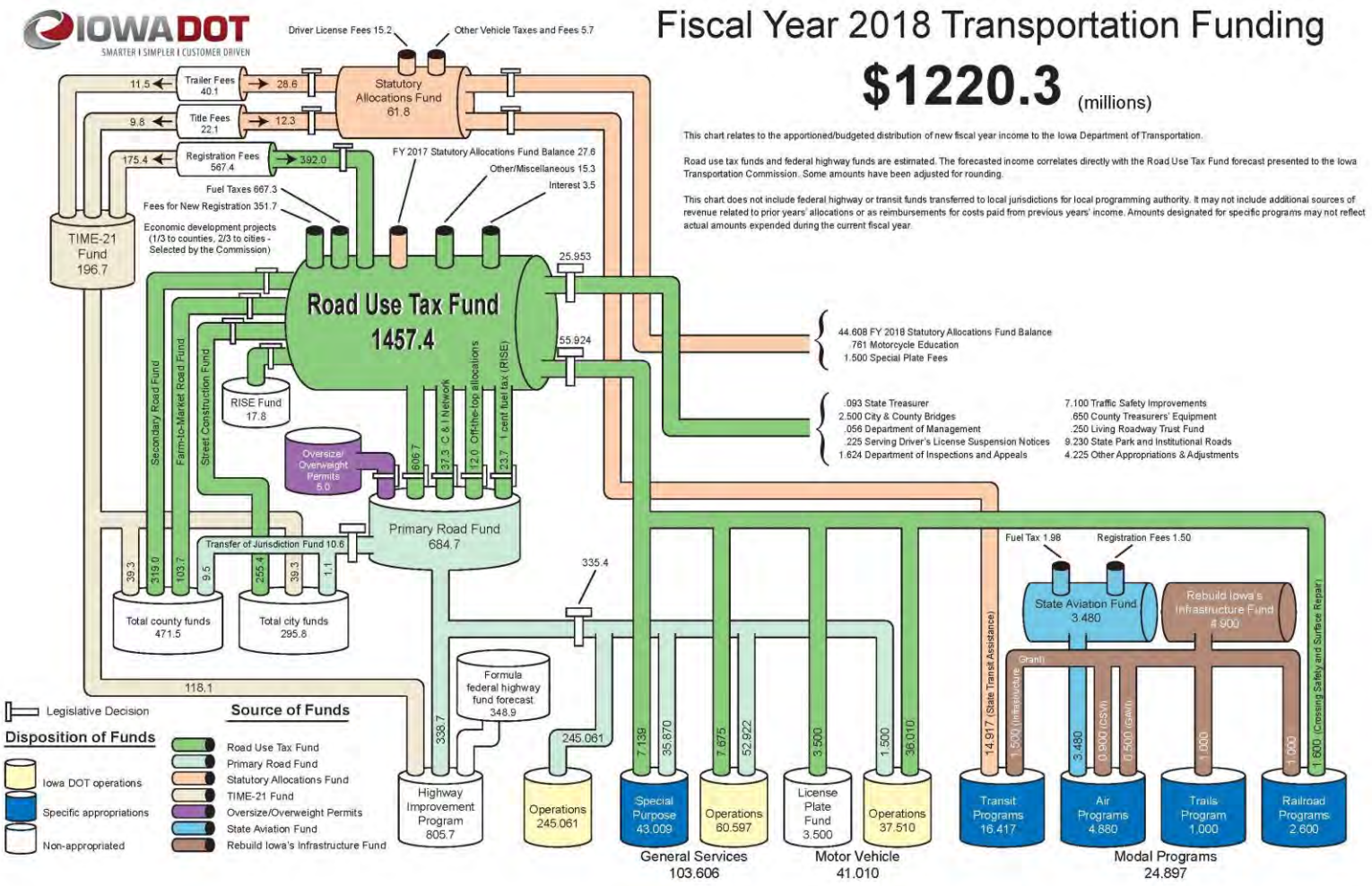
How does Iowa DOT decide what activities to fund?

Iowa DOT does not have full flexibility to spend federal funds. For example, it is required to spend a portion of these funds on activities related to rail crossings and recreational trails. Once these and other requirements are accounted for, Iowa DOT allocated **$349 million** in federal funds to its Highway Improvement Program in 2018.

The allocation of state funding is similarly constrained. The figure on the following page shows how state funds are allocated. After accounting for all state funding sources and allocations, **$457 million** in state funding was available for Iowa DOT's Highway Improvement Program in 2018.

The total budget for the Highway Improvement Program in 2018 is **$805 million**. This program funds construction projects on Iowa DOT's bridges and pavements, and represents the bulk of the funds available for asset management activities.

An additional **$245 million** is available for Iowa DOT's highway operations. These funds cover employee salaries, day-to-day activities, and maintenance activities. Some maintenance activities play an important role in preserving roadway conditions and extending pavement life. Examples include crack filling, and crack sealing.


IOWADOT
SMARTER | SIMPLER | CUSTOMER DRIVEN
Fiscal Year 2018 Transportation Funding
$1220.3 (millions)
This chart relates to the apportioned/budgeted distribution of new fiscal year income to the Iowa Department of Transportation.
Road use tax funds and federal highway funds are estimated. The forecasted income correlates directly with the Road Use Tax Fund forecast presented to the Iowa Transportation Commission. Some amounts have been adjusted for rounding.
This chart does not include federal highway or transit funds transferred to local jurisdictions for local programming authority. It may not include additional sources of revenue related to prior years' allocations or as reimbursements for costs paid from previous years' income. Amounts designated for specific programs may not reflect actual amounts expended during the current fiscal year.
Driver License Fees 15.2
Other Vehicle Taxes and Fees 5.7
Trailer Fees 40.1
Title Fees 22.1
Registration Fees 567.4
Statutory Allocations Fund 61.8
FY 2017 Statutory Allocations Fund Balance 27.6
Other/Miscellaneous 15.3
Interest 3.5
Fuel Taxes 667.3
Fees for New Registration 351.7
Economic development projects (1/3 to counties, 2/3 to cities - Selected by the Commission)
TIME-21 Fund 196.7
Road Use Tax Fund 1457.4
RISE Fund 17.8
Oversize/ Overweight Permits 5.0
Secondary Road Fund
Farm-to-Market Road Fund
Street Construction Fund
Primary Road Fund 684.7
Transfer of Jurisdiction Fund 10.6
Total county funds 471.5
Total city funds 295.8
Formula federal highway fund forecast 348.9
Highway Improvement Program 805.7
Operations 245.061
Special Purpose 43.009
Operations 60.597
General Services 103.606
License Plate Fund 3.500
Operations 37.510
Motor Vehicle 41.010
Fuel Tax 1.98
Registration Fees 1.50
State Aviation Fund 3.480
Rebuild Iowa's Infrastructure Fund 4.900
Transit Programs 16.417
Air Programs 4.880
Trails Program 1.000
Railroad Programs 2.600
Modal Programs 24.897
44.608 FY 2018 Statutory Allocations Fund Balance
.761 Motorcycle Education
1.500 Special Plate Fees
.093 State Treasurer
2.500 City & County Bridges
.056 Department of Management
.225 Serving Driver's License Suspension Notices
1.624 Department of Inspections and Appeals
7.100 Traffic Safety Improvements
.650 County Treasurers' Equipment
.250 Living Roadway Trust Fund
9.230 State Park and Institutional Roads
4.225 Other Appropriations & Adjustments
Legislative Decision
Disposition of Funds
Iowa DOT operations
Specific appropriations
Non-appropriated
Source of Funds
Road Use Tax Fund
Primary Road Fund
Statutory Allocations Fund
TIME-21 Fund
Oversize/Overweight Permits
State Aviation Fund
Rebuild Iowa's Infrastructure Fund

How does Iowa DOT set funding levels for its major investment categories?

The Iowa Transportation Commission (Commission) determines how to allocate the funding available through Iowa DOT's Highway Program. The Commission establishes funding levels for the following six major investment categories:

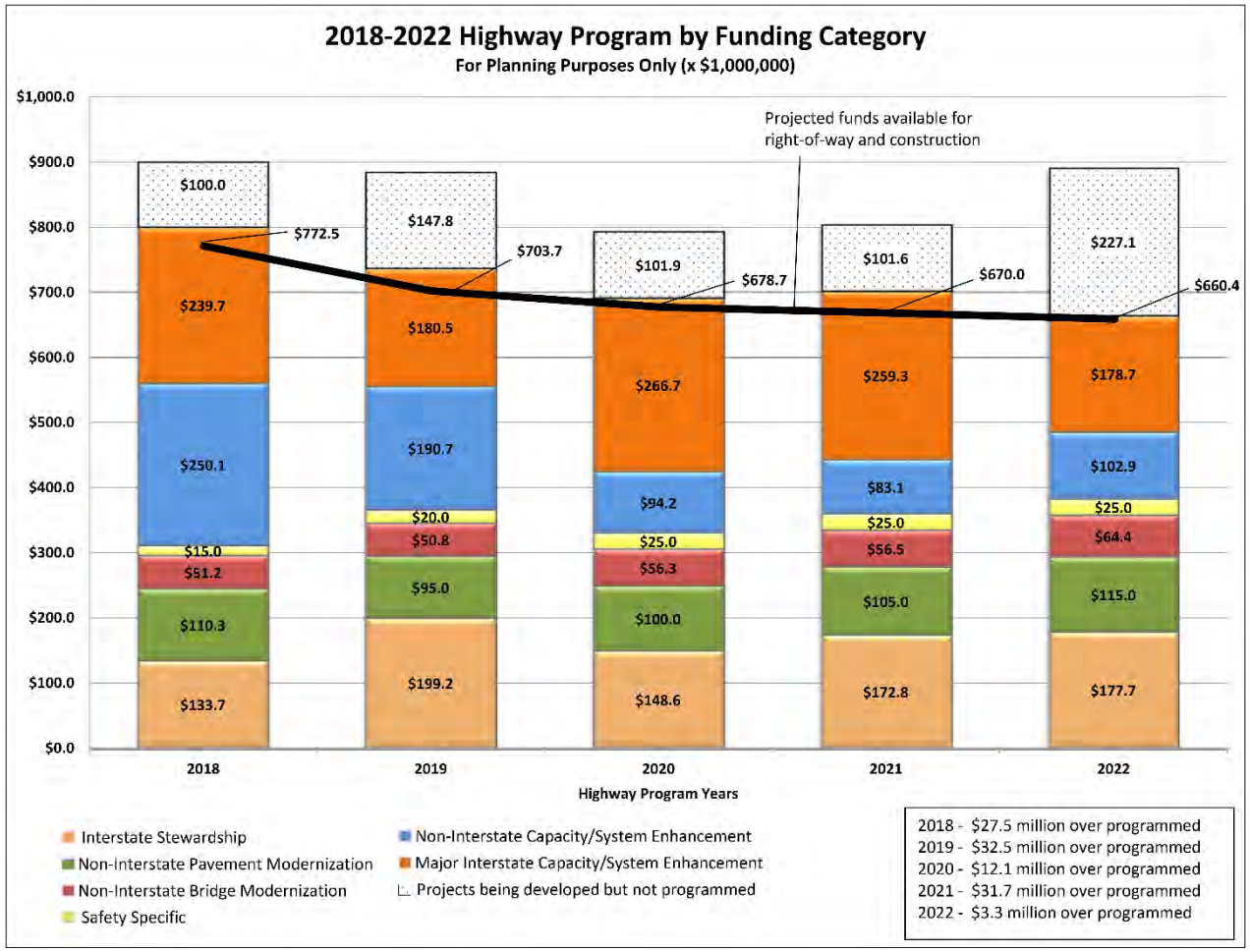
- Stewardship categories
  - Interstate pavement and bridge
  - Non-interstate pavement
  - Non-interstate bridge
  - Safety-specific
- Capacity categories
  - Major interstate
  - Non-interstate

In recent years, the Commission has incorporated recommendations from Iowa DOT staff for the appropriate funding levels for the four stewardship categories, and then allocated the remaining funds to the two capacity categories. Iowa DOT recommendations for stewardship funding levels are primarily based on historical funding trends. In the future, Iowa DOT plans to use bridge and pavement management systems and other resources to better link asset performance with funding levels, as well as to evaluate risk and whole-life cost. As these tools improve, Iowa DOT will be better able to inform the Commission and other stakeholders of the relationship between funding and future performance levels. In the past, Iowa DOT has used similar tools for specific asset classes, but rarely in a general fashion to describe investment trade-offs across assets and programs.

The Commission approves the Five-Year Highway Program in June of each year. The transportation programming process is a continuous, year-round effort. Once the Commission approves the funding for these categories, Iowa DOT allocates the funds to specific projects using the processes described in the Managing Bridges and Managing Pavement sections of this TAMP.

How much money is expected to be available for asset management over the next 10 years?

Iowa DOT forecasts state and federal revenue annually in preparation for the development of its Highway Program. State revenue sources have proven to be stable over time, and actual receipts typically track very closely to forecasted amounts. Iowa DOT estimates future federal funds based on existing funding identified in federal authorization bills. The current bill runs for four years. The absence of timely reauthorizations and the use of bill extensions lead to uncertainty in forecasting federal



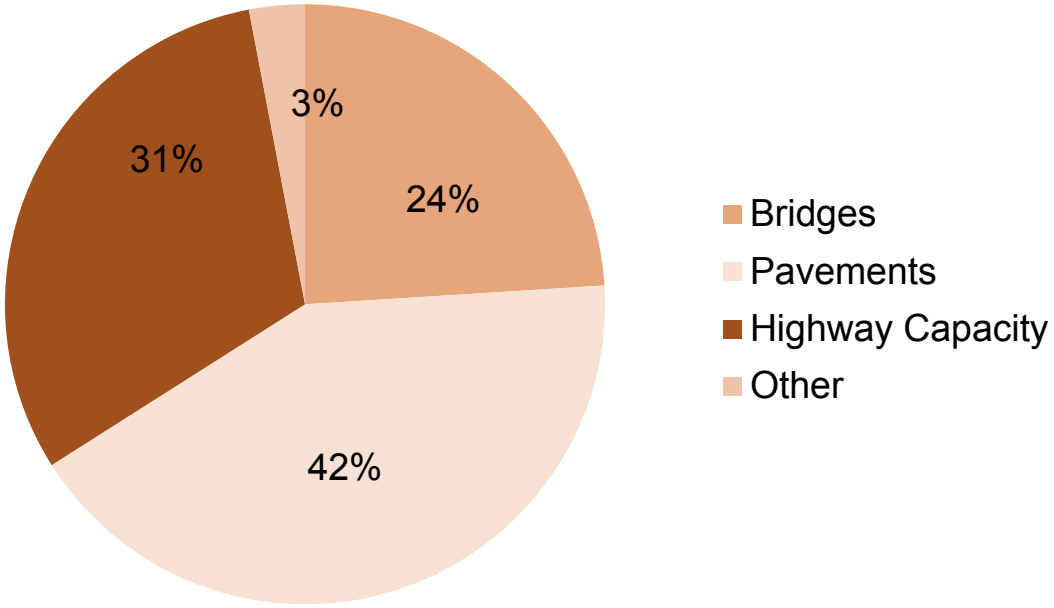
funding. Iowa DOT, therefore, uses a more conservative approach for forecasting federal funds than for forecasting state funds.

This chart shows the funding levels that Iowa DOT expects to be available for its Highway Program through 2022. It also shows how Iowa DOT plans to allocate these funds based on the process described above. This chart is prepared as part of the 5 Year Program development process and is illustrative only of projects which have been programmed.

The relationship between funding levels in Iowa DOT's Highway Program and asset management activities is shown in the pie chart below. In addition to the stewardship programs, a portion of the modernization and capacity programs will also impact bridge and pavement conditions. For example, when Iowa DOT widens a section of highway, it replaces the existing pavement.[5]

[5] Iowa DOT used the following assumptions to create this chart: 1) Grading work that accompanies paving work is considered "pavements"; 2) Grading work by itself is considered "other"; 3) "Other" also includes signs, guardrail, right-of-way, erosion control, grading, rest areas, and other roadside assets; 4) 50% of the cost of Major Interstate Capacity/System Enhancement projects is assumed to impact existing bridge and pavement conditions.

Breakdown of Funding Levels from Iowa DOT's 2018-2022 Highway Program



The table below shows a more detailed breakdown of Iowa DOT's anticipated funding levels beyond the current 5 year program. It shows the amount of funding that Iowa DOT expects to allocate to each of the asset groups described in this TAMP. In addition, it shows the amount included in Iowa DOT's 2018-2022 Highway Program, and the projected amount for 2023-2027.[6]

Anticipated Funding by Asset Category – 2018 through 2027

($ Millions)	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Bridge Stewardship										
Interstate	$108,467	$111,039	$133,147	$142,666	$114,162	$115,000	$115,000	$115,000	$115,000	$115,000
NHS (Non-Interstate)	$36,317	$28,671	$37,304	$37,312	$44,936	$65,000	$65,000	$65,000	$65,000	$65,000
Non-NHS	$19,460	$15,364	$19,990	$19,993	$24,079	$35,000	$35,000	$35,000	$35,000	$35,000
Subtotal	**$164,244**	**$155,074**	**$190,441**	**$199,971**	**$183,177**	**$215,000**	**$215,000**	**$215,000**	**$215,000**	**$215,000**
Pavement Stewardship										
Interstate	$117,455	$165,020	$136,546	$148,315	$109,222	$140,000	$140,000	$140,000	$140,000	$140,000
NHS (Non-Interstate)	$105,925	$118,287	$84,059	$92,367	$114,936	$105,000	$105,000	$105,000	$105,000	$105,000
Non-NHS	$72,583	$81,054	$57,601	$63,293	$78,759	$70,000	$70,000	$70,000	$70,000	$70,000
Subtotal	**$295,963**	**$364,361**	**$278,206**	**$303,975**	**$302,917**	**$315,000**	**$315,000**	**$315,000**	**$315,000**	**$315,000**
Total Stewardship	$460,207	$519,435	$468,647	$503,946	$486,094	$530,000	$530,000	$530,000	$530,000	$530,000
Capacity	$323,000	$202,000	$213,000	$192,000	$168,000	$97,000	$97,000	$97,000	$97,000	$97,000
Other	$17,000	$14,000	$10,000	$6,000	$10,000	$33,000	$33,000	$33,000	$33,000	$33,000
Total Program	**$800,207**	**$735,435**	**$691,647**	**$701,946**	**$664,094**	**$660,000**	**$660,000**	**$660,000**	**$660,000**	**$660,000**

The activities related to initial construction would be captured within the "capacity" line. All other asset management activities (reconstruction, rehabilitation, preservation and maintenance) are included in the "stewardship" category.

[6] Iowa DOT developed this table by translating the program structure used by the Commission to the six asset categories used throughout this document. For the first 5 years, this translation is based on actual projects in the 2018-2022 Highway Program and the assumptions listed in the footnote on the previous page. The last 5 years are based on projections for how funding may increase over time, and is contingent upon future revenue projections and future Commission direction and approvals.

What conditions can Iowa DOT achieve with these funding levels?

Iowa DOT expects that the overall condition of its bridges and pavements will get worse over next 10 years based on projected funding levels. Iowa DOT will revisit these projections as funding levels fluctuate in the future.

In the past, Iowa DOT has been able to periodically increase planned bridge and pavement funding levels. Increasing the funding levels could enable Iowa DOT to slow down or even stop the projected decline in asset conditions. In the most recent approved 5-year Program, the expenditure projection for the five years beyond the 5-year program indicated a significant increase in stewardship, particularly for bridges where the funding for non-Interstate bridges is proposed to double. Although funds have not been formally committed, showing additional funding for stewardship in the outer years of the program sets an expectation of the funding levels that may be reflected in future programming decisions.

An important part of the asset management planning process is to identify a performance gap. Iowa DOT defines the performance gap as the difference between performance targets and expected performance. Iowa DOT is working to develop specific performance targets for bridges and pavements. Once targets are established, Iowa DOT will compare these target values to the expected values, and define a performance gap. It will also estimate the amount of additional funds required to close this gap. Based on its initial analysis described above, Iowa DOT expects that it will have a performance gap over the next 10 years.

Specifically, the performance gap would be defined as the difference between the target values for bridge and pavement condition and the forecast conditions of these assets at the projected funding levels using Iowa DOT's pavement and bridge management systems. Federal regulations require the development of targets for the FHWA bridge and pavement performance measures. These required targets are short-term and use measures which are inconsistent with the Iowa DOT's management systems, so Iowa DOT is developing a method to translate the performance data from the FHWA measures into targets that can be incorporated into the Iowa DOT's management systems over a 10-year time horizon.

Iowa DOT is currently coordinating with local governments and planning agencies to establish the required targets. Because of the short-term nature of the targets (2 and 4 years), the Iowa DOT is taking a risk-based approach to target setting. This approach looks at recent trends in performance for pavements and bridges and forecasts future performance based on these trends. A prediction interval is then established based on past year-to-year variability, and the target will be established based on the probability of achieving the target value (this is where risk, or future uncertainty, is accounted for). These 2- and 4-year pavement and bridge condition targets will be established for the Interstate and NHS systems as required by 23 CFR 490, in consultation with MPOs. Iowa's nine MPOs have already seen one example of this process with the Safety Performance Measure targets there were established in 2017, and have been briefed on and involved with the methodology for pavement and bridge targets. Local agencies outside of MPOs that own NHS facilities are also being engaged through the DOT's Office of Local Systems to make them aware of the requirements and collaborate with those owners on target-setting. All agencies owning NHS assets will be provided data regarding the condition of the NHS assets they manage, as well as information about how to access pavement management data and tools through the Iowa Pavement Management Program and bridge management tools and resources.

In addition, 10-year condition levels are forecast for pavement and bridge using their respective management systems. Examples of these projections are shown in the corresponding sections of this document. Based on the Iowa DOT's desired State of Good Repair for pavements and bridges, it is possible to identify the projected performance gap between these target values and the forecast condition levels. For example, if the Iowa DOT set a target of no more than 10% of NHS bridge deck area rated in "Poor" condition, however the bridge management process suggests that at current funding levels we are anticipated to be at 12% poor by 2028, this would constitute a 2% performance gap. In this case, strategies would need to be identified such as: 1) allocate additional funds to bridge work, 2) focus existing bridge allocation on NHS bridges at the expense of non-NHS bridges, 3) develop new treatment strategies to make our bridge allocation go further. Strategies like these would be developed and evaluated by the bridge management team, with recommendations going through the TAM Governance process to key DOT decision makers and, in the case of determining funding priorities, to the Transportation Commission. Information developed in the gap analysis process will help determine the impacts of the strategies under consideration and will better help all stakeholders understand the impact of their decisions.

4 Financial Plan

Several Iowa DOT planning efforts and documents involve analysis of the transportation system, with the aim to improve its performance in areas aligned with national goals, including safety, infrastructure condition, system reliability, freight movement, and reduced congestion. Some of the strategies and projects identified in these plans will likely result in modifications to NHS pavements and bridges, though not necessarily within the 10-year timeframe of the TAMP. If all the strategies discussed below were implemented immediately, they would likely impact the gap between existing and desired pavement and bridge condition on the NHS by expanding NHS pavement and bridge assets, or by expending funding that may have otherwise been used to improve NHS pavement or bridge conditions. The intent, however, is that these strategies will be implemented over a longer period, and tactics to minimize their impact on the performance gap for pavement and bridge condition will be utilized. This would include tactics such as performing work when other pavement and bridge needs are being addressed and funding non-condition needs from sources other than funds targeted towards NHS condition improvement. Over time, if pavements and bridges on the NHS expand due to these strategies, their life-cycle costs and asset management needs will need to be incorporated into the State's overall asset management strategy.

The **State Long-Range Transportation Plan (SLRTP)**, adopted in 2017, includes analysis and strategies for the various modes of transportation in the state. For highways, this includes considerations related to capacity, mobility and safety, freight, condition, operations, and bridges. Pavement and bridge needs on the NHS are anticipated to be addressed primarily through asset management as described in the TAMP. Other SLRTP needs and strategies, which may result to changes to the NHS, include the following.

- Capacity needs were identified for three interurban interstate corridors and for several Interstate, NHS, and other State routes in urban areas. Strategies to address these needs include targeting investment toward areas anticipated to become congested by 2045, and considering targeting anticipatory investments at locations with potential congestion issues beyond 2045. Improvements affecting some NHS routes could include added capacity and/or operational improvements.
- Mobility and safety, or "Super-2" needs, were identified for five U.S. routes across Iowa, all of which are part of the NHS. Strategies to address these needs include targeting investment toward improvements such as wider paved shoulders, turn lanes, passing lanes, limited access, and geometric improvements.

These improvements are largely anticipated to be opportunistic, and are likely to occur at spot locations when other pavement, bridge, or safety issues are being addressed.

- The operations analysis focused on prioritizing interstate corridors from an operations perspective, and implementing appropriate transportation system management and operations (TSMO) strategies on those corridors.

The analysis included in the **State Freight Plan**, updated in 2017, identifies important considerations that may lead to changes to some NHS routes to enhance mobility and/or reduce delay. One such consideration is the identification of the Iowa Multimodal Freight Network (IMFN), which includes several NHS routes. This network is meant to recognize corridors that are critical to truck freight in order to protect and enhance their ability to facilitate freight movement. The IMFN may also lead to department policies regarding the design and use of these corridors, and help assist in programming decisions. Another consideration is the identification and prioritization of bottlenecks on the highway system. These locations represent areas that should be considered for further study and possibly for future improvements. A detailed analysis was performed to prioritize the bottlenecks based on their value to the overall system, traffic and infrastructure condition, and travel time performance.

The State Freight Plan identifies several strategies that may result in investments on NHS routes. These include:

- Target investment to address mobility issues that impact freight movements.
- Emphasize the IMFN and utilize designs that are compatible with significant freight movements.
- Right-size the highway system and apply cost-effective solutions to locations with existing and anticipated issues.

Specific investments identified in the Freight Plan include three interstate projects that will improve the condition and performance of the NHS, including a bridge replacement on I-74 over the Mississippi River and interstate reconstruction/realignment work in Council Bluffs and Johnson County.

4 Financial Plan

The **2017 Strategic Highway Safety Plan (SHSP)** includes engineering strategies to help address issues with lane departure crashes and to improve intersections. These improvements are being implemented as appropriate throughout the State's highway system, and may include enhancements to NHS routes. Many of these strategies would not necessarily impact the condition of pavements or bridges or the timeframe in which assets are rehabbed or replaced. Strategies to help prevent lane departures include the installation of countermeasures such as centerline rumble strips, shoulder/edgeline rumble strips, curve delineation, shoulder treatments, and median cable barriers. Strategies to help improve intersections include implementing innovative improvements such as roundabouts, reduced conflict intersections, diverging diamond interchanges, and offset turn lanes; traffic signal modifications; intersection lighting; and bicycle/pedestrian intersection improvements.

Is the transportation system financially sustainable?

As bridges and pavements deteriorate, work is required to fix them. As the backlog of required work increases, the value of the assets decreases. This decrease is further impacted by inflation, which increases the cost of the required work. This loss of value can be offset by investing in the assets. Over the long term, if the investment levels keep up with the loss of value due to deterioration, then a transportation system is considered financially sustainable. If, however, the system loses value over time, it is unsustainable. Because bridge and pavement conditions are expected to deteriorate over the next 10 years, Iowa DOT considers its highway system to be financially unsustainable.

Iowa DOT is working to develop a more detailed approach for assessing financial sustainability. The goal of this effort is to better understand and communicate the long-term financial implications of the expected budget levels.

4 Financial Plan

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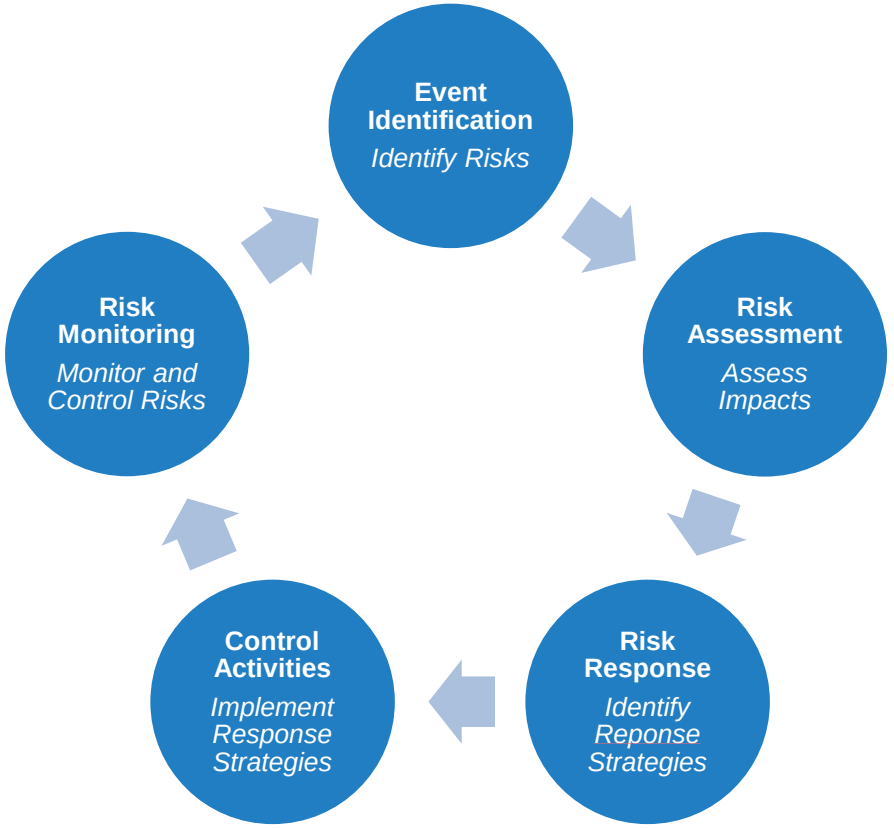
What are risks and how do they relate to asset management?

Risk is defined as "the positive or negative effects of uncertainty or variability upon agency objectives."[7] Risk management is "the processes and framework for managing potential risks."[8]

A key part of the asset management planning process is identifying and mitigating risks associated with implementing the TAMP. The iterative process that Iowa DOT uses to manage its asset management risks consists of the following elements:

- **Event Identification.** Identify events that could impact Iowa DOT's ability to effectively manage its bridges and pavements.
- **Risk Assessment.** Assess the likelihood of an event happening and the consequences if it were to happen.
- **Risk Response.** Identify a strategy for responding to each of the priority risks.
- **Control Activities.** Implement the risk response strategies.
- **Risk Monitoring.** Monitor and respond to possible events, and evaluate the response strategies.



7 Federal Register, Asset Management Plan, Notice of Proposed Rule Making, February 20, 2015.
8 Ibid.

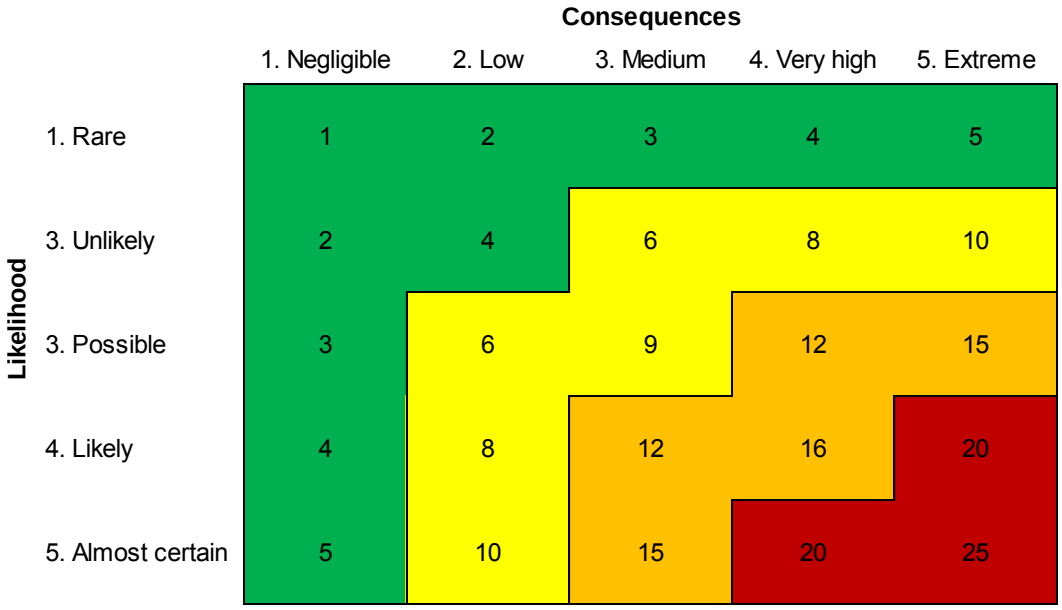
How does Iowa DOT identify and assess asset management risks?

To begin the risk identification process, Iowa DOT distributed an online survey to agency staff. The survey asked respondents to identify significant risks that could enhance or constrain Iowa DOT's ability to manage its bridges and pavements.

Iowa DOT compiled the results of the online survey, combined similar risk statements, and presented them for refinement at an asset management risk workshop. The workshop participants refined the risk statements, and then they assessed the likelihood and consequences of each risk, as follows:

- **Risk likelihood.** Workshop participants cast votes to reflect their assessment of risk likelihood on a scale of one (rare) to five (almost certain). Iowa DOT averaged the votes to determine the overall likelihood score.
- **Risk consequence.** Workshop participants also cast votes to reflect their assessment of risk consequences on a scale of one (negligible) to five (extreme). Iowa DOT averaged the votes to determine the overall consequences score.

The figure below illustrates how Iowa DOT combined the likelihood score and the consequences score to determine the relative priority of the risk. Using this approach, the highest priority risk would be almost certain to occur and would have extreme consequences. The lowest priority risk would be rare and would have negligible consequences.



How does Iowa DOT respond to potential asset management risks?

After assessing and prioritizing the risks at the risk workshop, participants defined a response strategy for each risk. The following are Iowa DOT's potential risk response strategies:

- Strategies for responding to risks with *negative* impacts:
  - Avoid
  - Transfer
  - Mitigate
  - Accept
- Strategies for responding to risks with *positive* impacts:
  - Exploit
  - Share
  - Enhance
  - Accept

The workshop participants also developed a more specific risk action plan for each priority risk. This plan consists of specific activities that Iowa DOT will implement. The results are summarized in Iowa DOT's initial risk register, which is provided on the following pages.

Iowa DOT's risk management process does not stop with the development of this initial risk register. The next steps in the process are to implement the risk action plan, monitor the risks over time, and periodically update the risk register. Through its Asset Management Governance Structure, Iowa DOT also will identify an owner for each risk. The owners will be responsible for implementing the risk action plans and reporting progress quarterly to Iowa DOT's management team. Iowa DOT will update its risk register every two years. As Iowa DOT implements the risk action plans, it is anticipated that, over time, some risks will fall off the priority list. These risks will be replaced with new priorities.

5 Risk Management

What are Iowa DOT's highest priority risks?

The following risk register defines Iowa DOT's priority risks related to asset management. These risks are tracked and managed by the Highway Program Development Group. This group meets weekly, which gives the proper forum to monitor these risks and implement any necessary response strategies.

#	Risk	Impact Type	Likelihood	Conse-quences	Severity Level	Risk Response	
						Risk Response Strategy	Risk Action Plan
1	*If* efficiency and accuracy of data collection and access significantly improve, *then* improved data may be available for decision making.	Positive	Likely/ Almost Certain	Medium/ Very High	Orange	Enhance	1.1 Continue to implement data collection enhancements. 1.2 Develop a plan for data and system coordination and integration. 1.3 Explore opportunities for enhanced data analytics. 1.4 Continue to form and institutionalize the Asset Management Governance Structure.
2	*If* Iowa DOT is unable to adequately communicate the how and why of asset management (AM), *then* the program may not be adequately funded or properly implemented.	Negative	Possible/ Likely	Very High	Orange	Mitigate	2.1 Develop a communication plan that defines who to communicate with, what to communicate to them, and how to communicate to them. 2.2 Address AM in the statewide transportation plan. 2.3 Continue efforts to educate the Iowa Transportation Commission about AM. 2.4 Develop an AM training plan.
3	*If* capacity improvement projects on the Interstate Highway System are delayed, *then* some condition deficiencies on the system may not be addressed.	Negative	Likely	Medium/ Very High	Orange	Mitigate	3.1 Continue to advance the interstate capacity improvement projects. 3.2 Develop corridor plans that identify how AM and capacity improvement projects will be coordinated.

#	Risk	Impact Type	Likelihood	Conse-quences	Severity Level	Risk Response	
						Risk Response Strategy	Risk Action Plan
4	*If* staffing is constrained due to reductions or lack of training, *then* AM may not be properly implemented.	Negative	Likely	Medium	Orange	Mitigate	4.1 Develop an AM staffing plan, and include contingency plans in case staffing levels decrease. Examples include reallocating staff or exploring contracting alternatives.
5	*If* population continues to shift to urban areas, *then* additional funds may be allocated to non-AM needs, decreasing AM funding statewide.	Negative	Possible/ Likely	Medium	Orange	Mitigate	5.1 Evaluate the highway system, and identify priority rural assets that should take precedence if AM funding decreases.
6	*If* the Iowa Transportation Commission approves future increases to planned stewardship expenditures, *then* Iowa DOT may be able to maintain existing bridge and pavement conditions.	Positive	Possible	Medium/ High	Orange	Enhance	6.1 Communicate with the Iowa Transportation Commission to understand the implications of current funding levels. 6.2 Improve the ability to forecast funding levels and look for sustainable funding options. 6.3 Advocate that unused funding from the capacity program or new revenue be allocated to stewardship.
7	*If* freeze/thaw cycles occur more frequently, *then* pavements may deteriorate faster.	Negative	Possible	Medium	Yellow	Mitigate	7.1 Conduct research to determine if this is an issue, and if so, identify cost-effective strategies to mitigate it. Example strategies include collecting additional condition data, updating deterioration models in the pavement management system, and crack sealing pavements more frequently.
8	*If* Iowa DOT systematically delivers sub-optimal bridge and pavement projects, *then* AM costs may increase and conditions may decrease.	Negative	Unlikely/ Possible	Very High	Yellow	Mitigate	8.1 Iowa DOT's Asset Management Governance Structure will charge subject matter experts with improving the project selection process. 8.2 Fully implement state-of-the-art bridge and pavement management software programs.

#	Risk	Impact Type	Likelihood	Conse-quences	Severity Level	Risk Response	
						Risk Response Strategy	Risk Action Plan
9	*If* flooding emergencies occur more often, *then* the costs of managing the transportation system may increase.	Negative	Possible/ Likely	Medium	Yellow	Mitigate	9.1 Continue ongoing resiliency efforts, in which Iowa DOT identifies potential flooding issues and evaluates mitigation strategies.
10	*If* Iowa DOT can treat bridges and pavements during the winter with cost-effective, less corrosive materials, *then* deterioration rates may decrease.	Positive	Possible	Medium/ Very High	Yellow	Accept	10.1 Conduct research to quantify the cost implications of Iowa DOT's current winter strategies, and determine if there are opportunities to improve.
11	*If* Iowa DOT is unable to institutionalize the use of its bridge and pavement management systems, *then* it may be difficult to identify optimal AM strategies, leading to increased costs and worsening conditions.	Negative	Unlikely/ Possible	Medium/ Very High	Yellow	Mitigate	11.1 Iowa DOT's Asset Management Governance Structure will charge subject matter experts with improving confidence in the bridge and pavement management systems' models and recommendations. 11.2 Communicate the importance of the bridge and pavement management software programs to the Districts, and generate buy-in for them. 11.3 Integrate the bridge and pavement management software programs into the project selection process. 11.4 Once the bridge and pavement management software programs are implemented, develop a tracking process to assess the degree to which the construction program is consistent with system recommendations.
12	*If* asset repairs perform worse than intended, *then* deterioration rates may increase.	Negative	Unlikely/ Possible	Medium/ Very High	Yellow	Mitigate	12.1 Conduct research to determine if this is happening, and if needed, identify strategies to mitigate this issue. Examples include staff training and updated QA/QC processes.

#	Risk	Impact Type	Likelihood	Conse-quences	Severity Level	Risk Response	
						Risk Response Strategy	Risk Action Plan
13	*If* there are advances in vehicle technology, *then* Iowa DOT's AM costs may decrease over the next 10 years.	Positive	Possible	Medium	Yellow	Enhance	13.1 Continue to proactively develop partnerships with universities and other researchers to further the advancement of autonomous vehicles.
14	*If* funding increases by more than 15 percent, *then* Iowa DOT may be able to implement additional AM projects.	Positive	Unlikely/ Possible	Medium/ Very High	Yellow	Enhance	14.1 Communicate AM needs and the benefits of increasing AM funds. 14.2 Develop and maintain a list of AM projects that can be implemented quickly if new funds become available.
15	*If* new state or federal regulations are passed, *then* the cost of AM projects may increase.	Negative	Unlikely/ Possible	Medium	Yellow	Mitigate	15.1 Communicate with regulators and legislators to help them understand the impact of potential regulations on AM.
16	*If* the Legislature mandates earmarks into Iowa DOT's 5-year Highway Improvement Program, *then* AM funding may be reduced.	Negative	Unlikely/ Possible	Medium	Yellow	Mitigate	16.1 Communicate with legislators to help them understand the impact of potential earmarks on the condition of the highway system.
17	*If* funding decreases by more than 15 percent, *then* Iowa DOT may implement fewer AM projects.	Negative	Unlikely	Very High	Yellow	Mitigate	17.1 Communicate with legislators to help them understand the impact of decreased funding on the condition of the highway system. 17.2 Develop a contingency plan that identifies priorities if the AM budget is cut. (Coordinate with item 5.1.)

How is resilience to extreme events considered?

As part of a separate regulation promulgated by FHWA, state DOTs must perform periodic evaluation of facilities repeatedly requiring repair and reconstruction due to emergency events. According to FHWA, state DOTs "shall conduct statewide evaluations to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events." Evaluation is defined as "an analysis that includes identification and consideration of any alternative

that will mitigate, or partially or fully resolve, the root cause of the recurring damage, the costs of achieving the solution, and the likely duration of the solution." Reasonable alternatives are defined as "options that could partially or fully achieve the following:

1. Reduce the need for Federal funds to be expended on emergency repair and reconstruction activities;
2. Better protect public safety and health and the human and natural environment; and
3. Meet transportation needs as described in the relevant and applicable Federal, State, local, and tribal plans and programs."

While the requirement for evaluations is its own rule (23 CFR 667), the FHWA requires that the TAM risk management process include a summary of the evaluations for NHS pavements and bridges. This process is required to be completed for the NHS system in November, 2018. Iowa DOT is currently compiling all available data regarding qualifying events since 1997 in order to satisfy this requirement. Once the data has been compiled, Iowa DOT will analyze the results and create a spatial layer (a computer map) that indicates all qualifying locations. This information will be maintained and updated, and as required will be screened and analyzed during the environmental process for all highway projects as defined in 23 CFR 771.

Prior to the 2020 deadline, the Iowa DOT is working toward a full analysis of all roads, as well as a system to provide similar information to local agencies in order to comply with the intent of the regulations relative to all public roads in Iowa.

How will Iowa DOT achieve its desired asset management outcomes at a minimum cost while managing risks?

Iowa DOT will implement asset management investment strategies to achieve its desired asset management outcomes at a minimum practicable cost while managing risks. These strategies reflect a combination of the following:

- **Funding levels.** Section 4, Financial Plan, describes how Iowa DOT evaluates trade-offs among competing needs and allocates funds to the various parts of the system. The funding levels presented in the Financial Plan reflect Iowa DOT's priorities and the needs of its assets.

- **Programming process**. Section 2, Managing Bridges, and Section 3, Managing Pavements, describe how Iowa DOT identifies, evaluates, and prioritizes specific bridge and pavement projects. These processes reflect a variety of considerations, including current conditions, whole life costs, and public needs. The result of these processes is a list of projects that Iowa DOT funds with the available budget.

- **Risk response activities**. Section 5, Risk Management, presents Iowa DOT's asset management risk register. The risk register identifies risks that could impact Iowa DOT's ability to achieve its desired asset management outcomes. It also defines how Iowa DOT will respond to these risks—mitigating the negative risks and enhancing the likelihood and impact of positive risks.

Taken collectively, the financial plan, programming process, and risk response activities presented in this TAMP will enable Iowa DOT to manage the decline of bridge and pavement conditions over the next 10 years.

6 Investment Strategies

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Who is responsible for asset management at Iowa DOT?

Iowa DOT has established a two-phase approach for its transportation asset management AM efforts. The initial phase was led by an Asset Management Steering Committee. A Governance Committee is directing the second phase.

The Steering Committee's role was to provide direction in the development of the initial TAMP. Once the first TAMP was completed in November 2016, Iowa DOT began developing TAM Governance within the agency, with the goal of supporting Transportation Asset Management implementation throughout the agency.

The Governance Committee's role is to design a process and governance structure that will do the following:

- Add transparency to the programming process, align associated tools and plans, and incorporate appropriate stakeholders
- Define roles and responsibilities of the associated stakeholders
- Create a process that is adaptable over time as technology, initiatives, and priorities change

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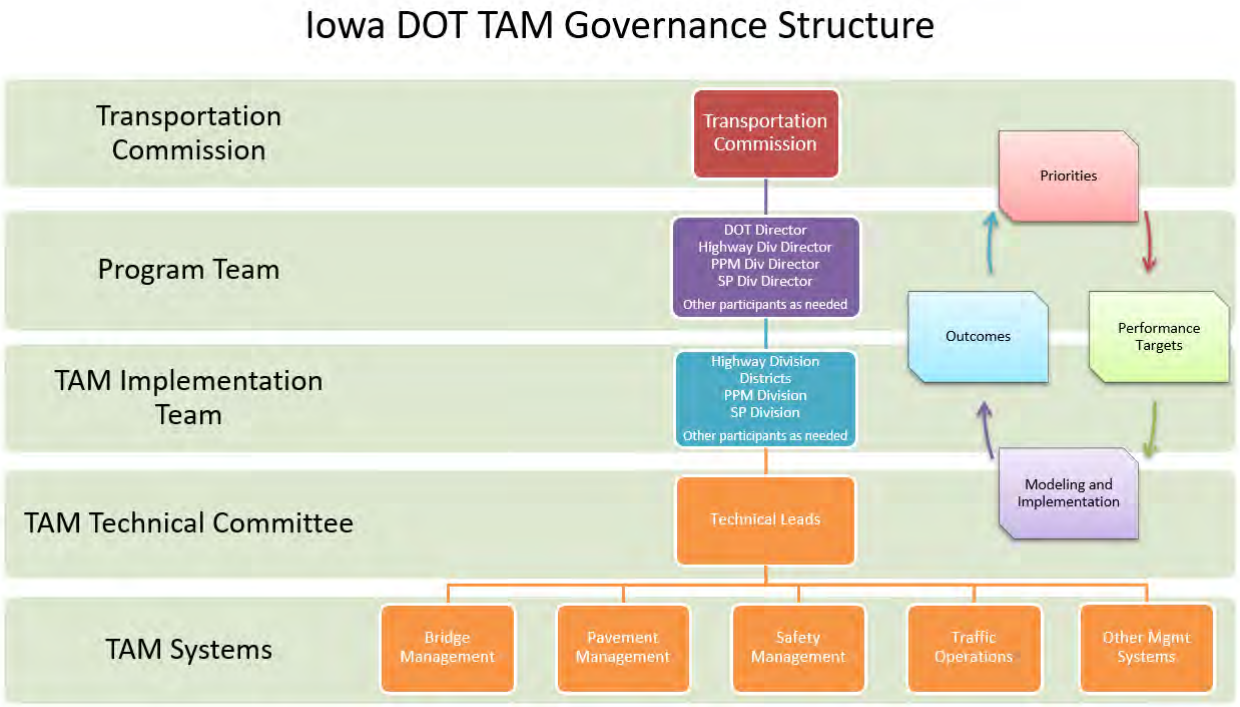
- Oversee the incorporation of risk management into the prioritization process
- Provide input to critical plan development efforts, including the TAMP and long-range transportation plan
- Propose performance targets, propose funding levels to achieve those performance targets, and coordinate the associated monitoring and reporting



The Governance Committee is comprised of staff involved with developing and delivering the highway program. The members are listed in the following table.

Role	Name	Organizational Unit
Program Team	Mark Lowe	Department of Transportation
	Stuart Anderson	Planning, Programming & Modal Division
	Mitch Dillavou	Highway Division
	John Selmer	Strategic Performance Division
TAM Implementation Team	Matt Haubrich	Organizational Improvement
	Peggi Knight	Office of Research & Analytics
	Deanna Maifield	Project Management Office
	Scott Marler	Operations Bureau
	Tammy Nicholson	Office of Location and Environment
	Garrett Pedersen	Office of Systems Planning
	Charlie Purcell	Project Delivery Bureau
	Jon Ranney	District 2
	Don Tebben	Office of Program Management

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How will Iowa DOT improve its asset management practices?

This TAMP describes Iowa DOT's existing asset management practices. With an eye toward the future, Iowa DOT recently conducted an asset management self assessment and identified a series of initiatives for enhancing asset management.

The self assessment effort consisted of the following activities:

- **Step 1. Gap analysis survey.** Over 30 Iowa DOT staff members completed an online gap analysis survey based on one provided in the American Association of State Highway and Transportation Officials' (AASHTO's) *Transportation Asset Management Guide*, Volume I. Participants were asked to rate the degree to which Iowa DOT practices align with the state-of-the-art in asset management.
- **Step 2. In-depth interviews.** Several staff members participated in a series of face-to-face interviews. The objective of these interviews was to discuss existing practices in more detail.
- **Step 3. Self-assessment workshop.** The objective of this workshop was to discuss and prioritize the gaps, and to discuss options for addressing them. The workshop was an all-day event in which senior staff discussed Iowa DOT's asset management vision and goals, and identified initiatives for asset management improvement.
- **Step 4. Development of an implementation plan.** The results of the assessment are documented in an Asset Management Implementation Plan. The plan identifies the following initiatives:
    1. Implement an asset management governance structure. Iowa DOT has already made progress on this item as described above.
    2. Develop an asset management communications plan that describes how Iowa DOT will communicate with key stakeholders regarding asset management. The plan, which is already under development, will address the strengths, weaknesses, opportunities, and threats to implementing transportation asset management.
    3. Develop an asset management training plan that identifies who needs asset management training and defines a training strategy for each group.

4. Develop asset management procedures for each asset class. The goal of this initiative is to advance each asset class into a mature state so that Iowa DOT can eventually incorporate all assets into its performance-based planning framework.
5. Develop a maintenance quality assurance program that can be applied to the assets managed by Iowa DOT's Districts. This effort focuses on assets that go beyond bridges and pavements. The goal of the effort is to understand the performance of Iowa DOT's maintenance operations and relate outcomes to expenditures.
6. Develop an asset management data governance strategy that identifies the data and analytical capabilities required to support asset management practices, and that defines an approach to meet these needs in the most efficient and effective manner.
7. Develop a formal risk management process that enables Iowa DOT to formally consider risks in investment decisions.
8. Develop procedures for managing bridges and pavements throughout their whole life, and for incorporating whole life costs into Iowa DOT's decision-making process.
9. Develop a method for performing risk-based trade-offs between investments in bridges and pavements in order to optimize budget allocations.

7 Asset Management Implementation

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[i] Reference "Using A Life Cycle Planning Process to Support Asset Management", Federal Highway Administration, November 2017