

Oregon Transportation Asset Management Plan

Oregon Department of Transportation

June, 2019

A risk-based asset management plan for Oregon's pavements and bridges on the National Highway System

Oregon
Kate Brown, Governor

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Oregon Transportation Asset Management Plan
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Section 119(e)(8) of title 23 United States Code requires each state department of transportation to develop an asset management plan for the National Highway System (NHS) to improve or preserve the condition of NHS infrastructure and performance of the system. Contents of the plan are to be in a form determined by the Secretary of Transportation. A requirement established by the Secretary is that the developed plan is to be approved by the head of the State Department of Transportation.

In accordance with these requirements, I hereby acknowledge that I have reviewed the Oregon Transportation Asset Management Plan and approve its submission to the Federal Highway Administration for formal review and certification.

Matthew L. Garrett
Director, Oregon Department of Transportation

6-10-19
Date

EXECUTIVE SUMMARY

Transportation Asset Management Plan Overview

Overview and Purpose of the Transportation Asset Management Plan

Oregon's Transportation Asset Management Plan, or TAMP, documents information about Oregon's National Highway System (NHS) pavement and bridge assets, their condition, use and performance, the processes by which they are managed, and results of alternative management practices and investment decisions.

The development of a TAMP aims not only to document current asset management practices performed by the Oregon Department of Transportation, but also to document process improvements the agency is undertaking to improve decision-making, investment strategies, and accountability in its use of public revenue.

MAP-21 TAMP Requirements

Provisions of *Moving Ahead for Progress in the 21st Century Act* (MAP-21) mandate that states develop a risk-based asset management plan which, at a minimum, is in a form that the Secretary determines to be appropriate and includes:

1. A listing and condition of pavement and bridge assets on the National Highway System.
2. Asset management objectives and measures.
3. Identification and analysis of performance gaps between national goals and asset condition.
4. Lifecycle costs and risk-based management analyses.
5. A financial plan with a minimum forecast period of 10 years.
6. Investment strategies.

History of the Oregon TAMP Development

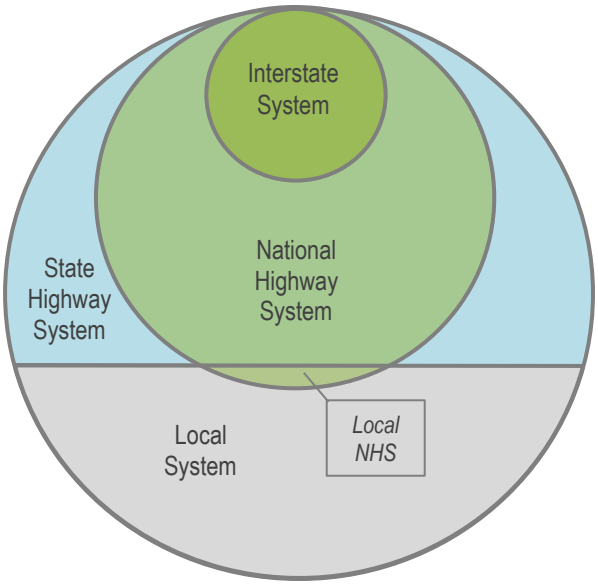
The development of Oregon's TAMP began in spring of 2016, and has involved collaborative work with several divisions of the Oregon Department of Transportation, as well as local partners including Metropolitan Planning Organizations (MPOs), cities, counties, and other local agencies that own National Highway System assets. Along with documenting existing asset management practices of the agency, the TAMP identifies several efforts that have been launched with the goal of improving the agency's asset management processes and procedures. Further, the TAMP aims to improve internal and external communication around ODOT's evolving asset management practices.

Scope of Plan and Asset Inventory

Scope of Assets

Major physical assets owned by ODOT are organized into four Priority Tiers based on considerations including asset value and criticality. The highest priority assets (Tier 1) include bridges, pavements, tunnels, culverts, traffic signals, and ADA ramps. Among these Tier 1 assets, both bridge and pavement assets have the highest asset management maturity level, with robust data capable of supporting lifecycle cost analysis, proactive program management, and advanced modeling. Based on the management capacity and maturity level reached in managing these assets, the current TAMP limited its scope to bridge and pavement assets.

ODOT Tier 1 Assets	Current TAMP (2019)	*Future TAMPs (2022, 2026, etc.)*
Bridges	Included	*Included*
Pavement	Included	*Included*
Tunnels	Not included	*Future consideration*
Culverts	Not included	*Future consideration*
Traffic Signals	Not included	*Future consideration*
ADA Ramps	Not included	*Future consideration*



Scope of Roadway Jurisdiction

The National Highway System (NHS) is a network of strategic roads identified by the Federal Highway system (FHWA) as important to the nation's economy, defense, and mobility. The scope of the TAMP is limited to pavement and bridge assets on the NHS. However, some components of the TAMP, including investment plans, investment priorities, and asset management improvement strategies look beyond this narrow jurisdictional and asset scope. To this end, the TAMP emphasizes the central role of Oregon's Key Performance Measures, or KPMs, in shaping investment decisions for bridge, pavement and other assets.

Of the 4,315 miles of highway on the National Highway System, 4,052 miles (94%) are owned and maintained by ODOT, with the remaining 263 miles belonging to local agencies. Of the 1,814 bridges on the National Highway System, 1,733 bridges are owned and maintained by the ODOT. An additional 81 NHS bridges belong to local agencies.

State and National Performance Measures

For more than 25 years, ODOT has used performance measures to track the agency's performance at meeting a series of transportation-related benchmarks, including public safety, asset condition, livability, and economic prosperity. In 2012, a series of National Goals and National Performance Measures was established as part of the Moving Ahead for Progress in the 21st Century Act (MAP-21). The National Performances Measures established under MAP-21 are in many ways thoroughly consistent with Oregon's transportation performance measures, particularly in the areas of pavement and bridge infrastructure condition. To address the challenge of overlapping state and federal performance measures and targets and how they impact agency decision-making, ODOT's policy is to continue to emphasize the central role of state KPMs in shaping investment decisions for bridge, pavement and other assets.

State Highway Pavement Condition Targets:	National Highway Pavement Condition Targets: *(4-yr)*
• ***At least 85% of pavement miles in fair-or-better condition***	• ***Less than 0.5% interstate in poor condition*** • ***At least 35% interstate in good condition*** • ***Less than 10% non-interstate in poor condition*** *(IRI)* • ***At least 50% non-interstate in good condition*** *(IRI)*
State Highway Bridge Condition Targets:	**National Highway Bridge Condition Targets:** *(4-yr)*
• ***At least 78% of bridges not 'distressed'***	• ***Less than 3% of bridge deck area in poor condition*** • ***At least 10% of bridge deck area in good condition***

Performance Gap Analysis

The Performance Gap Analysis provides an overview of the *Desired State of Good Repair* for Oregon's National Highway System pavements and bridges, and compares this desired state to both current conditions and future conditions based on the latest funding projections. The Performance Gap Analysis discusses policy guidance derived from the Oregon Transportation Plan and Oregon Highway Plan that defines a state of good repair as well as strategies for closing gaps in system performance under a constrained funding scenario.

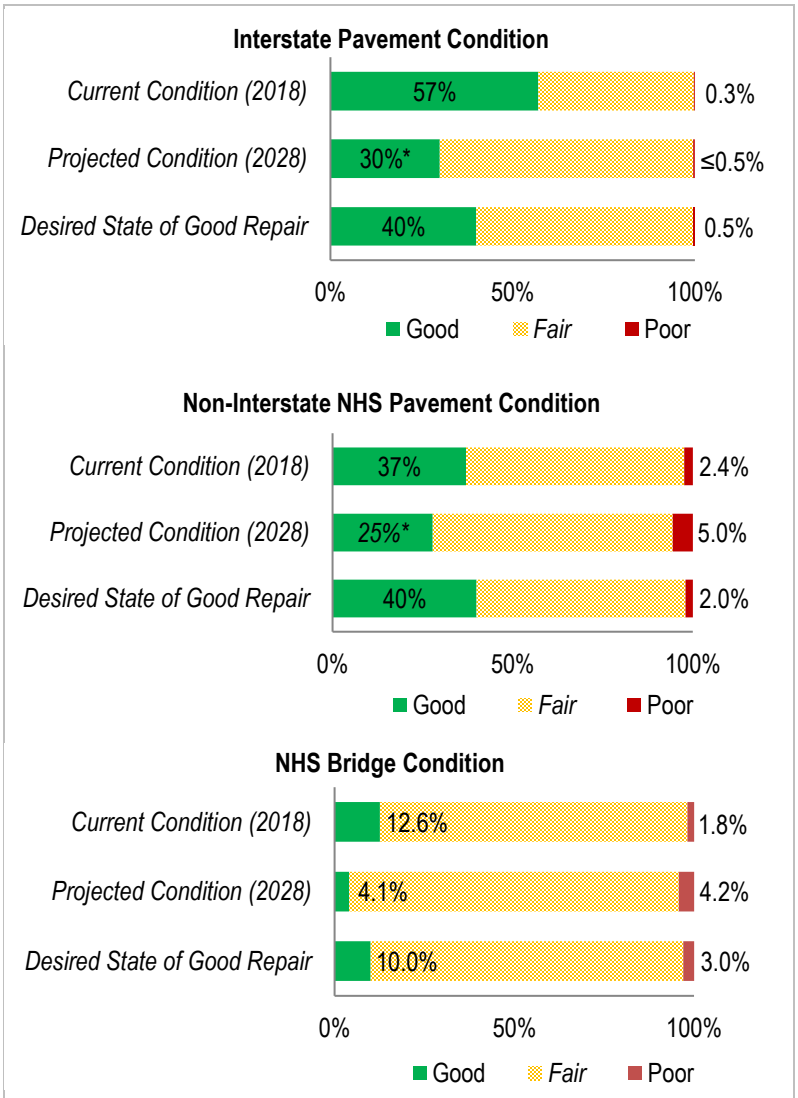
Pavement Condition Gap Analysis

The Pavement Condition Gap Analysis projects a moderate decline in pavement conditions on the NHS and State Highway Systems based on the state Key Performance Measure. It is worth noting that the condition of Oregon's interstate system is projected to remain at or above 95% fair-or-better using the state performance measure. This is consistent with OTP investment policy which prioritizes critical and high-volume transportation corridors under a constrained funding scenario (*See Section 9: Investment Strategies).*

While ODOT projects a moderate decline in overall NHS and State Highway System conditions over the next 10 years, these projected conditions are improved significantly over earlier projections before HB2017, and reflect the impacts of new infusions of transportation revenue, as well as ODOT asset management strategies aimed at optimizing investments in pavement assets.

Bridge Condition Gap Analysis

An analysis was performed to project the state bridge condition KPM over the next 10 years with varying funding. New revenue from HB2017 is expected to slow the decline of the *Percent Not Distressed* bridges across the state; however, this decline will continue under the latest funding projections. The decline in theKPM is primarily due to the aging bridge system and a long history of underfunding in the Bridge Program that precluded systematic replacement of deteriorated bridges. The aging bridge system is captured in the KPM as *Low Service Life Bridges,* as well as bridges projected to become structurally deficient.



**Projected pavement conditions estimated to have a +/-5% margin of error*

ODOT Asset Management Practices

The mission of the Oregon Department of Transportation is to "provide a safe and reliable multimodal transportation system that connects people and helps Oregon's communities and economy thrive." The major challenge the agency faces is in accomplishing this mission under a constrained revenue forecast. As revenue available for transportation continues to be outpaced by system demands and the costs of an aging system, ODOT must identify how to use its resources to accomplish its multiple goals in the most efficient and effective ways possible.

ODOT's overall objective is to manage the transportation system as effectively as possible within an environment of growing system needs and constrained financial resources. The primary focus of ODOT's asset management efforts is the safety and preservation of the state's existing transportation infrastructure. Asset management has typically been integrated with the agency's planning process, and data on asset conditions is used to make strategic funding decisions supporting maintenance, preservation, and modernization of critical assets.

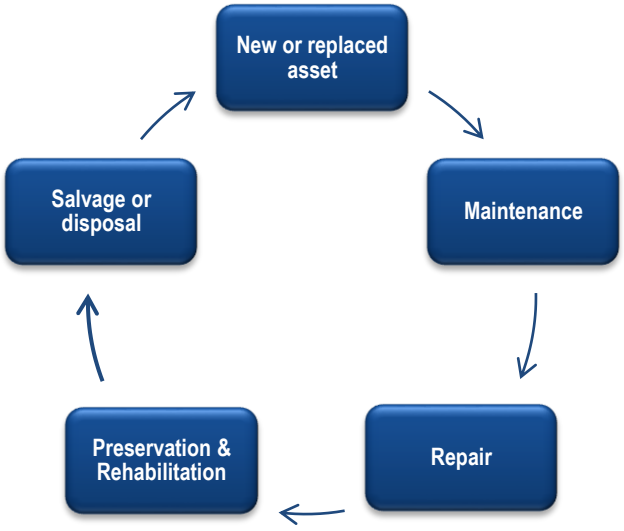
The integration of Asset Management into the agency's everyday operations and decisions continues to be a work in progress. To date, a number of accomplishments are notable: both the availability and reliability of asset data on a statewide basis continue to improve and increase. For example, the FACS-STIP Tool (Features, Attributes, and Conditions Survey – Statewide Transportation Improvement Program) continues to increase the quantity and reliability of asset inventory information, and helps inform decision-making around investments in the maintenance, preservation, and enhancement of roadway assets including bridge and pavement.

Lifecycle Planning Considerations

Like all infrastructure, transportation assets owned by ODOT are threatened by physical deterioration over time. In addition to the ordinary wear and tear caused by hundreds of thousands of cars, trucks, buses, and other vehicles using the system every day, Oregon's roads and bridges are damaged by inclement weather, natural disaster, roadway crashes, and the chemical processes of deterioration.

Maximizing the value from transportation investments is one of ODOT's major goals. Each year, the agency spends more than a billion dollars in federal and state funds constructing, operating, preserving, and maintaining the components of its transportation system. Stretching transportation revenue to get the greatest return on investment is not limited to minimizing the costs of constructing and purchasing transportation assets. Costs must be minimized at all phases of a transportation asset's lifecycle. Timely maintenance and preservation activities extend the asset's useful life and help avoid more expensive repair and replacement costs.

Lifecycle Planning analysis is an engineering and economic analysis tool that focuses on the consideration of all the costs incurred during the service life of an asset. The general phases of a typical transportation asset lifecycle are shown in the figure to the left.



Pavement Lifecycle Practices

Pavements must be resurfaced or rehabilitated at periodic intervals (typical average 15 to 20 years for asphalt and 40 to 50 years for concrete) to keep them out of poor condition. As long as degradation is confined to the surfacing only, and the pavement's foundation and base layers are protected, a given pavement can be resurfaced over and over again, with occasional strengthening, but without the need for a complete replacement. However, if resurfacing is delayed for too long, the pavement structure and underlying base materials can become excessively damaged and complete replacement (e.g. reconstruction) becomes necessary at a much higher cost.

ODOT's Fix-It Preservation and Maintenance programs have dedicated, steady funding streams to accomplish these objectives. Rather than following a "worst-first" philosophy, the Fix-It Preservation program applies a "mix of fixes" including preventive maintenance seal coats, resurfacing preservation projects, pavement rehabilitation, and reconstruction. Likewise, the Maintenance program has a long history and well established philosophy to proactively do crack sealing, chip seals, thin patching and overlays to keep pavements from failing. Lifecycle cost analysis techniques are considered when making decisions regarding pavement type selection and determination of appropriate pavement design or pavement rehabilitation strategies.

Bridge Lifecycle Practices

Most bridges today are designed with 75-year design life. With regular attention, the actual service life can be expected to extend to 100 years or more. Based on a service life of 100 years, a conservative approach would be to replace about one percent of all bridges every year. This would, in practice, amount to roughly 18 bridges (out of 1,814) per year on the National Highway System, or 27 bridges (out of 2,737) per year on the State Highway System.

Keeping bridges in fair-to-good condition requires routine inspections, proactive maintenance and preservation treatments. Examples of proactive maintenance are sealing or replacing leaking joints to minimize the deterioration of superstructure and substructure elements beneath the joints; painting/coating or overcoating structural steel to protect against corrosion; and/or installing scour countermeasures to protect the substructure from undermining and failure due to scour. Timing is critical when performing the work because the longer the deterioration occurs, the more extensive and expensive the required treatment.

Risk Management

The management of risk is a key component of an effective transportation asset management program. Risk management complements asset management which seeks to provide transportation assets that are safe, reliable and maintained in a state of good repair for the lowest possible costs.

Risk Management Policies and Procedures

ODOT's approach to risk management is to focus resources to minimize threats to the condition and operation of the state's multimodal transportation system and maximize opportunities to improve its transportation programs. This approach necessitates balancing risk across multimodal programs and the diverse geographic areas with a focus on minimizing threats and challenges to the provision of "a safe and reliable multimodal transportation system that connects people and helps Oregon's communities and economy thrive." ODOT has a number of robust procedures and practices already in place to identify, analyze, evaluate, address, and communicate risks faced by the organization. The risks considered in the TAMP fall broadly into six general categories:

- *Bridge-related Risks*
- *Pavement-related Risks*
- *Other Tier 1 Asset Risks*
- *Environmental Risks*
- *Economic and Financial Risks*
- *Organization and Leadership Risks*

In order to improve upon the way ODOT manages the many agency risks, asset management staff worked with consultants on an agency-wide risk management assessment. This assessment was aimed at supporting ODOT in its ongoing effort to better identify, prioritize and develop mitigation plans for major risks facing the agency.

Risk Management Improvement Efforts

As an outcome of the agency-wide risk assessment and the TAMP development process at large, ODOT has identified four broad areas where improvements can be made in the near-term in how the agency assesses and manages risks:

1. **Identification of Risk Management Process Owners and Responsibility:** The first gap that was identified in the risk assessment was the need to better identify who is responsible for the risk management process. This includes identifying asset owners who are responsible for identifying, analyzing, evaluating, and addressing risks, as well as identifying shared responsibility for monitoring and reviewing risks across multiple assets.

2. **Improvement of the Risk Register:** As an outcome of the agency-wide risk assessment, ODOT identified the need to update and improve the agency's risk register. Identified risks were updated and new risks were identified to reflect current conditions and challenges faced by the agency. The risk registry structure was also organized to more clearly communicate risks faced by the agency, and to build consensus around the likelihood and impact of identified risks. In total, 44 significant risks to the agency were identified and documented in the updated *Risk Register.*

3. **Identification of Top Priority Risks and Mitigation Actions:** Based on an effort to rank and prioritize risks identified in the *Risk Register* by their likelihood of occurrence and their impact, ODOT identified a total of ten risks considered *High* or *Extreme*. A summary of these *High* or *Extreme* risks and their corresponding mitigation potential, strategy, and actions are documented in the *Mitigation Plans for High Priority Risks.*

Likelihood \ *Impact*	Insignificant	Minor	Significant	Major	Catastrophic
Very Unlikely	*Very Low*	*Very Low*	*Low*	*Moderate*	*High*
Unlikely	*Very Low*	*Low*	*Moderate*	*High*	*High*
Possible	*Low*	*Moderate*	*Moderate*	*High*	*Extreme*
Likely	*Moderate*	*Moderate*	*High*	*Extreme*	*Extreme*
Very Likely	*Moderate*	*High*	*High*	*Extreme*	*Extreme*

4. **Documentation of Risk Management Activities** ODOT is already engaged in a number of risk management activities, and in many cases is already addressing high priority risks that may impact achieving the goals of the TAMP. In order to better manage and communicate the many risks impacting Oregon's pavement and bridge assets, ODOT will continue to document and update the major risks facing the agency through the asset management program and the ongoing TAMP development process.

Periodic Evaluation of Facilities Repeatedly Requiring Repair

Part of the Final Rule for the development and implementation of a risk based Transportation Asset Management Plan requires state DOTs to conduct periodic evaluations of transportation infrastructure to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction on two or more occasions due to emergency events.

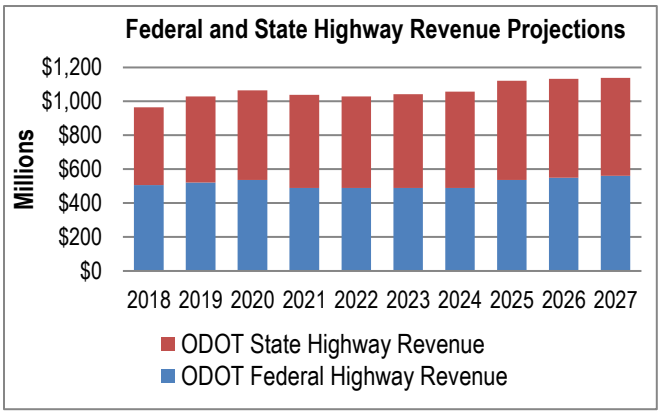
ODOT has long recognized the vulnerability of transportation infrastructure to extreme weather and emergency events and the risks they present to the condition and performance of pavements and bridges. The TAMP identifies instances where portions of NHS routes within specific counties have experienced damage from more than one emergency event during the 20-year period from January 1, 1997 through December 31, 2018. Alternatives that would mitigate or partially resolve the root cause of reoccurring damage are considered and evaluated for all identified instances.

Financial Plan

Oregon pays for the construction, preservation, maintenance, and operation of the highway system with revenues derived from a variety of state and federal sources. The majority of state and federal revenues are derived from fuel taxes and other taxes and fees on vehicles.

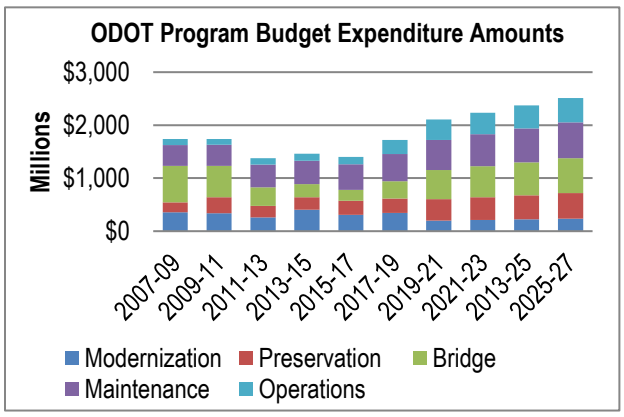
The development of ODOT's financial plan and investment strategies is influenced by a variety of factors including demographic and revenue trends, federal and state regulations, system physical conditions, technological innovations, environmental conditions, and public input. The actions and priorities adopted by the agency seek to balance investments in preserving and improving the condition and performance of the transportation system with investments in safety, multi-modal transportation and other projects that enhance Oregon's economic competiveness and quality of life.

The TAMP presents ODOT's financial plan and investment strategies, summarizes federal and state requirements, revenue sources and uses, revenue trends and projections, and highlights investment levels and strategies proposed for State and National Highway System bridges and pavements. The processes employed in the development of the financial plan and investment strategies use established procedures for financial decision-making and analysis. The processes highlight the use of information from proven management systems, involve input from across the agency, reflect coordination with agency short-term and long-term planning efforts, and are guided by the transportation policies and priorities of the Oregon Transportation Plan, Oregon Transportation Commission, and the Oregon State Legislature.



Revenue Projections

The TAMP provides a 10-year summary of Oregon's expected transportation funding from federal and state sources. The federal funding identified represents expected Federal-aid Highway Program formula obligation limitation. The state funding identified represents ODOT's expected share of transportation funding deposited in the State Highway Fund.



Revenue Uses

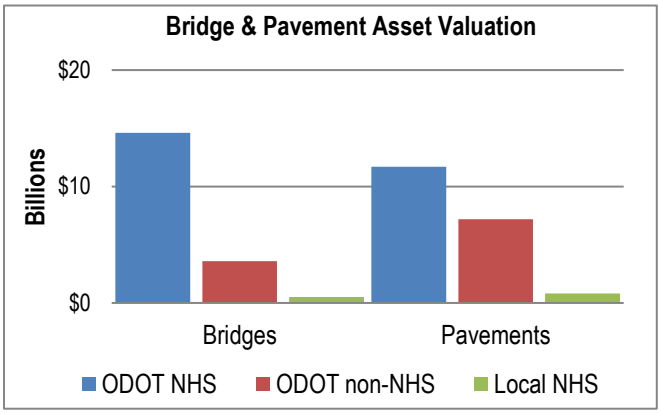
Spending for the preservation and improvement of Oregon transportation assets can be divided into five major budget categories: Modernization, Preservation, Bridge, Maintenance and Operations.

The TAMP presents past as well as projected future expenditure amounts by ODOT in these five major budget categories. Decisions guiding the balance of investments in these five categories are made through an application of asset management principles, management system analyses, Oregon Transportation Plan and Oregon Transportation Commission policy guidance, and decision processes used in the development of the Statewide Transportation Improvement Program.

Asset Value

A key component of transportation asset management is determining the total value of transportation assets. There are a number of ways that asset valuation can support proper management and efficient investment in the transportation system. By effectively quantifying the value of transportation assets, investments that maintain, preserve, and enhance the transportation system can be measured to the degree to which they add value or minimize loss to the system. Valuation can also be used to determine funding needs as well as the levels of funding necessary to ensure that assets do not lose their value over time.

Asset value estimates developed for the TAMP place the value of ODOT's NHS bridges at $14.6 billion and ODOT's NHS pavements at $11.7 billion.



Investment Strategies

Prioritization of Investments

One of the major challenges facing Oregon's transportation system is that increases in revenue dedicated to transportation have not kept pace with the funding needed to maintain, preserve, and enhance the condition and performance of an aging transportation system. While transportation funding for pavements and bridges has stagnated or increased incrementally with new state and federal investments, inflation and rising construction costs have substantially reduced the buying power of available resources needed for aging facilities.

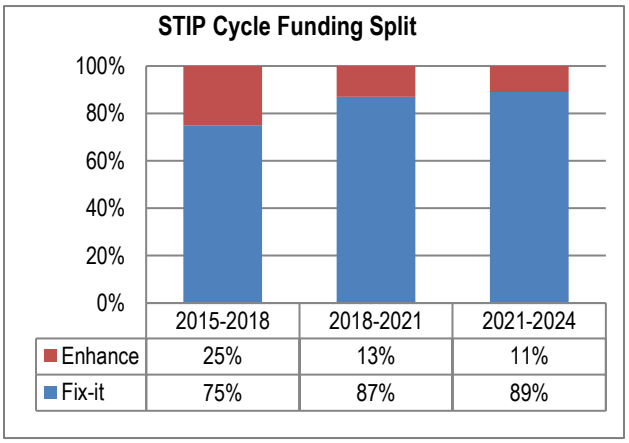
Specific guidance around how ODOT should invest in its transportation system under a constrained funding environment is outlined through policy guidance from the Oregon Transportation Plan as well as the Oregon Highway Plan. The Oregon Transportation Plan specifies that under this constrained funding scenario, investment should *"support Oregonians' most critical transportation needs, broadly considering return on investment and asset management."* Efforts should focus on preservation and operational improvements to maximize system capacity and safety at the least cost possible.

The Statewide Transportation Improvement Program, known as the STIP, is Oregon's four-year transportation capital improvement program. This document identifies the funding for and scheduling of transportation projects and programs. It includes projects on the federal, state, city, and county transportation systems, multimodal projects (highway, passenger rail, freight, public transit, bicycle and pedestrian), and projects in the National Parks, National Forests, Bureau of Land Management, and Indian tribal lands.

Dedication of Fix-it Funding in the STIP

In 2012, the OTC and ODOT changed how the STIP is structured. The STIP is no longer developed as a collection of projects for specific pools of funding dedicated to specific transportation modes or specialty programs. Instead, the STIP primarily divides funding into two broad categories: **Fix-It** (activities that maintain and preserve the transportation system) and **Enhance** (activities that enhance, expand, or improve the transportation system).

Since its inception, the division of STIP funding between Enhance and Fix-it has trended toward an increased share of revenue dedicated to Fix-it projects. This shift is consistent with Oregon Transportation Plan policy guidance, which stipulates an increased focus on maintaining and improving the existing transportation system under a constrained revenue scenario. Furthermore, it is emblematic of a transformation in agency focus toward data-driven project identification and selection built on asset management principles.



Prioritization of Fix-it Corridors in the STIP

In addition to the STIP's continued focus on *Fix-it* activities that maintain and preserve the transportation system, ODOT employs a "corridor approach" that aims to preserve movement of freight and economic activity under a constrained funding environment. This approach prioritizes resources to keep key freight corridors open to truck traffic and maintain critical connections across the state. ODOT has designated the main routes of the state highway system connecting most of the state's communities and carrying most freight and automobile traffic as "Fix-It Priority Corridors" and focuses scarce resources on maintaining bridge and pavement conditions on these routes. Additionally, the Fix-it Priority Corridors include Seismic Lifeline Routes that have been identified as critical through risk analysis of a potential Cascadia Subduction Zone Earthquake.

Investment Strategy Improvement Efforts

Past efforts to dedicate additional revenue to Oregon's state and local transportation systems have been successful in helping preserve and maintain the condition and performance of Oregon NHS Bridge and Pavement assets. These investment efforts have included, but are not limited to, the Oregon Transportation Investment Acts (OTIA I, II, III), the 2009 Jobs and Transportation Act (JTA), and the 2017 Keep Oregon Moving Act (HB2017), as well as federal funding secured through the 2015 Fixing America's Surface Transportation (FAST) Act.

In addition to securing needed funding for asset management activities, ODOT is continuously seeking ways to improve the process for identifying, developing, and selecting projects in the Statewide Transportation Improvement Program with the objective of optimizing the state's investment in its transportation system under a constrained revenue scenario. The TAMP identifies process improvements the agency is undertaking to improve how it invests in capital assets, including through its STIP program. These improvement efforts draw heavily on asset management strategies, including data-driven decision-making, gap analysis, lifecycle management, and risk management

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Overview and Purpose of a Transportation Asset Management Plan (TAMP)

Oregon's Transportation Asset Management Plan, or TAMP, documents information about Oregon's National Highway System (NHS) pavement and bridge assets, their condition, use and performance, the processes by which they are managed, and results of alternative management practices and investment decisions. The TAMP is focused primarily on Oregon's bridge and pavement assets that are part of the National Highway System. However, some components of the TAMP look broadly at the entire State Highway System (SHS) that ODOT is responsible for and identify how asset management principles support investment plans that maximize the long-term condition of the transportation system at large.

The TAMP aims not only to document current asset managed practices performed by ODOT, but also to document process improvements the agency is undertaking to improve decision-making, investment strategies, and accountability in its use of public revenue. The TAMP seeks to provide accurate and reliable information for ODOT to share with internal and external stakeholders and partner agencies, and presents the current status of pavement and bridge assets, including their condition, use, and performance. The TAMP also describes the key risks faced by the agency and how the agency intends to manage and mitigate these risk in the near term and long term. Additionally, the TAMP outlines an investment strategy aimed at efficient use of public revenue that extends the functional life of major assets including pavements and bridges.

MAP-21 TAMP Requirements

With the adoption of the Moving Ahead for Progress in the 21st Century Act (MAP-21) of 2012, all state transportation agencies, including ODOT, must demonstrate the use of asset management principles and strategies and develop a transportation asset management plan that incorporates lifecycle costs and risk management.

Provisions of MAP-21 mandate that states develop a risk-based asset management plan which, at a minimum, is in a form that the Secretary of Transportation determines to be appropriate and includes:

1. A listing and condition of pavement and bridge assets on the National Highway System.
2. Asset management objectives and measures.
3. Identification and analysis of performance gaps between national goals and asset condition.
4. Lifecycle costs and risk-based management analysis.
5. A financial plan with a minimum forecast period of 10 years.
6. Investment strategies.

If a state fails to satisfy minimum conditions for pavements or bridges on the NHS system or fails to develop an asset management plan or implement the plan in accordance with federal expectations and requirements, the state is subject to a number of financial consequences such as the establishment of minimum required annual expenditures in Interstate System pavements and NHS bridges; the loss of the ability to expend annual National Highway Performance Program funds; or a reduction of the federal share provided for transportation projects. It is the policy of the Oregon Department of Transportation to undertake the work necessary to meet these minimum condition and asset management planning requirements so as to avoid any penalties pertaining to MAP-21 legislation.

ODOT Asset Management Practices

The preparation of a risk-based Asset Management Plan represents the latest step in an ongoing effort by ODOT to incorporate the principles of transportation asset management into the agency's business processes and culture. Asset management has been a central part of ODOT's business practice since the 1990s, and a formal Asset Management Integration Unit has been in place for over 10 years. The TAMP is built upon several asset management plans, processes, and procedures that document and guide the agency's asset management efforts.

Further details on the history of ODOT's asset management efforts are outlined in ***Section 5: ODOT Asset Management Practices.***

History of the Oregon TAMP Development

The development of Oregon's TAMP began in earnest during the spring of 2016, and has involved collaborative work with several divisions of the Oregon Department of Transportation, as well as local partners including Metropolitan Planning Organizations (MPOs), cities, counties, and other local agencies that own National Highway System assets. Alongside documenting existing asset management practices of the agency, several efforts have been launched aimed at improving the agency's asset management processes and procedures, and improving internal and external communication around ODOT's evolving asset management practices.

2016 Asset Management Gap Analysis

As an initial step in the development of ODOT's asset management plan and to further the integration of asset management systems and philosophies into agency practices, the agency was one of 10 states that participated in an asset management gap analysis project sponsored by the Federal Highway Administration (FHWA). Some 60 ODOT staff representing sections throughout the agency participated in a gap analysis survey and demonstrated varying degrees of asset management understanding and commitment. Based upon survey results, an implementation plan was developed to further advance asset management principles and practices within ODOT.

The complete 2016 Asset Management Gap Analysis is included in ***Appendix D****. This 2016 Asset Management Gap Analysis is distinct from the Performance Gap Analysis in Section 4*

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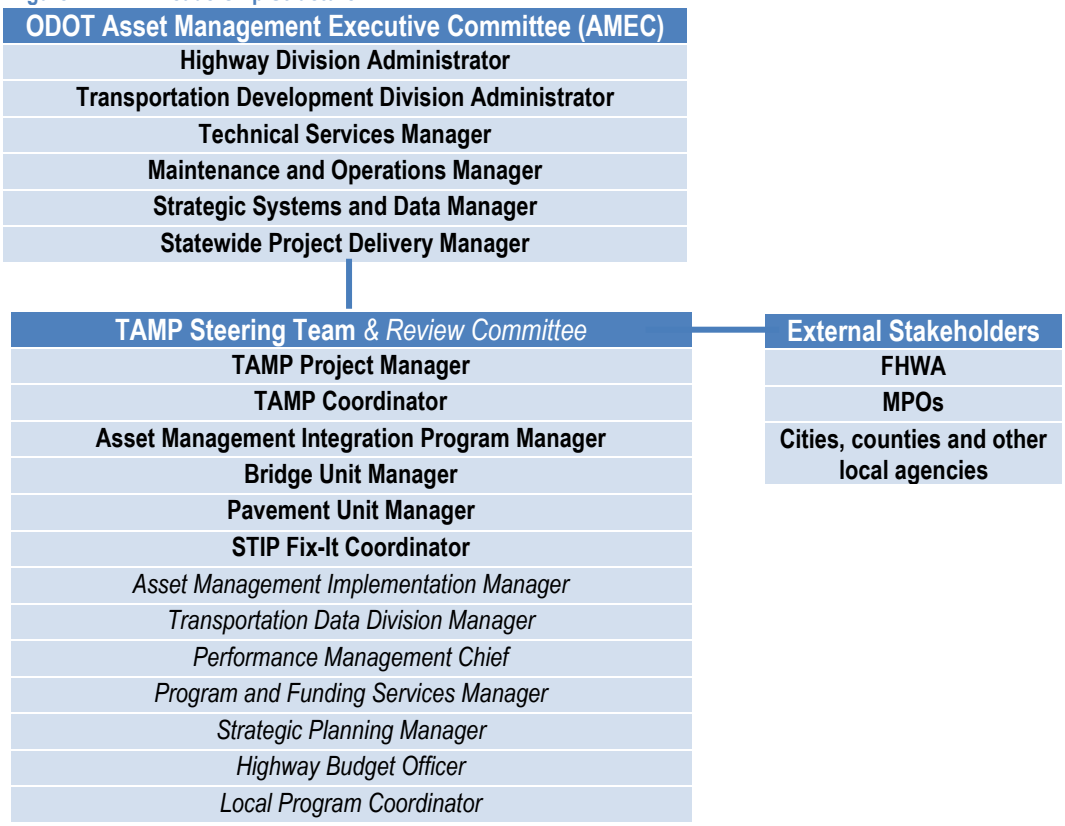
Development of a TAMP Steering Team

Under the direction of an executive asset management steering committee composed of the agency's Transportation Development Division Administrator, Highway Division Administrator, the Chief Engineer, and the State Maintenance and Operations Engineer, a TAMP development team was formed in the summer of 2016. Members of the development team included staff of the agency's asset management section to ensure the accuracy and reliability of asset data and the ongoing application of asset management principles and techniques. The team also included staff from the Director's Office to reflect the level of agency commitment to TAMP development and facilitate the coordination of development activities and efforts within and outside the agency. A representative from the Director's Office served as the project manager for the TAMP development, with staff from the Transportation Development Division and Strategic Business Services playing supporting roles in preparing a TAMP that accurately reflects the agency's integration of asset management principles into its business practice.

Following the guidance provided by FHWA and in recognition of the fact that the TAMP touches upon many aspects of ODOT's governance structure and involves many internal and external stakeholders, the TAMP Steering Team developed a TAMP leadership structure to guide development of the plan. A larger TAMP Review Committee was formed that included subject matter experts in the areas of performance management, planning, highway budgeting, funding services, and local coordination. Members of this review committee serve on ODOT's major internal stakeholder groups, ensuring that components of the TAMP are consistent with agency policies and decision-making. They also work closely with external stakeholders including MPOs, cities, and counties. The TAMP Steering Team structure is summarized in *Figure 1: TAMP Leadership Structure.*

Figure 1: TAMP Leadership Structure:



Asset Management Executive Committee: Providing executive-level guidance on the TAMP's scope, form, and content is ODOT's existing Asset Management Executive Committee. The executive committee oversees the asset management efforts of ODOT at large.

TAMP Steering Team: The TAMP Steering Team and Review Committee included a broad selection of ODOT subject matter experts to provide review and alignment across multiple agency disciplines.

Internal Stakeholders: In addition to ensuring accuracy and consistency of the TAMP, these committee members each serve as members of ODOT's major internal leadership and decisionmaking groups, ensuring that components of the TAMP are consistent with agency policies and decision-making.

External Stakeholders:

FHWA: The TAMP Steering Team and the Oregon FHWA office participated in a series of bimonthly meetings to coordinate TAMP development and ensure compliance with federal requirements

MPO's, Cites, and Counties: TAMP coordination between ODOT, MPOs and local agencies has taken place with alongside collaborative efforts around meeting bridge and pavement performance measure (PM2) requirements.

Further details on local coordination are outlined in ***Appendix A: MPO and Local Agency Coordination***

Ongoing Coordination with Local FHWA Office

In an effort to ensure consistency with FHWA requirements and to keep FHWA informed on key process steps in the development of the TAMP, ongoing meetings were established between the TAMP Steering Team and the Oregon FHWA Branch Office.

Ongoing Coordination with MPOs and Other Stakeholders

With the establishment of National Performance Measures as part of MAP-21, ODOT has established ongoing coordination efforts with MPOs across the state, as well as cities and counties that have ownership of National Highway System assets.

Further detail on ODOT's coordination with MPOs and local agencies is outlined in *Appendix A: MPO and Local Agency Coordination*.

Staff Training for TAMP Development

As a follow up to the FHWA sponsored 2016 Gap Analysis, and the October 2016 publishing of final rules guiding TAMP, ODOT coordinated with FHWA to schedule asset management training session in January 2017 and March 2018. The sessions were intended to help agency managers,

technical staff and others with the development and enhancement of asset management programs and practices, and provide guidance on the form, content and development of a state TAMP required by the final rules.

Training session participants included: asset managers and technical leads, senior planners, financial and budget representatives, risk managers, data managers and analysts, region liaisons, MPO representatives, and FHWA regional staff. Various participants of the training sessions were asked to serve on a TAMP review team and help guide the content and form of the TAMP.

ODOT Risk Management Assessment

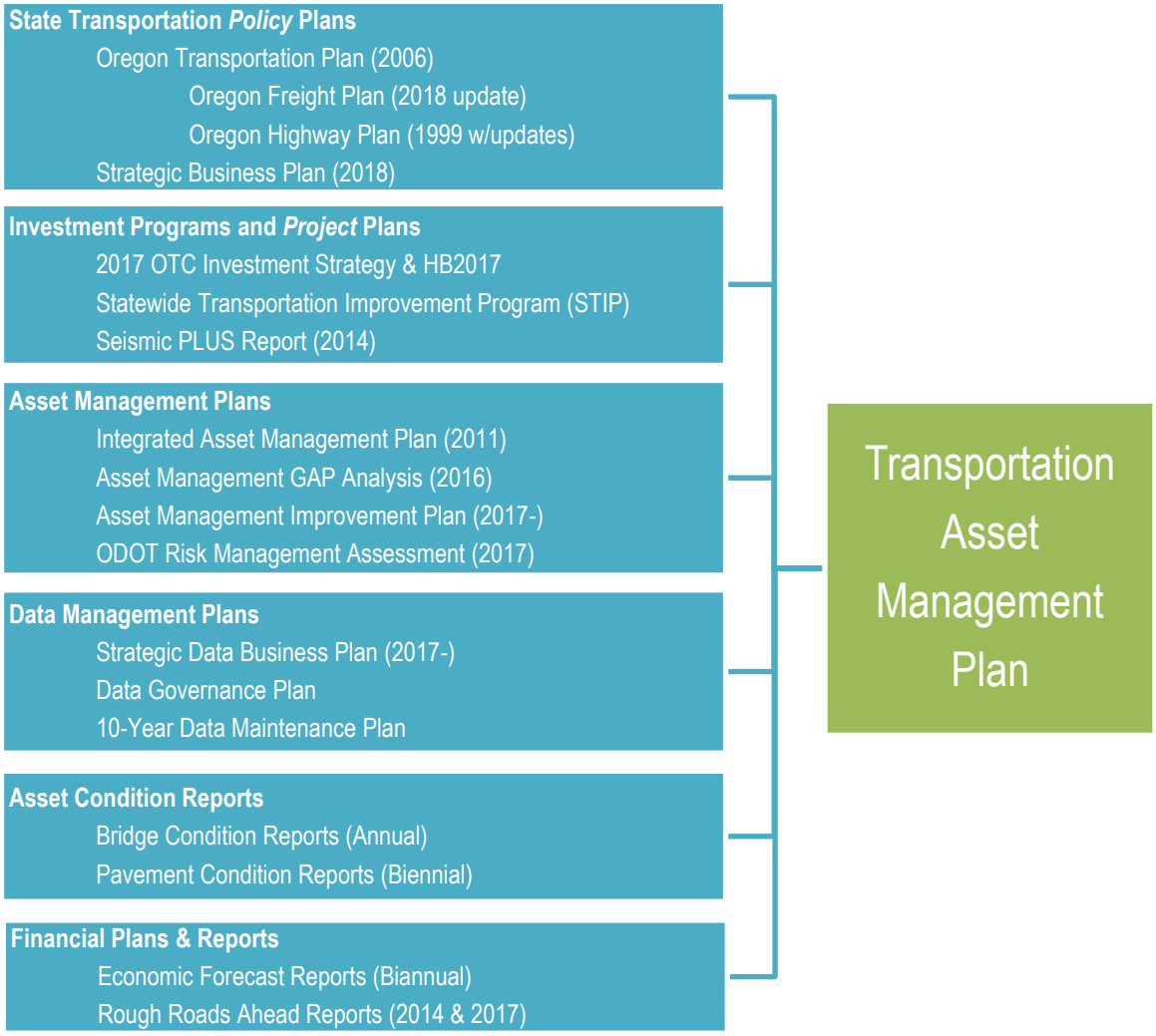
A major outcome of the January 2017 TAMP training was the recognition by ODOT's executive and asset management staff that a greater agency-wide effort around risk management was needed to better identify, prioritize and develop mitigation plans for major risks facing the agency. Acting on this recognition, consultants were brought in to conduct an assessment of risks facing the agency and existing practices in responding to those risks. Further, the consultants made recommendations around how the agency can better identify and prioritize risks and identified process improvements aimed at how the agency manages risks.

> *The Risk Management Assessment White Paper is included in* ***Appendix C.*** *Further details on the actions ODOT is taking to manage risks are outlined in* ***Section 7: Risk Management***

Agency Plans, Programs, and Initiatives Supporting the TAMP

Asset management is integrated into the fabric of the work that ODOT performs. Development of the TAMP therefore draws heavily upon a series of Policy Plans, Project Plans Financial Plans, and Condition Reports. Major agency work products that support the TAMP are summarized in Figure 2. For further details see *TAMP Glossary*

Figure 2: Relation of TAMP to other Agency Plans, Programs and Initiatives



Section 2

SCOPE OF PLAN & ASSET INVENTORY

- Scope of Assets Included in the TAMP
- Scope of Roadway Jurisdiction
- National Highway System Overview
- Ownership of NHS Assets

Introduction

Over the past century, the state of Oregon has invested billions of dollars into the transportation system that we enjoy today. This transportation system consists of many types of major physical assets including bridges, pavements, culverts, overhead signs, traffic signals and sidewalks. It also includes smaller- yet critical assets- such as illumination lighting, signage, and sound barriers. Ownership of Oregon's transportation system is not limited to the Oregon Department of Transportation, but also includes Oregon's 36 counties, 241 cities, 23 ports, as well as additional state, local, and federal agencies.

This section provides an overview of the asset and jurisdictional scope of Oregon's Transportation Asset Management Plan and an inventory of assets included in the TAMP.

Scope of Assets Included in the TAMP

The 2016 Asset Management Gap Analysis identified the major physical assets owned by the Oregon Department of Transportation and organized these assets into four Priority Tiers based on several considerations including asset value and asset criticality. The highest priority assets (Tier 1) include bridges, pavements, tunnels, culverts, traffic signals, and Americans with Disabilities Act (ADA) compliant ramps. (See chart below)

Among these Tier 1 assets, both bridge and pavement assets were determined to have the highest asset management maturity level: ODOT bridge and pavement data enjoys a high level of reliability and quality, and undergoes frequent updates by trained technical staff. This data maturity was found to be sufficient to support lifecycle cost analysis, proactive program management, and advanced modeling. While statewide programs are in place to provide project-level decision making for other Tier 1 Assets (tunnels, culverts, traffic signals, and ADA ramps), these assets do not *yet* enjoy the same maturity level as compared to pavement and bridge systems.

Based on the management capacity and maturity level reached in managing these assets, ODOT's Asset Management Executive Committee determined that the current TAMP should be limited to bridge and pavement assets. This scope is consistent with final TAMP rule requirements that, at a minimum, state TAMPs include pavement and bridge assets. As efforts to improve the management systems supporting other Tier 1 Assets (tunnels, culverts, traffic signals, and ADA ramps) continue, these assets will be considered for possible inclusion in future TAMP updates required every four years. *For further details, see Appendix B: TAMP Scope Recommendation Memo.*

ODOT Tier 1 Assets[1]	*Current TAMP* (2018/2019)	*Future TAMPs* (2022, 2026, etc.)
Bridges	*Included*	*Included*
Pavement	*Included*	*Included*
Tunnels	*Not included*	*Future Consideration*
Culverts	*Not included*	*Future Consideration*
Traffic Signals	*Not included*	*Future Consideration*
ADA Ramps	*Not included*	*Future Consideration*

Table 1: Scope of TAMP Assets

[1] ODOT's Asset Priority Tiers were established through the 2016 Asset Management Gap Analysis. *See Appendix D*

Scope of Roadway Jurisdiction Included in the TAMP

The final Transportation Asset Management Plan rules, released in October 2017, require that state TAMPs include pavement and bridge assets *on the National Highway System*, with an option of also including pavement and bridge assets beyond the National Highway System. The ODOT Asset Management Executive Committee determined in spring 2017 that an initial TAMP limited to the National Highway System would be most appropriate for the plan due in 2019, and that further consideration of the TAMP scope could be appropriate in future TAMP updates. *For further details, see Appendix B: TAMP Scope Recommendation Memo*

While the main scope of the TAMP is limited to National Highway System pavement and bridge assets, some components of the TAMP including investment plans, investment priorities, and asset management improvement strategies look beyond this narrow jurisdictional and asset scope. To this end, the TAMP emphasizes the central role of state's Key Performance Measures, or KPMs, in shaping investment decisions for bridge, pavement and other assets. The TAMP communicates that the ODOT process for selecting investments is aimed at achieving a more complex set of performance measures that are intended to result in a balanced program across many competing needs rather than solely meeting the limited scope of condition-based performance measures on the NHS system.

The subsections below summarize the ownership and jurisdiction of NHS pavement and bridge assets that are included in the TAMP, as well as ODOT non-NHS pavement and bridge assets that are used for Oregon's Key Performance Measures.

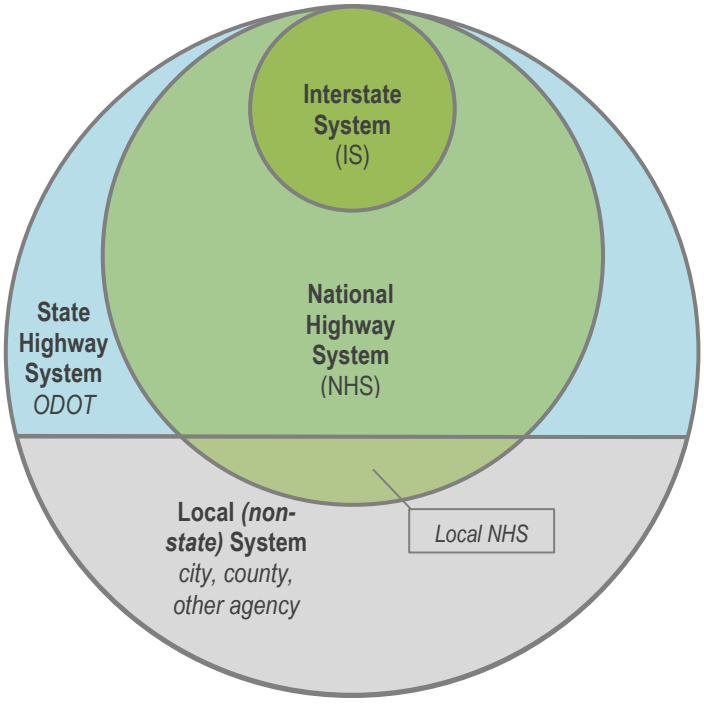


Figure 3: State and National Highway Systems *(not to scale)*

National Highway System Overview

Pavement Assets:

Oregon's National Highway System is comprised of 4,315 miles of highways throughout the state. These highways range from two-lane rural roads in eastern Oregon to six-lane limited-access freeways with metered ramp entrances in the Portland metropolitan area. While the National Highway System accounts for just over 5% of the state's 79,275 miles of public roadways in the state, these roads carry nearly 60% of the vehicle traffic and more than 20.8 billion vehicles miles of travel each year.[3] ODOT's total state highway portfolio totals roughly 7,660 miles, meaning slightly more than half of these state highway miles are also part of the National Highway System and are included in the scope of the TAMP.

	ODOT *Interstate*	ODOT *non-Interstate*	Local *(non-state) System*
National Highway System	***729***	***3,323***	***263***
Non-National Highway System	-	***3,608***	***71,352***

Table 3: Pavement *Centerline Miles*[2]

Bridge Assets:

Oregon's National Highway System also includes 1,814 bridges across the state, 1,733 of which are state-owned. ODOT's complete portfolio of bridges on the State Highway System totals 2,737, meaning more than 63% of state highway bridges are also part of the National Highway System and are included in the scope of the TAMP. When measured by bridge deck area, ODOT owns roughly 94% of National Highway System bridges in the state. Additionally, these state-owned National Highway System bridges comprise more than 78% of the deck area of ODOT's total bridge portfolio.

	ODOT *Interstate & non-Interstate*	Local *(non-state) System*
National Highway System	**1,733 bridges** 28.5 million sq.ft.	**81 bridges** 1.7 million sq.ft.
Non-National Highway System	***1,004 bridges*** *8.0 million sq.ft.*	***4,025 bridges*** *13.6 million sq.ft.*

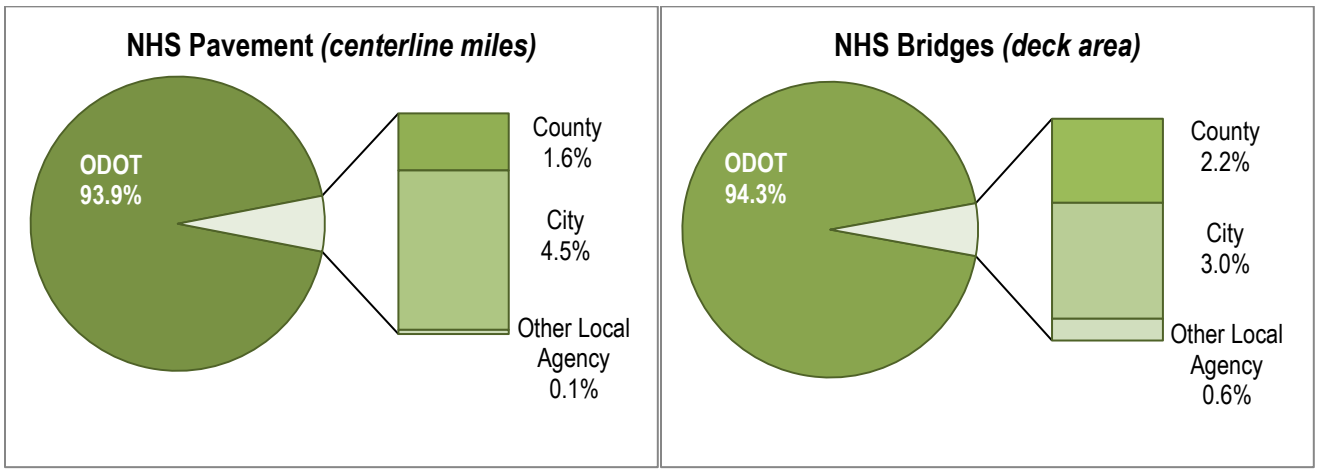
Table 2: Bridges by count and deck area

[2] *Note: Excludes frontage and connector road mileage*
[3] *FHWA, 2017 Highway Statistics Series, Table VM-3*

Ownership of Oregon's National Highway System

Of the 4,315 miles of highway on the National Highway System, 4,052 miles (94%) are owned and maintained by ODOT, with the remaining 263 miles belonging to agencies other than ODOT. This includes counties (68 miles), cities (190 miles) and other local agencies (5 miles). Of the 1,814 NHS bridges, 1,733 bridges are owned and maintained by the Oregon Department of Transportation. An additional 81 NHS bridges belong to agencies other than ODOT, including counties (23 bridges), cities (51 bridges), and other local agencies (7 bridges).

Figure 4: Ownership of NHS Bridge and Pavement assets



Non-ODOT NHS Ownership

Local ownership of the National Highway System in Oregon totals 263 centerline miles and 81 bridges. Owners of these assets include nine counties, 23 cities, one regional transit district, and four ports along the Columbia River:

City:	Centerline miles	# of Bridges
Ashland	2.00	
Astoria	0.35	
Beaverton	1.60	
Bend	9.98	3
Boardman	0.56	
Central Point	1.96	
Coos Bay	4.88	
Eugene	16.64	8
Grants Pass	1.59	
Gresham	22.25	
Keizer	3.23	
Lake Oswego	6.32	
McMinnville	2.01	
Medford	5.16	
North Bend	0.38	
Ontario	2.66	
Phoenix	1.22	
Portland	68.25	30
Redmond	3.28	
Roseburg	6.16	1
Salem	28.52	9
Silverton	0.32	
Springfield	1.02	
City Total	190.34	51

County:	Centerline miles	# of Bridges
Clackamas	0.21	
Coos	2.30	1
Douglas	2.54	
Jackson	2.62	2
Lane	4.44	
Marion	28.16	4
Morrow	0.83	1
Multnomah	6.49	10
Washington	19.97	5
County Total	67.56	23

Other Local Agency	Centerline miles	# of Bridges
TriMet		4
Port of Hood River	0.53	1
Port of Morrow	1.11	1
Port of Portland	2.57	
Port of Cascade Locks	0.40	1
Other Total	4.61	7

Table 4: List of non-ODOT NHS asset owners

For more details on locally-owned NHS assets and coordination efforts between ODOT, MPOs, and local agencies, see: *Appendix A: MPO and Local Agency Coordination.*

Section 3

STATE AND NATIONAL PERFORMANCE MEASURES

- Performance Measures Overview
- State Goals and Performance Measures
- National Goals and Performance Measures
- Scope of State and National Performance Measures
- Pavement and Bridge Performance Targets
- Pavement Rating Methods, Conditions and Targets
- Bridge Rating Methods, Condition and Targets
- Additional Performance Measures and Targets

Performance Measures Overview

For more than 25 years, the Oregon Department of Transportation has used performance measures to track the agency's performance at meeting a series of transportation-related benchmarks, including public safety, asset condition, livability, and economic prosperity. For the past 15 years, ODOT has submitted performance measures to the Oregon State Legislature as part of its formal budgeting process for legislative review and approval. These measures, established by the state legislature, are regularly updated and adjusted through a collaborative process that includes the legislature, the Oregon Transportation Commission, and ODOT staff.

The National Goals and Performance Measures established under MAP-21 are in many ways thoroughly consistent with Oregon's transportation performance measures, particularly in the areas of pavement and bridge infrastructure condition. While slight discrepancies exist between these state and national performance measures in terms of the scope of assets considered and condition metrics, they are largely congruent with each other. Smart investments that rely upon asset management strategies to improve the condition and performance of Oregon's pavement and bridges according to state performance measures will also have the direct impact of improving asset condition and performance according to national performance measures.

To address the challenge of overlapping state and federal performance measures and targets and how they impact agency decision-making, ODOT's policy is to continue to emphasize the central role of *state* performance measures in investment decisions for bridge, pavement and other assets. ODOT's process for selecting investments is aimed at achieving a more complex set of performance measures that are intended to result in a balanced program across many competing needs rather than solely meeting the limited scope of the national performance measures pertaining to asset condition. This continued focus on, and prioritization of, state performance measures is anticipated to have the practical effect of meeting the more narrow scope of the national performance measures and targets for NHS bridges and pavements.

The following section provides a detailed overview of state and national performance measures pertaining to transportation, pavement and bridge-related rating methods and targets, past and current trends in Oregon's pavement and bridge conditions, and future condition trends and condition targets based on levels of investment and application of asset management strategies.

State Goals and Performance Measures

ODOT's progress on performance measures began in the late 1980's as an agency effort to identify which programs or working groups were efficiently using resources and doing the highest quality work. A key element of the effort involved training staff in the development and use of performance measurements. At the same time, a series of benchmarks aimed at tracking progress toward a set of initiatives for enhancing health, livability, and prosperity were developed. Together, these initiatives led to the establishment of performance measures, called Key Performance Measures, or KPMs, for a number of transportation assets.

In 1991, the Oregon Progress Board established a series of benchmarks aimed at measuring the state's performance related to the economy, education, civic engagement, social support, public safety, community development, and the environment. The board's report to the Oregon State Legislature included benchmarks aimed at tracking transportation performance, including the "…backlog of city, county, and state roads and bridges

in need of repair and preservation" and the "…percentage of Oregonians who commute to work during peak hours by means other than a single occupancy vehicle." In 1993, the Oregon State Legislature established an ongoing requirement for state agencies to develop performance measures and to connect these to the benchmarks established by the Oregon Progress Board.

In 2003, the state legislature took the additional step of requiring state agencies to submit agency performance measures as part of the formal budget process for legislative review and approval and prepare an Annual Performance Report. In 2005, the legislature added the requirement that performance measures be linked to specific agency organizational units and that they include performance targets. The Annual Performance Report summarizes the agency's performance for the preceding year. It reviews agency progress in achieving performance measure targets, challenges encountered, and any corrective action undertaken. It also discusses how the agency is managing for results, training staff, and communicating performance data.

ODOT currently tracks and monitors more than two-dozen transportation-related KPMs identified by the Oregon State Legislature. These measures directly support agency goals for the safety, condition, and performance of transportation infrastructure, economic vitality, community livability, and the environment. They also affect all modes of transportation, including bicycle, pedestrian, transit, and rail, reflecting the multimodal nature of the agency.

https://www.oregon.gov/odot/performmang/pages/index.aspx

The current transportation performance measures the agency uses to assess and manage the condition and performance of its transportation system reflects the seven major goals established in the 2006 Oregon Transportation plan. *(see Table 5: State and National Goals and Performance Measures)*

National Goals and Performance Measures

In accordance with provision of MAP-21, states are required to establish a performance and outcome-based transportation program. The objective of this effort is for states to invest resources in projects that will make progress toward achieving national goals. Seven national performance goals are established as part of MAP-21, including enhancements to safety, infrastructure maintenance, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reductions in project delivery delays. These seven national goals generally coincide with the goals established by the Oregon Transportation Plan. For a demonstration of how Oregon's goals align with National Goals outlined in MAP-21, *see Table 5: State and National Goals and Performance Measures.*

MAP-21 requires that the Secretary, in consultation with state departments of transportation, metropolitan planning organizations, and other stakeholders, establish performance measures and standards for the condition and performance of the Interstate System (IS), the National Highway System (excluding the interstate system), and bridges on the National Highway System. Additionally, performance measures include serious injuries per vehicle mile traveled, the total number of serious injuries and fatalities, traffic congestion measures, and on-road mobile source emissions. In satisfying the requirements of a risk-based asset management plan, states are required to demonstrate progress toward achieving targets for the condition and performance of pavements and bridges, and support progress toward achievement of these seven national transportation goals.

Table 5: State & National Goals and Performance Measures

Oregon Transportation Plan Goals	Oregon Key Performance Measures[4]	National Goals — 23 U.S. Code § 150(b)	National Performance Measures
Goal 1 — Mobility and Accessibility Provide a balanced, efficient and integrated transportation system that ensures interconnected access to all areas of the state, the nation and the world. Promote transportation choices that are reliable, accessible and cost-effective.	Average number transit rides per each elderly and disabled Oregonian annually Number of state-supported rail service passengers Percent of lane blocking crashes cleared within 90 minutes	**System Reliability** Improve the efficiency of the surface transportation system. **Congestion Reduction** Achieve a significant reduction in congestion on the National Highway System.	Percent of reliable person-miles traveled on the Interstate System Percent of reliable person-miles traveled on the non-Interstate NHS Annual hours of peak hour excessive delay per capita Percent of non-single occupancy vehicle travel (incl. travel avoided by telecommuting)
Goal 2 – Management of the System Improve the efficiency of the transportation system by optimizing operations and management. Manage transportation assets to extend their life and reduce maintenance costs.	**Percent of pavement miles rated *fair-or-better* out of total miles on ODOT system** **Percent of State highway bridges that are not distressed** Percent of public transit buses that meet replacement standards	**Infrastructure Condition** Maintain the highway infrastructure asset system in a state of good repair.	**Percent of pavement on the Interstate System in Good condition** **Percent of pavement on the Interstate System in Poor condition** **Percent of pavement on the non-Interstate NHS in Good condition** **Percent of pavement on the non-Interstate NHS in Poor condition** **Percent of NHS Bridges Classified as in "Good" condition** **Percent of NHS Bridges Classified as in "Poor" condition**
Goal 3 – Economic Vitality Expand and diversify Oregon's economy by transporting people, goods, services and information in safe, energy-efficient and environmentally sound ways. Provide Oregon with a competitive advantage by promoting an integrated freight system.	Percent of ODOT awarded contracts to Oregon Certified Firms (Small Businesses) Percent of state administered projects that have satisfactorily completed all on-site work within 90 days of the baselined last contract completion date	**Freight Movement & Economic Vitality** Improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.	Percent of Interstate System Mileage providing for Reliable Truck Travel Times

[4] *The listed state Key Performance Measures are current as of 2018. These measures are subject to possible modifications, additions, and deletions for 2019. However, no changes pertaining to pavement and bridge condition measures are anticipated at this time.*

Table 6: State & National Goals and Performance Measures *(cont'd)*

Oregon Transportation Plan Goals	Oregon Key Performance Measures[5]	National Goals — 23 U.S. Code § 150(b)	National Performance Measures
Goal 4 – Sustainability Meet present needs without compromising the ability of future generations to meet their needs from the joint perspective of the environment, economy and communities. Encourage conservation and communities that integrate land use and transportation choices.	Percent of urban state highway miles with bike lanes and pedestrian facilities in fair-or-better condition	**Environmental Sustainability** Enhance performance of transportation system while protecting and enhancing the natural environment.	Total emissions reductions for applicable criterial pollutants
Goal 5 – Safety & Security Build, operate and maintain the transportation system so that it is safe and secure. Take into account the needs of all users: operators, passengers, pedestrians and property owners.	Traffic fatalities per 100 million vehicles miles traveled (VMT) Serious traffic injuries per 100 million vehicle miles traveled (VMT) Number of large truck at-fault crashes per million vehicle miles traveled (VMT) Number of train derailments caused by human error, track, or equipment	**Safety** Achieve a significant reduction in traffic fatalities and serious injuries on all public roads.	Number of Fatalities Number of Serious Injuries Rate of Fatalities per 100 million VMT Rate of Serious Injuries per 100 million VMT Number of non-motorized fatalities and non-motorized serious injuries
Goal 6 – Funding the Transportation System Create sources of revenue that will support a viable transportation system today and in the future. Expand ways to fund the system that are fair and fiscally responsible.	Percent of projects for which total construction expenditures are within 10 percent of its baselined construction authorization	**Reduced Project Delivery Delays** Reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.	
Goal 7 – Coordination, Communication & Cooperation Foster coordination, communication and cooperation between transportation users and providers so various means of transportation function as an integrated system. Work to help all parties align interests, remove barriers and offer innovative, equitable solutions.	Percent of customers rating their satisfaction with agency's customer service as "good" or "excellent" Percent of DMV Field Office Customers Served within 20 Minutes		

[5] *The listed state Key Performance Measures are current as of 2018. These measures are subject to possible modifications, additions, and deletions for 2019. However, no changes pertaining to pavement and bridge condition measures are anticipated at this time.*

Scope of State and National condition-based performance measures

State Key Performance Measures (KPM's) pertaining to bridge and pavement conditions measure a distinct cost of assets as compared to National Performance Measures (PM2s) pertaining to bridge and pavement conditions. State KPMs pertaining to bridge and pavement conditions include assets on the entire State Highways System, which contains the entire Interstate System, and nearly the entirety of the National Highway System. This scope of assets is demonstrated in *Figure 5: State and National Highway Systems*.

In addition to a distinct scope of assets, State KPMs are distinct from PM2s by the manner in which assets are measured. State KPMs measure pavement conditions by centerline miles, and bridges by bridge count. By contrast, PM2s measure pavement by lane miles, and bridges by square feet of deck area. The resulting scope of assets evaluated by these two sets of performance measure approaches is summarized in *Table 7* below.

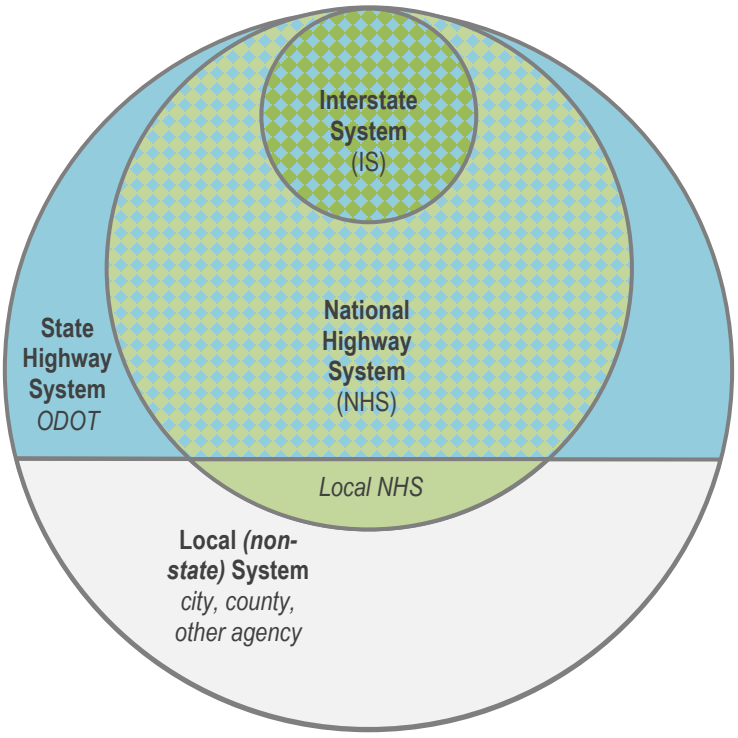


Figure 5: State and National Highway Systems *(not to scale)*

Ownership	System		*State* Key Performance Measures (KPMs)		*National* Performance Measures (PM2s)	
			Pavement	Bridge	Pavement	Bridge
State Highway (ODOT)	Interstate	NHS	**729 centerline mi.** *(3,130 lane mi.)*	**700 bridges** *(15.4M Sq.Ft. Deck Area)*	**3,130 lane mi.** *(729 centerline mi.)*	**15.4M Sq.Ft. Deck Area** *(700 bridges)*
	Non-Interstate		**3,323 centerline mi.** *(8,065 lane miles)*	**1,033 bridges** *(13.0M Sq.Ft. Deck Area)*	**8,065 lane mi.** *(3,323 centerline mi.)*	**13.0M Sq.Ft. Deck Area** *(1,033 bridges)*
		Non-NHS	**3,608 centerline mi.** *(7,369 lane mi.)*	**1,004 bridges** *(8.0M Sq.Ft. Deck Area)*	-	-
Local Agency		NHS	-	-	**873 lane mi.** *(263 centerline mi.)*	**1.7M Sq.Ft. Deck Area** *(81 bridges)*
Total in scope:			**7,660 centerline mi.** *(18,566 lane mi.)*	**2,737 bridges** *(36.5M Sq.Ft. Deck Area)*	**12,068 lane mi.** *(4,315 centerline mi.)*	***30.2M Sq.Ft. Deck Area*** *(1,814 bridges)*

Table 7: Assets in scope of State and National condition-based performance measures

Figure 6: Summary of State Performance Measures and Targets:

Ownership	System		Pavement	Bridge
State Highway (ODOT)	Interstate	NHS	Percent of pavement miles in *Fair-or-better (FOB)* condition	Percent of state highway bridges that are not distressed
	Non-Interstate			
		Non-NHS		
2018 Statewide Target			85%	78%

Figure 7: Summary of National Performance Measures and Targets:

System		Ownership	Pavement				Bridge	
NHS	Interstate	State Highway (ODOT)	Percent of lane-miles in *Poor* condition	Percent of lane-miles in Good condition			Percent by deck area in *Poor* condition	Percent by deck area in Good condition
	Non-Interstate				Percent of lane-miles in *Poor* condition	Percent of lane-miles in Good condition		
		Local Agency						
2020 *(2-Year)* Target			-	-	10.0%	50.0%	2.4%	11.4%
2022 *(4-Year)* Target			0.5%	35%	10.0%	50.0%	3.0%	10.0%
Minimum Condition: (to avoid penalty)			*Less than 5% poor condition*	-	-	-	*Less than 10% poor condition*	-

State Performance Measures: Pavement

Pavement Rating Methods to meet State Key Performance Measures (KPMs)

Two separate and distinct pavement rating methods are used to gather pavement condition data – the Distress Survey procedure and the Good-Fair-Poor (GFP) rating procedure. Lower traffic non-NHS state highways are rated using the GFP Pavement Condition Rating Manual which is a much less expensive "windshield-based" rating procedure appropriate for the lower priority highways. Pavement condition data for all Interstate and NHS routes on both state and local jurisdiction are collected by a data collection vendor, under contract with ODOT, to ensure the data obtained is consistent and accurate. Interstate conditions are collected annually and the remaining systems are collected every two years. Data collection is performed in accordance with the ODOT Pavement Data Collection Manual, the HPMS Field Manual, and applicable AASHTO standards and is subjected to quality control / quality assurance (QC/QA) procedures in accordance with ODOT's Pavement Data Quality Management Plan.

Figure 8: Illustration of ODOT Pavement Data Collection Vehicle

An overall condition index is derived from six individual indices for each 0.10 mile: a rut index, a fatigue index, a patching index, a no load (environmental) index, and a raveling index. The 0.10 mile overall condition indices are averaged together to calculate the overall condition score for each pavement management section. The overall condition score puts the most weight on safety deficiencies such as rutting, structural defects such as fatigue cracking and potholes, and severe environmental cracking or raveling distress. The International Roughness Index (IRI) is not part of the overall condition score because pavement roughness tends to decay at a slower rate and lag behind the other factors which are better suited for preservation treatment selection and timing.

The overall condition score is used to assign one of the five condition categories as shown in the figure below. Oregon's Key Performance Measure (KPM) for pavement is percent "fair" or better which is sum of the mileage in the "very good", "good", and "fair" categories divided by the total miles. More information is available in ODOT's Pavement Condition Report.

	Condition Score	Pavement Condition
	96-100	Very Good (VG)
	76-95	Good (GD)
Fair-or-better (FOB) line	46-75	Fair (FR)
	21-45	Poor (PR)
	0-20	Very Poor (VP

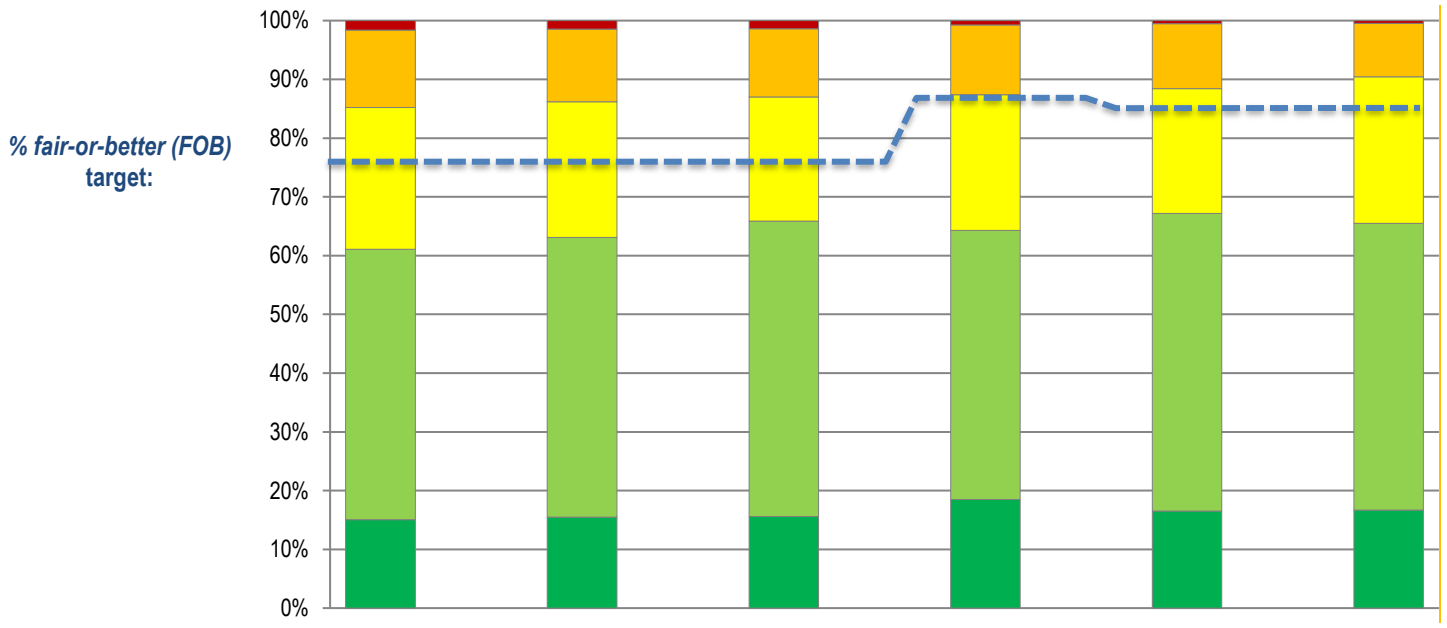
State Highway System Pavement Condition and Targets

Pavement condition is one of ODOT's key performance measures and is reported as the percentage of total state highway miles that are rated in "fair-or-better" (not poor) condition. For the period 2005 through 2013, the target for the pavement condition of state highways was set at 78% fair-or-better. In 2014, the Oregon State Legislature increased the target to 87% for 2014 and 2015, and subsequently reduced the target to 85% for 2016 and 2017.

Asset Type	System	State Performance Measure	Target
Pavement	State Highway	% miles rated 'fair-or-better'	85%

The following chart presents the pavement condition of State Highway roads over the course of the last 10 years. Presented in the chart are actual pavement condition values calculated from collected pavement data and established pavement condition targets:

Figure 9: State Highway Pavement Conditions 2008-2016:



		2008		2010		2012		2014		2016		2018
Percent of State Highway Pavement	Very Poor	2%		2%		1.5%		1%		0.5%		0.5%
	Poor	13%		12%		11.5%		12%		11.5%		9.5%
	Fair	24%		23%		21%		23%		21%		25%
	Good	46%		48%		50%		46%		51%		49%
	Very Good	15%		15%		16%		18%		16%		16%
Key Performance Measure	**% Fair-or-Better**	**85%**		**86%**		**87%**		**87%**		**88%**		**90%**
	Target	78%		78%		78%		87%		85%		85%
	+/- Target	+7%		+8%		+9%		-		+3%		+5%

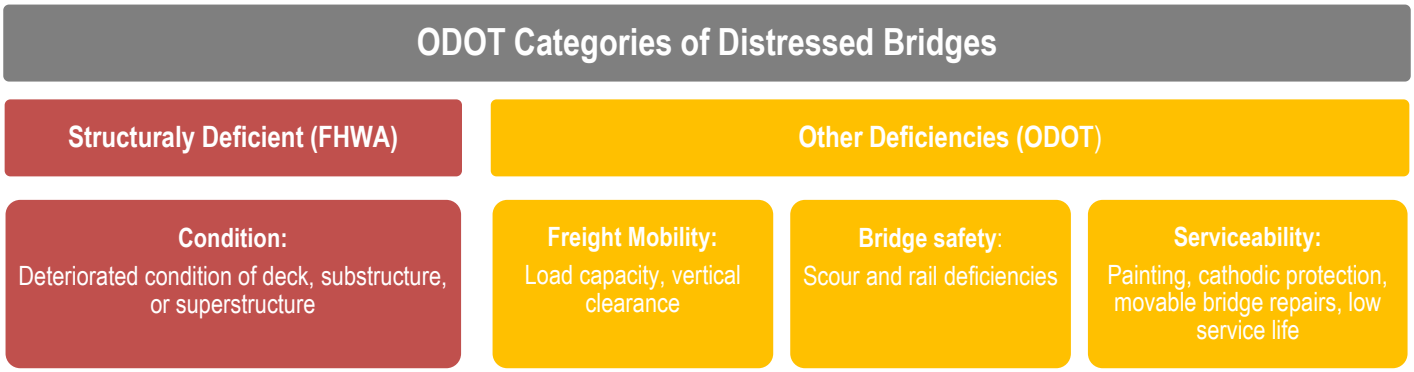
State Performance Measures: Bridge

Bridge Rating Methods to meet State Key Performance Measures

ODOT measures bridge conditions based on the Key Performance Measure of the percent of bridges *Not Distressed*. Bridges that are considered *Distressed* under this performance measure fall into one of two categories:

1. Bridges that are *Structurally Deficient* (as defined by FHWA)[6]
2. Bridges that have *Other Deficiencies* (as defined by ODOT)[7]

The following chart identifies characteristics of bridges considered distressed under these two categories:



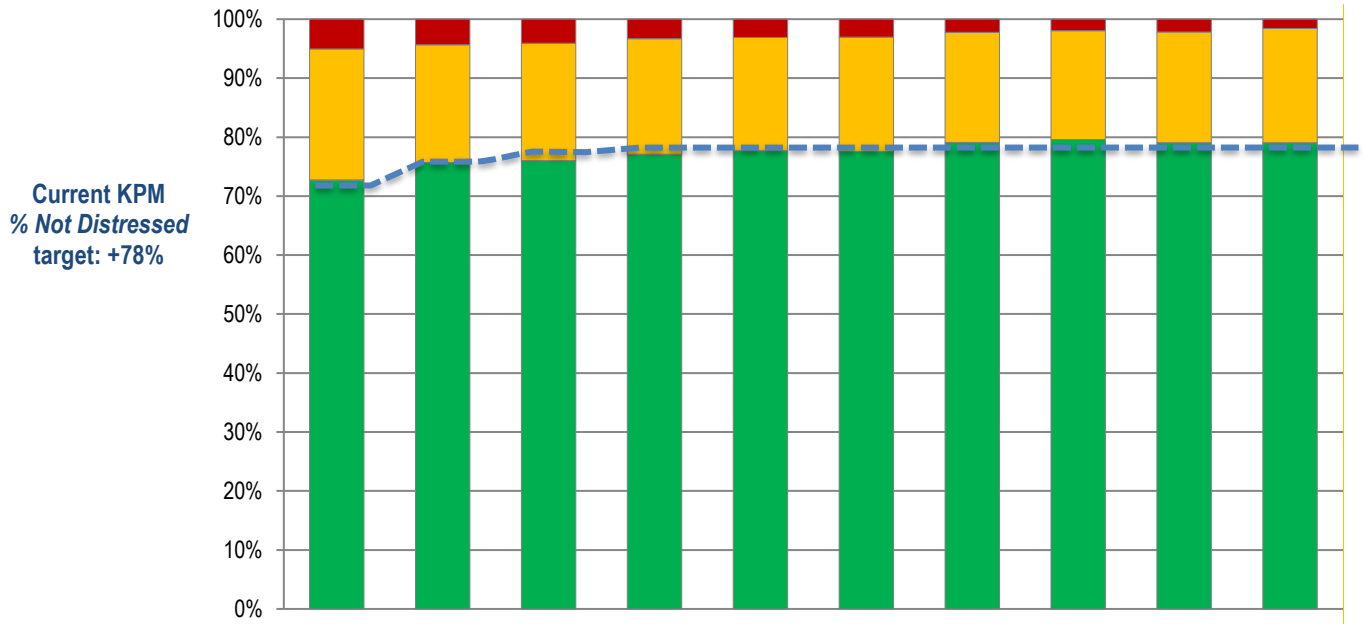
[6] https://www.fhwa.dot.gov/bridge/britab.cfm

[7] 2018 Bridge Condition Report: https://www.oregon.gov/ODOT/Bridge/Documents/Bridge-Condition-Report-2018.pdf

State Highway System Bridge Condition and Targets

Asset Type	System	State Performance Measure	Target
Bridges	State Highway	% of bridges (count) not 'distressed'	78%

Figure 10: State Highway System Bridge Condition 2009-2018



		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
% by bridge count	Structurally Deficient	5.0%	4.3%	4.1%	3.3%	3.1%	3.0%	2.2%	2.0%	2.2%	1.6%
	Other Deficiencies	22.2%	19.9%	19.9%	19.6%	19.2%	19.4%	18.7%	18.4%	18.7%	19.4%
	Not Distressed (ND)	**72.7%**	**75.7%**	**76.0%**	**77.1%**	**77.7%**	**77.6%**	**79.1%**	**79.6%**	**79.1%**	**79.0%**
Key Performance Measure	Target *(% ND)*	*72.0%*	*76.0%*	*77.0%*	*78.0%*	*78.0%*	*78.0%*	*78.0%*	*78.0%*	*78.0%*	*78.0%*
	+/- Target	+0.7%	-0.3%	-1.0%	-0.9%	-0.3%	-0.4%	+1.1%	+1.6%	+1.1%	+1.0%

National Performance Measures (PM2): Pavements

National Highway System Pavement Conditions and Targets

The 2017 National Performance Measures assesses pavement conditions on the National Highway System. While the scope of roadway jurisdiction is distinct from the state KPM for pavement condition, the National Performance Measures take a similar approach, assessing the percent of pavement rated in good, fair, and poor condition. In addition to targeting the percent of pavement considered poor (comparable to the state measure of fair-or-better), an additional National Performance Measure considers the percent of pavement in good condition.

Additionally, the National Performance Measures assesses the condition of interstate pavements as a distinct category from the assessment on non-interstate National Highway System pavement, resulting in four distinct condition measures. These measures are summarized in the following chart:

Asset Type	System	National Performance Measure	Target	Minimum Condition
Pavement	Interstate	Percent lane-miles in Poor condition	*2022: 0.5%*	*No more than 5% Poor condition*
		Percent lane-miles in Good condition	*2022: 35%*	-
	Non-Interstate NHS	Percent lane-miles in Poor condition	*2020: 10%* *2022: 10%*	-
		Percent lane-miles in Good condition	*2020: 50%* *2022: 50%*	-

Pavement Rating Methods to meet National Performance Measures (PM2)

Historically, ODOT has collected smoothness and rutting measurements by machine, and determined cracking measurements by visual survey. Highway Performance Monitoring System (HPMS) reporting of pavement conditions on the interstate and non-interstate National Highway Systemic is currently limited to only International Roughness Index (IRI) metrics.

Metrics for determining the conditions of pavement to meet National Performance Measures includes a combination of IRI, rutting, faulting, and cracking percent measurements. However, with the rollout of new performance measure requirements and targets, these additional metrics will be phased in. The condition metrics of rutting, faulting, and cracking percent will be reported for interstate pavements starting in 2018 and non-interstate NHS pavements starting in 2020.

Overall pavement condition ratings are determined using a combination of these metrics. *Figure 11* provides an overview of the metric thresholds for each individual measure, and the resulting good, fair, and poor condition ratings is based on a summation of these measures applicable by pavement type.

The following charts include past estimates of pavement condition on both the interstate system using the expansive combination of metrics which include IRI, rutting, faulting, and cracking percent measurements, and on the non-interstate NHS system using the more limited IRI metrics.

Figure 11:Metric Thresholds in Final Rule

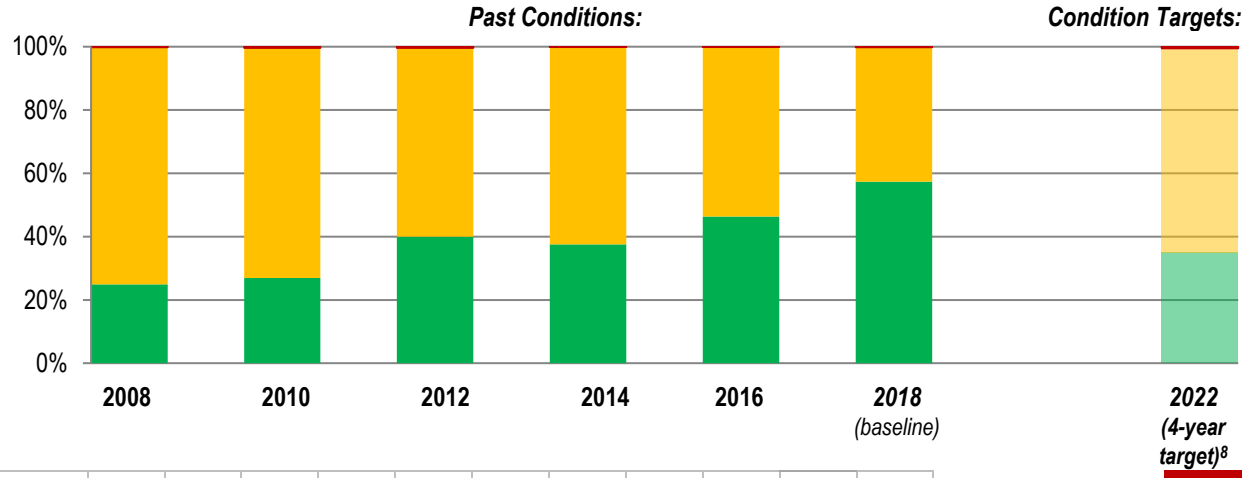
Rating:	Good	Fair	Poor
IRI *(inches/mile)*	<95	95- 170	>170
Cracking *(%)*	<5	CRP: 5- 10 Jointed: 5- 15 Asphalt: 5- 20	>10 >15 >20
Rutting *(inches)*	<0.20	0.20- 0.40	>0.40
Faulting *(inches)*	<0.10	0.10- 0.15	>0.15

	Asphalt & Jointed Concrete	Continuously Reinforced Concrete
Metrics used:	*1. IRI* *2. Cracking* *3. Rutting/Faulting*	*1. IRI* *2. Cracking*
Good Condition Rating:	All three metrics rated good	Both metrics rated good
Poor Condition Rating:	Two or more metrics rated poor	Both metrics rated poor
Fair Condition Rating:	*All other combinations*	*All other combinations*

Past Interstate Pavement Conditions and Future Targets (PM2 metrics by percent lane miles)

The following chart summarizes the estimated pavement conditions on the Interstate System from 2008 to 2018 using all the PM2 pavement metrics (IRI, cracking, rutting, and faulting) and identifies 2-year and 4-year condition targets based on these historic trends, the latest funding projections, and future deterioration modeling.

Figure 12: Past Interstate Pavement Conditions and Future Targets (PM2 Metrics):

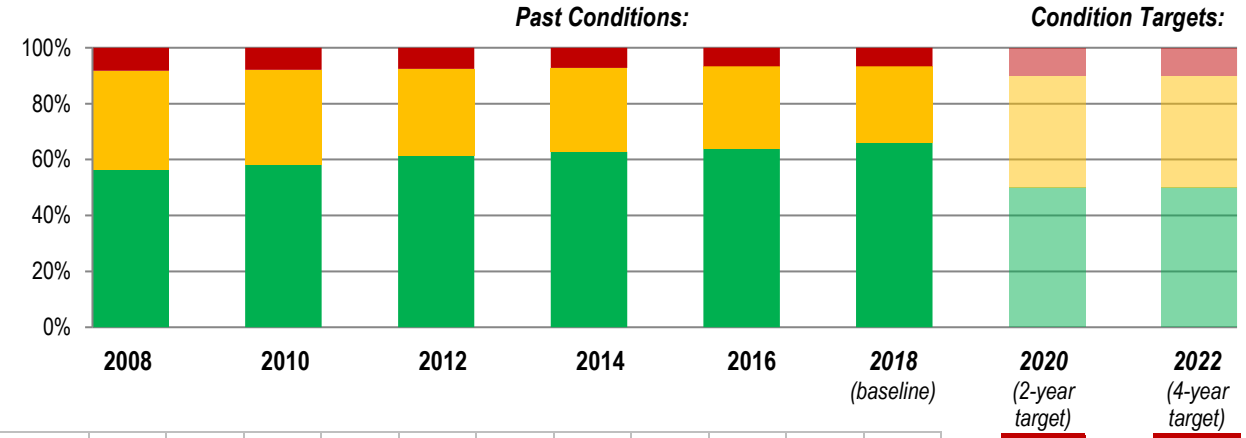


		2008		2010		2012		2014		2016		2018 (baseline)	2022 (4-year target)[8]
Percent of Interstate Pavement	Poor	0.2%		0.4%		0.4%		0.1%		0.1%		*0.2%*	***0.5%***
	Fair	74.9%		72.7%		59.6%		62.4%		53.6%		*42.4%*	
	Good	24.9%		26.9%		40.0%		37.5%		46.3%		*57.4%*	***35%***

Past Non-Interstate NHS Pavement Conditions and Future Targets (IRI metric only)

The chart below summarizes the estimated pavement conditions on the Non-Interstate National Highway System from 2008 to 2018 using just the Internationally Roughness Index (IRI) methodology[9] and identifies 2-year and 4-year condition targets based on these historic trends, the latest funding projections, and future deterioration modeling.

Figure 13: Past non-Interstate Pavement Conditions and Future Targets (IRI Metric):



		2008		2010		2012		2014		2016		2018 (baseline)	2020 (2-year target)	2022 (4-year target)
Percent of non-Interstate NHS Pavement	Poor	8.2%		7.9%		7.6%		7.2%		6.6%		*6.6%*	***10.0%***	***10.0%***
	Fair	35.3%		33.8%		31.1%		30.0%		29.5%		*27.3%*		
	Good	56.5%		58.3%		61.3%		62.8%		63.9%		*66.1%*	***50.0%***	***50.0%***

[8] Minimum condition requirement: Maximum 5% Poor Condition

[9] ** According to 409.309 data requirements, only IRI is used for pavement condition data collection prior to: January 1, 2018 for Interstate highways; January 1, 2020 for Non-Interstate NHS routes.*

National Performance Measures (PM2): Bridges

National Highway System Bridge Conditions and Targets

In contrast to Oregon's key performance measure methodology that considers bridge condition as well as other bridge features such as freight mobility, bridge safety, and serviceability, national performance measures for bridges are calculated by looking more narrowly at condition of the bridge deck, substructure, and superstructure. Additionally, national performance measures are based on a calculation of the total bridge deck area, whereas Oregon's key performance measure calculates by total bridge count.

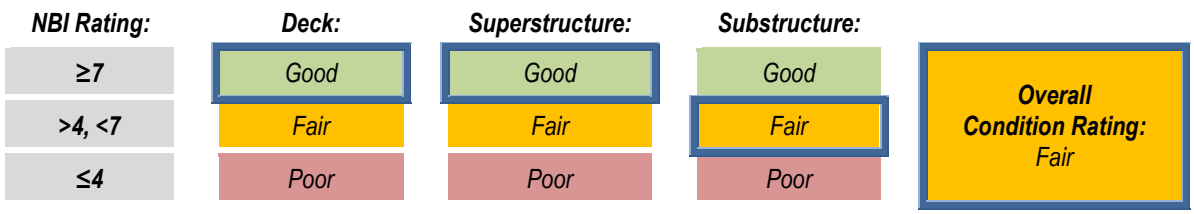
Two performance measures have been established for bridges on the National Highway System: the percent of NHS deck area in poor condition, and the percent of NHS deck area in good condition. Whereas National Performance Measures for pavements make separate calculations for Interstate and non-Interstate NHS pavements, bridge condition measures calculate the combined condition of all bridges on the National Highway System:

Asset Type	System	National Performance Measure	Target	Minimum Condition
Bridges	National Highway	% deck area in Poor condition	*2020: 2.4%* *2022: 3.0%*	No more than 10% poor condition
		% deck area in Good condition	*2020: 11.4%* *2022: 10%*	-

Bridge Rating Methods to meet National Performance Measures (PM2)

The condition rating for an individual bridge is determined by the lowest rating of deck, superstructure, and substructure. If the lowest rating is greater than or equal to 7, the bridge is classified as good; if less than or equal to 4, the classification is poor. Bridges that are rated below 7 but above 4 are classified as fair.

Example: *Condition classification is based on the lowest-rated feature. If the deck and substructure are both rated Good, but the superstructure is rated Fair, then the overall condition rating would be considered Fair:*



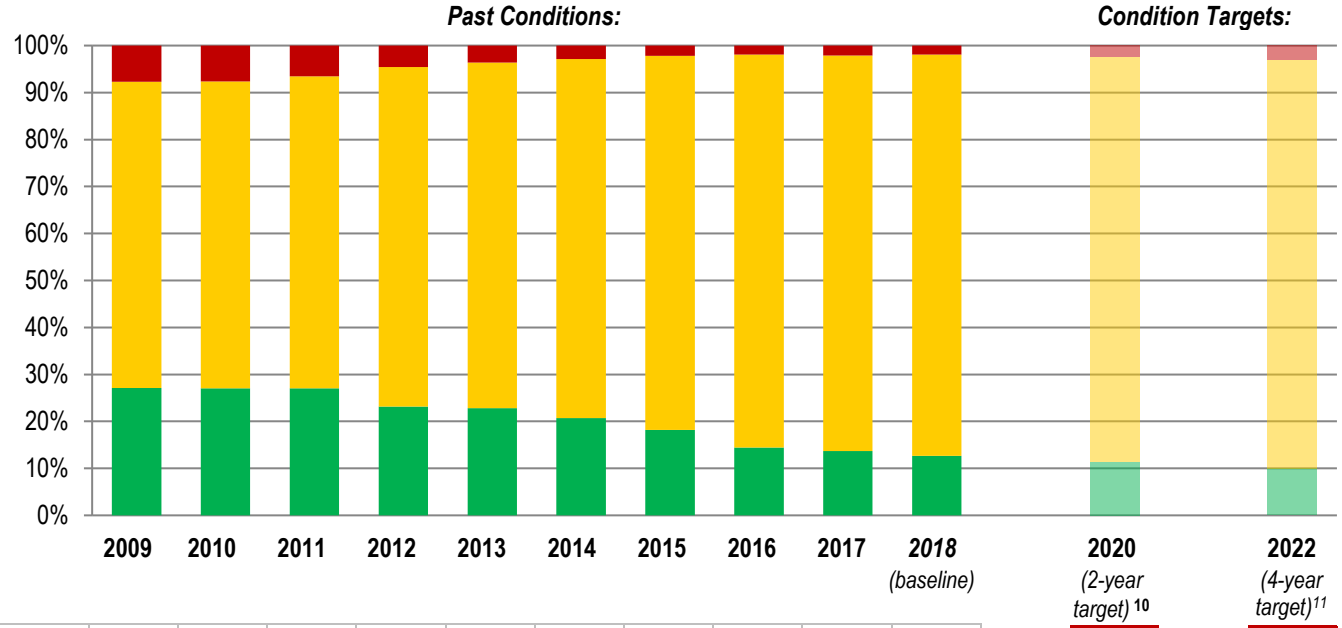
Because the National Bridge Inventory methods for assessing deck, superstructure, and substructure condition have been well established, this new National Performance Measure methodology can be applied to past bridge inventory condition information on Oregon's NHS bridges. The following subsection uses the PM2 bridge rating methodology to retroactively evaluate and summarize past trends in Oregon's NHS bridge conditions.

National Highway System Bridge Conditions and Targets

Since 2009, the total number of NHS bridges within Oregon classified in *poor* condition has decreased on an annual basis: from 67 bridges in 2009 to 32 bridges in 2017. Measured as a percentage of deck area, square feet of bridges in *poor* condition have also decreased on an annual basis; from 7.7% in 2009 to 2.2% in 2017.

While this decrease in NHS bridges in *poor* condition marks a positive trend, an increasing number of bridges on the system are degrading from *good* to *fair* condition. The number of NHS bridges classified in *good* condition has decreased from 711 bridges (27.1%) in 2009 to 454 bridges (13.8%) in 2017. The decrease in bridges in both *poor* and *good* condition, coupled with the increase in bridges in *fair* condition is demonstrated in the following chart depicting the condition of all NHS bridges over the past 10 years:

Figure 14: Past NHS Bridge Conditions and Future Targets *(by deck area)*



		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 (baseline)	2020 (2-year target) [10]	2022 (4-year target)[11]
Percent by Deck Area	Poor	7.7%	7.6%	6.5%	4.6%	3.6%	2.8%	2.2%	1.9%	2.1%	1.9%	2.4%	3.0%
	Fair	65.1%	65.3%	66.4%	72.3%	73.5%	76.4%	79.6%	83.7%	84.2%	85.4%		
	Good	27.1%	27.0%	27.0%	23.2%	22.9%	20.7%	18.2%	14.4%	13.7%	12.7%	11.4%	10.0%

The increasing number of bridges in *fair* condition presents a challenge for meeting bridge condition targets over the next 20-30 years. While recent bridge investments targeted at NHS bridges in the worst state of repair had reduced the number of bridges in poor condition, the degradation of bridges from good to fair increases the total number of bridges that are at risk of degrading to a poor condition, particularly as many bridges on the NHS system reach the end of their design life.

[10] Minimum Condition Requirement: Maximum 10% Poor condition
[11] Minimum Condition Requirement: Maximum 10% Poor condition

Additional State & National Performance Measures and Targets:

In addition to the state and national performance measures pertaining to pavement and bridge conditions outlined in the preceding pages, ODOT currently tracks and monitors nearly two dozen transportation-related state performance measures identified by the Oregon State Legislature. FHWA has also identified more than 11 additional performance measures pertaining to safety, system performance, and emissions reductions. These state and national measures directly support agency goals for the safety, condition, and performance of transportation infrastructure, economic vitality, community livability, and the environment.

While the scope of the Transportation Asset Management Plan is limited to pavements and bridges on the National Highway System, investment strategies and risk management decisions undertaken by the agency are built around this larger portfolio of state and national performance measures targets.

State Key Performance Measures Summary, 2019:

https://www.oregon.gov/ODOT/PerformMang/Documents/KPM%20Rollup.pdf

National Performance Measures Baseline Report, Oregon, 2018:

See Appendix G

Local Performance Measure Targets

Statewide targets pertaining to the condition and performance of the National Highway System were developed in collaboration between ODOT and Oregon's Metropolitan Planning Organizations (MPOs). The process by which ODOT has established these statewide targets in coordination with MPO's is outlined in *Appendix A: Local Agency Target Setting Process MOU*.

In addition to statewide targets set by ODOT, MAP-21 legislation provides MPOs with the ability to either adopt the statewide target or establish a specific target for any federally required performance measure. In developing an MPO performance measure target, the MPO must coordinate with ODOT to ensure consistency to the maximum extent practical.

The 2-year and 4-year MPO targets pertaining to pavement and bridge conditions are summarized as follows:

	2020 Pavement Targets		2022 Pavement Targets		2020 Bridge Targets		2022 Bridge Targets	
	Poor	**Good**	**Poor**	**Good**	**Poor**	**Good**	**Poor**	**Good**
Statewide Targets	**10.0%**	**50.0%**	**10.0%**	**50.0%**	**2.4%**	**11.4%**	**3.0%**	**10.0%**
MPO Targets								
Albany (AAMPO)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Bend (BMPO)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Central Lane (CLMPO)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Corvallis (CAMPO)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Portland Metro (METRO)	**25.0%**	**32.0%**	**25.0%**	**32.0%**	**1.0%**	**5.0%**	**1.0%**	**5.0%**
Middle Rogue (MRMPO)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Rogue Valley (RVMPO)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Salem/Keizer (SKATS)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Longview/Kelso/Rainer (CWCOG)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%
Walla Walla (WWMVMPO)	10.0%	50.0%	10.0%	50.0%	2.4%	11.4%	3.0%	10.0%

Table 8: MPO Targets for NHS Non-Interstate Pavements and NHS Bridges

For a summary overview of past bridge and pavement conditions within each of Oregon MPO's see: *Appendix A: MPO Bridge and Pavement Conditions Summary (2016 Snapshot)*

Section 4

PERFORMANCE GAP ANALYSIS

- Performance Gap Analysis Overview
- ODOT Policy Defining a State of Good Repair
  - Oregon Transportation Plan Guidance
  - Oregon Highway Plan Guidance
- Past Efforts to Identify Performance Gaps
  - *Rough Roads Ahead* Reports (2014, 2017)
  - OTC Investment Strategy (2017)

Asset Management Plan Performance Gap Analysis (10 year)

- Pavement Performance Gap Analysis
- Bridge Performance Gap Analysis

Performance Gap Analysis Overview

The Performance Gap Analysis section provides an overview of the *Desired State of Good Repair* for Oregon's National Highway System pavements and bridges, and compares the desired state to both current conditions and future conditions (10 years) based on the latest funding projections. This section discusses policy guidance derived from the Oregon Transportation Plan and Oregon Highway Plan that defines a state of good repair as well as strategies for closing gaps in system performance under a constrained funding scenario. Past efforts by ODOT to identify future conditions and the funding needed to close gaps in performance are outlined. In the final subsection, projections of future conditions (10 years) of Oregon's NHS pavements and bridges are outlined based on the latest funding projections, and compared to current conditions and a *Desired State of Good Repair*. Strategies aimed at closing the gaps between projected and desired conditions for pavements and bridges are also summarized.

This Performance Gap Analysis section is distinct from ODOT's *2016 Asset Management Gap Analysis Report*, which can best be described as an assessment of the maturity of ODOT's asset management program. Further details on the *2016 Asset Management Gap Analysis* is provided in *Section 5: ODOT Asset Management Practices.*

ODOT Policy Defining a State of Good Repair

ODOT identifies and defines a *state of good repair* of the transportation system through policy guidance from the Oregon Transportation Plan. The Oregon Transportation Plan serves as the umbrella document for Oregon's multimodal transportation system. The Oregon Highway Plan, which is a modal plan under the Oregon Transportation Plan, further defines a state of good repair on Oregon's highway system and identifies policies and priorities for funding the highway system under constrained revenue scenarios.

Oregon Transportation Plan Needs Analysis

As part of the 2006 Oregon Transportation Plan, a needs analysis was conducted that assessed anticipated transportation revenue needs relative to available revenue. Transportation system needs were identified in this exercise based on the concept of feasible needs.

> *"Feasible need refers to the funding that maintains the system at a slightly more optimal level than current levels, replaces infrastructure and equipment on a reasonable life-cycle, brings facilities up to standard, and adds capacity in a reasonable way."*

As a matter of policy, the Oregon Transportation Plan Needs Analysis defines a state of good repair in terms of feasible needs. This 2004 Needs Analysis, which supplements the Oregon Transportation Plan, provides a snapshot in time both in terms of available transportation revenue, and the revenue necessary to meet feasible needs. As revenue needed to maintain and enhance the system has changed along with revenue available, this needs analysis has been supplanted by subsequent studies that consider the various funding scenarios and the revenue required to meet a state of good repair. These efforts are articulated further in the following subsections.

Oregon Highway Plan Policies and Priorities

The Oregon Highway Plan lays out a series of policies and priorities for investment in the state highway system aimed at maintaining a state of good repair. Further, it articulates minimum safety and infrastructure conditions that should be met before investments are made that add new capacity or

facilities to the system:

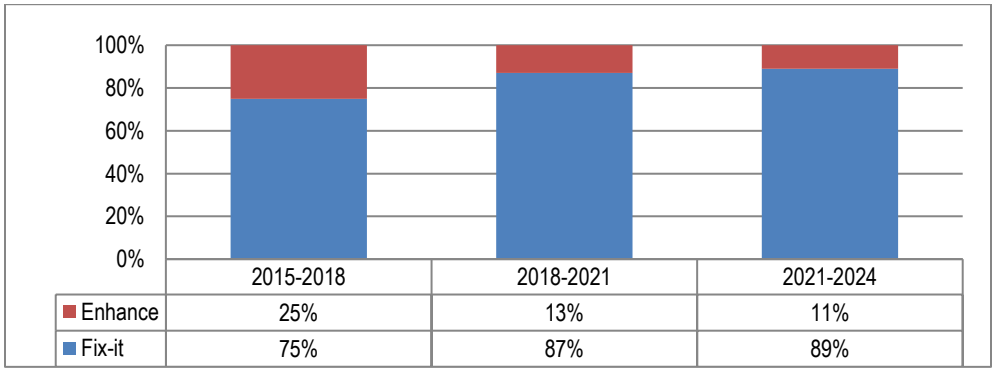
It is the policy of the State of Oregon to place the highest priority for making investments in the state highway system on safety and managing and preserving the physical infrastructure.

ODOT's funding priorities will change according to changes in available revenues. The following scenarios establish funding priorities for highway-related plans and programs at four general funding levels; the first applies at the 1998 funding level. With increases in funding, ODOT will progress toward the fourth funding scenario.

Scenario	Action
• **With funding that does not increase with inflation and subject to statutory requirements and regional equity, address critical safety issues and manage and preserve existing infrastructure at 77 percent fair-or-better before adding capacity.**	○ *Focus safety expenditures where the greatest number of people are being killed or seriously injured.* ○ *Fund modernization only to meet statutory requirements.* ○ *Preserve pavement conditions at 77% fair-or-better on all roads except for certain Regional and District Highways.* ○ *Do critical bridge rehabilitation and replace bridges only when rehabilitation is not feasible.* ○ *Fund operations to maintain existing facilities and services and extend the capacity of the system.*
• **Invest to improve infrastructure conditions and to add new facilities or capacity to address critical safety problems, critical levels of congestion, and/or desirable economic development.**	○ *Address the highest priority modernization projects.* ○ *Move toward pavement conditions of an average 78% fair-or-better on all state highways.* ○ *Maintain Bridge Value Index (percentage of total replacement value) at 86 percent.*
• **When critical infrastructure preservation, safety and congestion needs are met, pursue a balanced program of additional high priority modernization projects and preservation of infrastructure.**	○ *Move toward modernization funding to meet 55% of feasible needs.* ○ *Bring pavement conditions up to an average 84% fair-or-better level on all state highways.* ○ *Maintain bridge conditions at 87% of total replacement value and address the critical 1/3 of seismic retrofit needs.*
• **With significant funding increases, develop feasible modernization projects, address long-term bridge needs and upgrade pavements to a more cost-effective condition.**	○ *Move toward modernization funding to meet 100% of feasible needs.* ○ *Bring pavement conditions up to an average 90% fair-or-better level on all state highways.* ○ *Begin to replace 850 aging bridges and increase the Bridge Value Index (percentage of total replacement value) to 91%.*

Since completion of the Oregon Transportation Plan and the Oregon Highway Plan, ODOT has operated under a constrained revenue situation that resembles Scenario 1 of the Oregon Highway Plan. Under this constrained scenario, Statewide Transportation Investment Program (STIP) funds have been largely dedicated to Fix-it programs aimed at maintaining existing pavement and bridge assets while improving highway safety.

Figure 15: STIP Funding Cycle Split (2015-2024):



Past Efforts to Identify Performance Gaps

Multiple efforts by ODOT have looked at future conditions of Oregon's pavement and bridge system and analyzed the rate of deterioration under various future funding scenarios and the additional revenue required to maintain pavement and bridge assets in a state of good repair into the future.

Rough Roads Ahead Reports (2014 & 2017)

ODOT's 2014 *Estimated Impacts of Deteriorating Highway Conditions to Oregon's Economy*[12] report identified and analyzed two scenarios for state highway funding over the next 20 years. The Current Revenue Scenario analyzed ODOT's budget forecast for state highway spending over the next 20 years. The Maintain Current Conditions Scenario represents a 20-year forecast on highway spending designed to preserve current highway conditions:

Current Revenue Scenario	• System preservation and maintenance cannot be sustained • System will deteriorate at increasing rate over time • Highway repairs increase in cost over time • Funding for modernization (new construction) must be diverted to maintenance • Bridges increasingly require weight restrictions, forcing detours of heavy trucks
Maintain Current Conditions Scenario	• Revenue is sufficient for ODOT to keep state highway system close to current conditions • Deferred maintenance and preservation is avoided, preventing future need for diversion of modernization funds • Bridges avoid requiring new weigh restrictions and forcing detours of heavy trucks

In February 2017, ODOT completed the study *Rough Roads Ahead 2: Economic Implications of Deteriorating Highway Conditions*. This study considered four different scenarios of investment in Oregon's transportation system, and their impacts on pavement and bridge conditions over the next 20 years, as well as the economic impact of these asset conditions on Oregon's economy. The four scenarios included in the Rough Roads Ahead 2 report are as follows:

Scenario 1*:	*Current (as of February 2017) ODOT forecast budget for the state system.*
Scenario 2*:	*Limited expansion of current (as of February 2017) investment; adds the remainder of Interstate 5 and Interstate 84 to the limited network that can be addressed under the current budget.*
Scenario 3:	*Hypothetical "What Would It Take" to preserve and repair the entire network of high-priority state highways, known as the Fix-It priority routes.*
Scenario 4:	*Hypothetical "What Would it Take" to maintain current bridge and pavement conditions for the entire state-owned and operated system, including seismic preparation.*

**Scenario 1 and Scenario 2 are based on revenue projections that predate the Keep Oregon Moving (HB2017) statewide funding package*

[12] http://www.oregon.gov/ODOT/Planning/Documents/Estimated-Impacts-of-Deteriorating-Highway-Conditions-to-Oregons-Ecomony.pdf

20 Year Program Total: $8.7 B	Scenario 1: Current (2017) Forecast Budget: Inflation Adjusted 2016 dollars by Calendar Year				
	2017	2021	2026	2031	2036
Maintenance*	243	246	258	238	221
Pavement	83	74	68	62	58
Bridge	83	74	68	62	58
Enhance	73	38	0	0	0
Seismic	0	0	0	0	0
Other**	49	44	40	37	34
Total	529	477	433	399	371

*Maintenance cost rises 3% a year, taken from Enhance;
**Other category of expenditures includes Safety and Operations, Local Government and Special Operations

20 Year Program Total: $14.7 B	Scenario 2: 35% Increase in Budget (14 cent increase in state fuel tax)				
	2017	2021	2026	2031	2036
Maintenance*	250	271	299	330	345
Pavement	127	127	127	127	127
Bridge	150	150	150	150	150
Enhance	95	75	47	16	0
Seismic	49	49	49	49	49
Other**	64	64	64	64	64
Total	735	735	735	735	735

*Maintenance cost rises 2% a year, taken from Enhance
**Other category of expenditures includes Safety and Operations, Local Government and Special Operations

20 Year Program Total: $17.7 B	Scenario 3: 63% Increase in Budget (24 cent increase in Fuel Tax)				
	2017	2021	2026	2031	2036
Maintenance*	250	260	274	287	302
Pavement	154	154	154	154	154
Bridge	220	220	220	220	220
Enhance	116	105	92	78	63
Seismic	70	70	70	70	70
Other**	77	77	77	77	77
Total	887	887	887	887	887

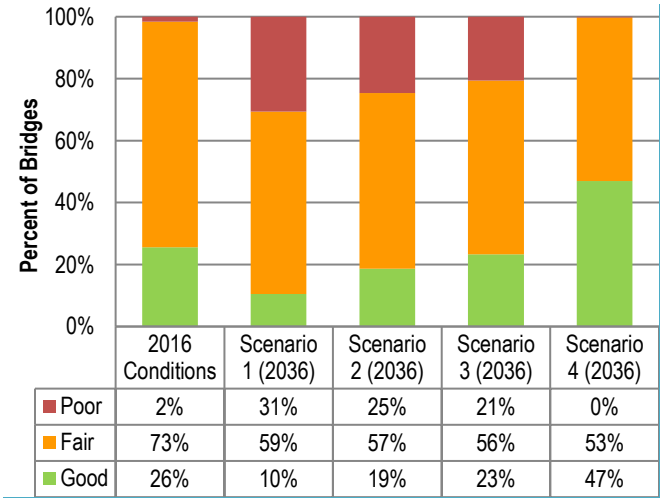
*Maintenance cost rises 1% a year, taken from Enhance
**Other category of expenditures includes Safety and Operations, Local Government and Special Operations

20 Year Program Total: $25.5 B	Scenario 4: 134% Increase in Budget (52 cent increase in Fuel Tax)				
	2017	2021	2026	2031	2036
Maintenance	300	300	300	300	300
Pavement	200	200	200	200	200
Bridge	435	435	435	435	435
Enhance	150	150	150	150	150
Seismic	90	90	90	90	90
Other*	100	100	100	100	100
Total	1275	1275	1275	1275	1275

*Other category of expenditures includes Safety and Operations, Local Government and Special Operations

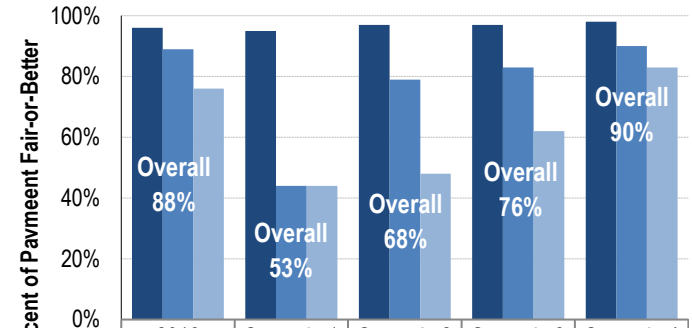
Bridge and Pavement Condition Estimates Resulting from Rough Roads Ahead 2 Scenarios

Bridge Conditions: Current & 2036 Forecast by Scenario



	2016 Conditions	Scenario 1 (2036)	Scenario 2 (2036)	Scenario 3 (2036)	Scenario 4 (2036)
Poor	2%	31%	25%	21%	0%
Fair	73%	59%	57%	56%	53%
Good	26%	10%	19%	23%	47%

Pavement Conditions: Current & 2036 Forecast by Scenario



	2016 Conditions	Scenario 1 (2036)	Scenario 2 (2036)	Scenario 3 (2036)	Scenario 4 (2036)
Interstate	96%	95%	97%	97%	98%
Statewide	89%	44%	79%	83%	90%
Reg./Dist.	76%	44%	48%	62%	83%

Oregon Transportation Commission Investment Strategy (2017)

In October of 2016, the Oregon Transportation Commission was approached by the Oregon Legislature's Joint Committee on Transportation Preservation and Modernization and asked to identify state transportation needs and strategies to address these needs. A process and strategy was established for developing an investment framework that lays out the need for investing limited resources in identified transportation areas and explained the outcomes achieved by these investments. The process brought together experts from throughout the agency who identified and quantified investment needs and outcomes, developed an initial set of findings for commission review, and revised these findings to incorporate guidance from the OTC. The strategy looked at the short, medium, and long-term needs, strategies and outcomes.

In January 2017, the OTC formally adopted *A Strategic Investment in Transportation*. The document discusses annual investment options for 10

transportation areas. The following chart summarizes three investment strategies identified for highway pavements, bridges, seismic and maintenance needs, and provides a brief discussion of the consequences of different levels of investment.[13]

	Status Quo *Annual investment (pre-HB2017)*	**Investment Scenario 1** *Moderate additional annual increase*	**Investment Scenario II** *Additional annual increase to meet total need*
Pavements	**$85 Million** 13% of highways are in poor or worse condition today, which will rise to 35% by 2035. Deteriorating pavements will increase maintenance costs and vehicle repair costs.	**$185 million *($100M additional)*** Keep pavement condition on priority (fix-it) corridors from degrading through preservation and rehabilitation. Save millions in pavement maintenance and rehabilitation costs.	**$200 Million *($115M additional)*** Improve pavement condition to meet state performance targets for pavement in fair-or-better condition across all state highways. Save million in maintenance and rehabilitation costs.
Bridges	**$85 Million** By 2035, 65% of Oregon's state highway bridges will be in distressed condition. At today's investment levels, it will take 900 years for ODOT to replace all its bridges.	**$185 Million *($100M additional)*** Replace and address structurally deficient bridges on key freight routes. Complete Phase I of the bridge component of ODOT's Seismic Plus Plan, replacing and retrofitting bridges to be resilient to a Cascadia Subduction Zone Earthquake.	**$435 Million *($350M additional)*** Address the backlog of deferred work and the Interstate Era bridges due for replacement over the next 25 years.
Seismic	**$35 Million (one time)** One-time commitment of funding to retrofit bridges on US 97 and OR 58 as first components of ODOT's Seismic Plus plan.	**$20 Million (annual)** Address the most critical landslides on priority routes. Address key state highway bridges on local lifeline routes.	**$250 Million (annual)** Execute all phases of work identified in Seismic Plus Report, completing the backbone system of Lifeline Routes within 20 years.
Maintenance	**$200 Million** There is a backlog of maintenance needs, particularly outside priority corridors. Lack of staff coverage for major storm events to help keep routes passable.	**$250 million *($50M additional)*** Offset increasing maintenance costs. Increase winter maintenance staff, materials and equipment. Increase number of incident responders.	Continual investment as the system ages, addressing issues early to prevent more costly fixes to the system, and keep pace with rising maintenance costs.

The strategies presented in the OTC Investment Strategy reflect the OTP and OHP policy guidance of focusing targeted cost-effective investments on high priority corridors and are aimed at achieving transportation goals for the condition and performance of ODOT's pavements and bridges. The *OTC Investment Scenario II* serves as a framework for the ODOT-defined Desired State of Good Repair (SORG) in the following subsections.

Asset Management Plan Performance Gap Analysis

In order to comply with MAP-21 Asset Management requirements and to assess future conditions based on the latest funding projections that include HB2017, the following projections were developed to provide a snapshot of future gaps in Oregon's pavement and bridge conditions. For both pavement and bridge, a ten-year timeframe was established for estimating conditions based on the latest funding projections and were compared with current bridge and pavement conditions. In order to assess the impact of new funding from HB2017, projected conditions following state performance measures were also estimated with and without new state transportation revenue. Finally, a *desired state of good repair* was quantified following both state and national performance measures and using the *2017 OTC Investment Strategy's* "Investment Scenario II" as policy guidance.

[13] *Note: While multimodal investments are central to delivering a transportation system that meets the needs of all Oregonians, this OTC Investment Strategy summary lists scenario categories that are most relevant to the TAMP; highway pavements, bridges, seismic, and maintenance needs*

Pavement Performance Gap Analysis

The Pavement Condition Gap Analysis utilized 2018 pavement conditions data as a baseline for current conditions, as this is the most recent compete dataset for Oregon's State and National Highway Systems. Future condition projections include the funding benefits from HB2017, and were calculated for a 2027 horizon.

Because existing pavement condition prediction models that use ODOT's pavement rating measure are more refined, it was possible to estimate future state KPM condition ratings on the Interstate System, the State Highway System, *and* the National Highway System. The desired state of good repair is based on the *OTC Investment Strategy* "Investment Scenario II" which makes minor improvements to current pavement condition and holds a constant in the long term.

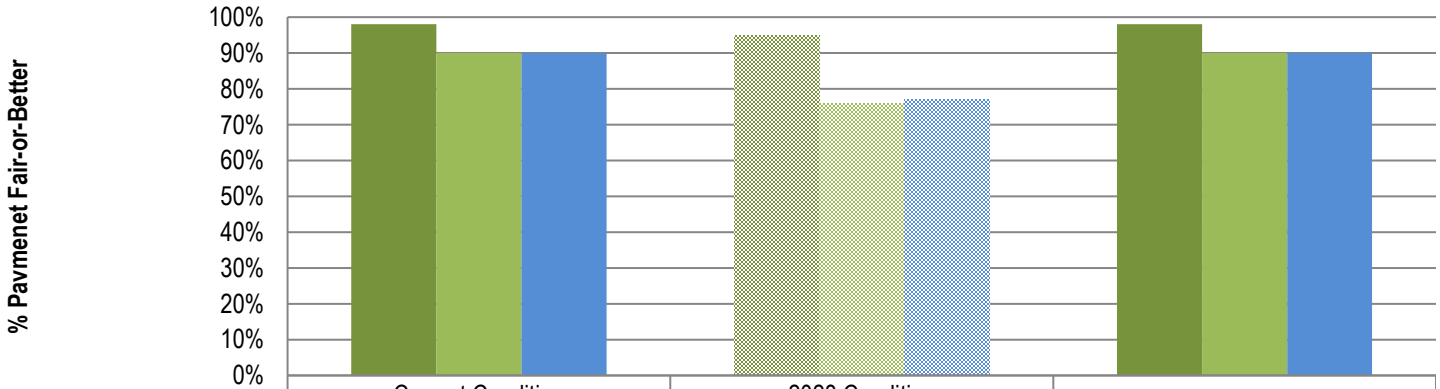
Projected annual pavement investment[14]	Annual pavement investment needed to *Maintain Current Conditions*	Annual pavement investment needed to meet *Desired State of Good Repair*[15]
State Highways: **$125M/year** NHS and Interstate only: Approx. **$115M/year**	State Highways: **$220M/year** NHS and Interstate only: Approx. **$195M/year**	State Highways: **$220M/year** NHS and Interstate only: Approx. **$195M/year**

Pavement Performance- State KPM Metric

The Pavement Condition Gap Analysis projects a moderate decline in pavement conditions on the NHS and State Highway Systems based on the state Key Performance Measure. It is worth noting that the condition of Oregon's interstate system is projected to remain at or above 95% fair-or-better using the state performance measure. This is consistent with OTP investment policy which prioritizes critical and high-volume transportation corridors under a constrained funding scenario (*See Section 9: Investment Strategies).*

While there is projected to be a moderate decline in overall NHS and SHS conditions over the next 10 years, these projected conditions are improved significantly over earlier projections before HB2017, and reflect the impacts of new infusions of transportation revenue, as well as ODOT asset management strategies aimed at optimizing investments in pavement assets.

Figure 16: Pavement Performance Scenarios using State KPM Metric



	Current Condition (2018)	2028 Condition (under current investment outlook)	Desired State of Good Repair
Interstate System	98%	95%	98%
Non-Interstate NHS	90%	76%	90%
State Highway System	90%	77%	90%

Pavement Performance- National Performance Measure Metrics

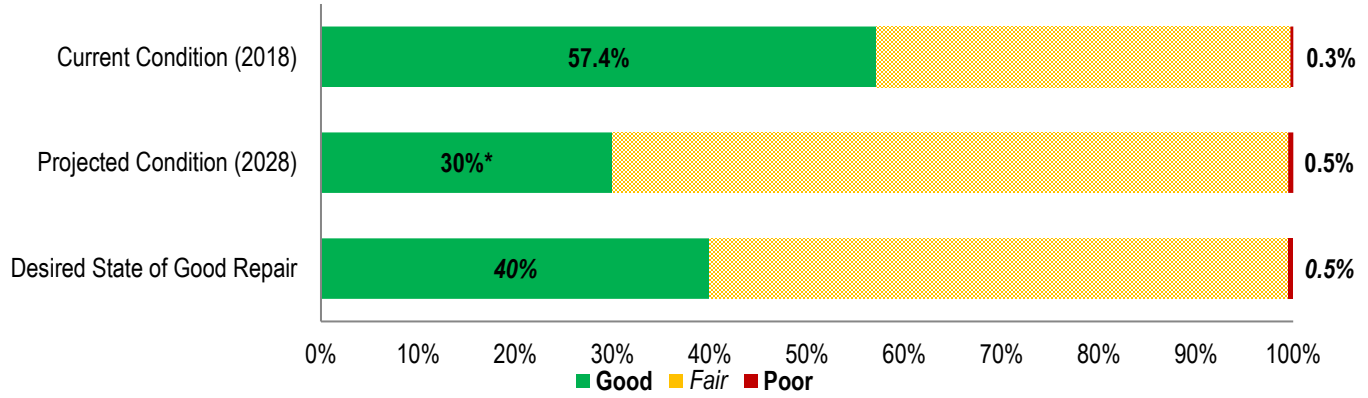
Similar projections on conditions of pavement over the next 10 years can be made using National Performance Measures as a yardstick. However, because the modeling capabilities using these new performance measures are still nascent, projected conditions are less certain than the State KPM

[14] *Based on February 2019 forecast prepared by ODOT Highway Budget Office and ODOT Director's Office. Does not include additional seismic funding*
[15] *Pavement SOGR is based on Rough Road 2 Scenario 4, and is also referred to as OTC Investment Scenario II, which identifies a need of $200M per year. The additional $20M per year in this estimate includes interstate signs ($2m), interstate major maintenance ($3m), and low volume paving and chip sealing ($15m)*

condition measures.

Similar to the projected conditions using the state KPMs, future conditions on the interstate are projected to remain nearly the same using the new national pavement metrics. However, a moderate decline in the percent of pavement rated *good* is projected over the next 10 years. The 30% (+/-5%) *good* condition projected for 2028 is consistent with the low and mid-range *good* condition between 2008 and 2018, and is less than the current 4-year target of 35%. Similarly, the percent of pavement in *poor* condition is projected to remain at the high end of the historic range at 0.5%, which is consistent with the 4-year target and comfortably below the maximum federal standard of 5% *poor*:

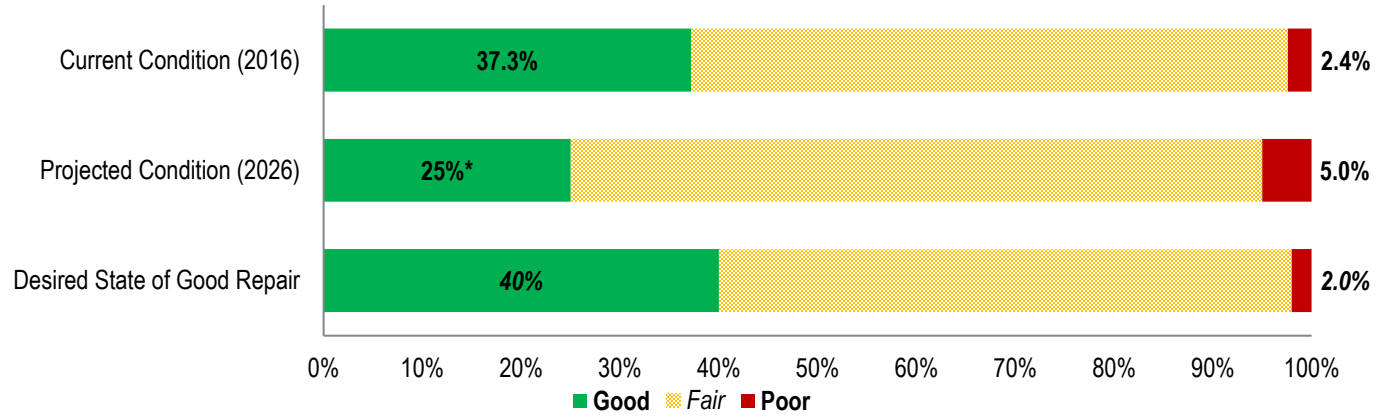
Figure 17: Interstate Pavement Performance Scenarios using National Metric



** Projected Good condition is estimated to have a +/-5% margin of error*

Using the National Performance Measure methodology, Oregon's Non-Interstate NHS pavements are projected to see declines of overall condition. Oregon current Non-Interstate NHS pavements are relatively close to a desired state of good repair but won't be able to maintain this condition without additional pavement funding. The percent of pavement rated *good* is projected to decline over the next 10 years to 25% (+/-5%) by 2028, which is at the low end of the range of *good* condition between 2008 and 2018. Further, the % of pavement classified as *poor* is projected to increase to 5%, an amount above the range of 1.5%-2.5% that the system experienced between 2008 and 2018:[16]

Figure 18: Non-interstate NHS Pavement Performance Scenarios using National Metric



**Projected Good condition is estimated to have a +/-5% margin of error*

[16] Results are not directly comparable to the current 4-year targets in this first performance period because the current targets are based on the IRI metric only, pursuant to 23 CFR 490.313(e). Target setting with the additional cracking, rutting and faulting pavement metrics will begin with the second performance period starting in 2022

Bridge Performance Gap Analysis

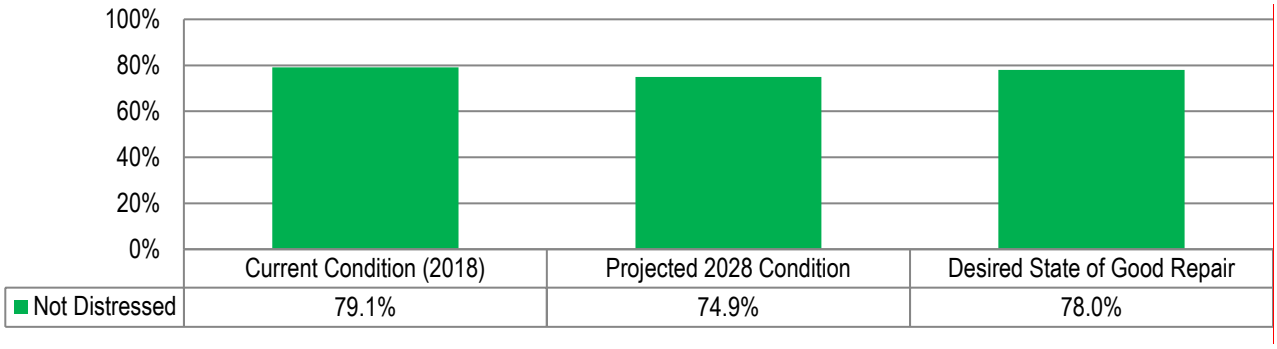
The Bridge Condition Gap Analysis relied on 2018 bridge condition data to determine current bridge conditions using both state and national performance measures. A desired state of good repair was determined based on policy guidance from the *OTC Investment Strategy* "Investment Scenario II". An analysis was then performed to project bridge conditions in ten years (2028) under three funding situations:

Projected annual bridge investment[17] *(includes funding for seismic work)*	Annual bridge investment needed to ***Maintain Current Conditions***	Annual bridge investment to meet ***Desired State of Good Repair*** *(based on OTC Investment Strategy)*
State Highways: **$128M/year** *ODOT NHS Only: Approx.* ***$115M/year***	State Highways: **258M/year** *ODOT NHS Only: Approx.* ***$219M/year***	State Highways: **$435M/year** *ODOT NHS Only: Approx.* ***$339M/year***

Bridge Performance- State KPM Metric

An analysis was performed to project the bridge condition KPM over the next 10 years with varying funding. As noted below, the HB2017 funding is expected to slow the decline of the *% Not Distressed* bridges; however, this decline will continue under the latest funding projections. The decline in KPM is primarily due to the aging bridge system and a long history of underfunding in the Bridge Program that precluded systematic replacement of deteriorated bridges, which is captured in the KPM as *Low Service Life Bridges,* as well as bridges projected to become structurally deficient.

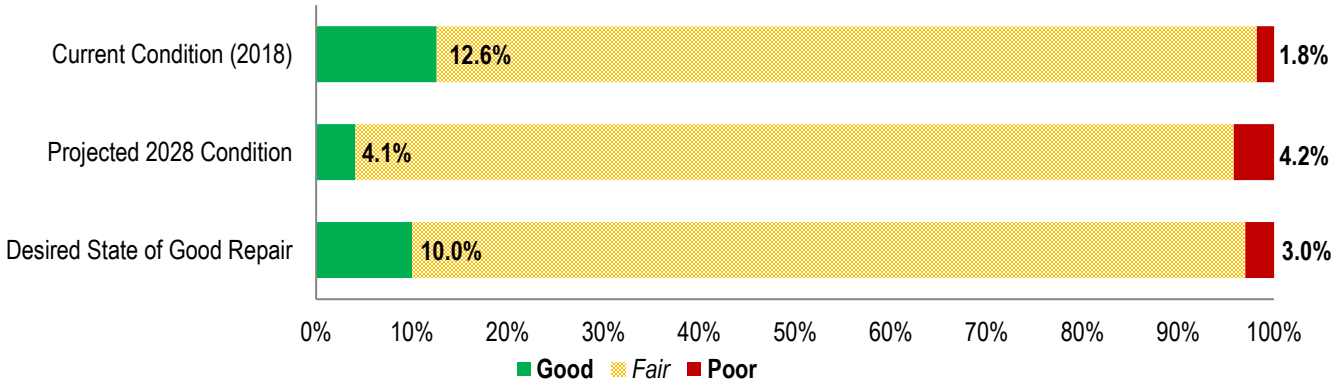
Figure 19: SHS Bridge Performance Scenarios using State KPM Metric



Bridge Performance- National Performance Measure Metrics

As shown in the graph below, NHS bridge condition projections indicate the percentage of bridges in good condition will continue to decline even with the new HB2017 funding. By 2021 the percentage is predicted to dip below the Desired State of Good Repair, which has been established to be 10%. Given the age of Oregon's NHS bridges, the decline is inevitable as bridge replacement is taking place at a much slower rate than the decline in conditions. Bridge preservation or rehabilitation actions generally cannot raise a bridge rating from a fair condition to a good condition. Bridge replacement, by contrast, is the primary action that results in a good rating. In addition there is a recent trend showing that new bridge decks are slipping from good to fair much earlier than normal, which reflects a construction quality issue in concrete mixtures and placement.

Figure 20: NHS Bridge Performance Scenarios using National Metric



[17] *Based on February 2019 forecast prepared by ODOT Highway Budget Office and ODOT Director's Office*

Based on the anticipated 2021-2024 STIP funding, the current Bridge Program allocation is $125 million with $10 million directed to seismic work. Future Bridge Program allocations are expected to be at about the same level. With the new funding, the amount to address bridge conditions is $115 million after subtracting the $10 million for seismic work. This amount represents a $30 million net increase over past allocations of $85 million. The increased amount will allow the bridge program to address more fair bridges at risk of becoming poor and to address poor bridges with localized repairs. The slight difference in the 10-year projection of %NHS bridges in good condition reflects the relatively small funding increase and the policy direction for the bridge program to continue emphasis on maintaining bridges at risk of reaching poor conditions over more expensive bridge replacements.

One impact of HB2017 funding for seismic resiliency is that Oregon may see more bridge replacements after 2024 to address seismic resiliency which will result in a slightly slower decline in the later years of the 10-year projection of %NHS bridges in good condition. The Phase 1 bridges outlined in the Seismic Plus Investment Strategy are all on NHS routes so the overall bridge network will benefit in terms of overall condition from the seismic work. The risk, however, is that the initial replacements may be more expensive than currently projected given the staging costs, so progress replacing these seismically-vulnerable bridges may be slower than anticipated.

Projections for the percent of bridges by deck area becoming poor shows a steady increase in the next 10 years. However, as the chart indicates, HB2017 funding is projected to slow this increase. By 2020-2021, the percentage is predicted to rise above the Desired State of Good Repair, which has been established at 3%. The increase in poor bridge conditions is expected to be managed with the use of Major Bridge Maintenance (MBM) funding which addresses the immediate repairs needed to keep an at-risk bridge from being classified as poor, as well as the prioritization of bridge work on priority fix-it corridors *(See Section 9: Investment Strategies)*. However, this strategy of relying on MBM continually increases the number of bridges with repairs that have a higher risk of additional deterioration and the need for future emergency actions to preserve public safety. As the number of bridges with less than optimal repairs and less predictable condition grows, overall risks to public safety may increase.

Section 5

ODOT ASSET MANAGEMENT PRACTICES

- Asset management governance and policy guidance
- Asset management Vision, Mission and History
- 2016 Asset Management Gap Analysis
- Asset Management Work Plan (2018)
- ODOT's Bridge Management Practices
- ODOT's Pavement Management Practices

ODOT Agency Mission

The mission of the Oregon Department of Transportation is to "provide a safe and reliable multimodal transportation system that connects people and helps Oregon's communities and economy thrive." The agency's central goals are to improve safety, move people and goods efficiently, preserve and maintain existing transportation infrastructure, and improve Oregon's livability and economic prosperity. Proactive management of Oregon's transportation asset conditions is central to achieving these outcomes.

The major challenge that the agency faces is in accomplishing this mission under a constrained revenue forecast. As revenue available for transportation continues be outpaced by system demand and the costs of an aging system, ODOT must identify how to use its resources to accomplish its multiple goals in the most efficient and effective ways possible.

Agency Governance

ODOT's asset management policies, along with all state transportation policies, are governed by the Oregon Transportation Commission, a five member, governor-appointed, volunteer citizen board. This commission guides the planning, development, and management of a statewide integrated transportation network that provides efficient access, is safe, and enhances Oregon's economy and livability.

Oregon Transportation Plan Guidance on Asset Management

Like many other states, Oregon faces a number of challenges in its ability to build and maintain a transportation system that meets its economic and community needs. These challenges include aging infrastructure, a growing population, increased congestion, state and federal revenue that has remained stagnant while faced with inflation, increased material and labor costs, and growing system demand.

In September 2006, the Oregon Transportation Commission adopted the Oregon Transportation Plan, or OTP, which identified six key initiatives for current and future improvements to the transportation system:

1. Maintain the existing transportation system to maximize the value of the assets. If funds are not available to maintain the system, develop a triage method for investing available funds
2. Optimize system capacity and safety through information technology and other methods
3. Integrate transportation, land use, economic development and the environment
4. Integrate the transportation system across jurisdictions, ownerships, and modes
5. Create a sustainable funding plan for Oregon
6. Invest strategically in capacity enhancements

As part of the overall plan, the OTP identified three investment scenarios that provide a framework for decision-making based on the amount of funding available for the transportation system. Under a scenario where available revenue remains flat and is insufficient to meet system needs, the plan identifies a policy for "Triage in the Event of Insufficient Revenue". It specifies that under this constrained funding scenario, investment should "support Oregonians' most critical transportation needs, broadly considering return on investment and asset management." Efforts should be focused on preservation and operational improvements to maximize system capacity and safety at the least cost possible.

2018 Oregon Transportation Plan Amendment on Performance Based Planning

In 2018, the Oregon Transportation Commission adopted an amendment to the Oregon Transportation Plan pertaining to performance-based planning and asset management. The purpose of this amendment is to demonstrate that the Oregon Transportation Plan contains a continuing, cooperative, and comprehensive performance-based statewide transportation planning process that is in compliance with the Moving Ahead for Progress in the 21st Century Act and the Fixing America's Surface Transportation Act. The amendment describes how ODOT's statewide transportation planning process considers performance based planning, how ODOT statewide policy plans are in compliance with FHWA's National Goals and Planning Factors, and how ODOT's statewide transportation planning process coordinates and cooperates with local jurisdictions and other stakeholders.

https://www.oregon.gov/ODOT/Planning/Pages/Plans.aspx

Oregon Transportation Plan Future Updates

The Oregon Department of Transportation has begun the process of updating the Oregon Transportation Plan, as well as the Oregon Highway Plan. Development of these plans is typically and two or three year process. Future versions of the Oregon Transportation Plan, along with modal plans such as the Oregon Highway Plan, will continue to emphasize asset management as a means to maximize the performance and condition of the transportation system with limited revenue.

ODOT Asset Management Vision and Purpose

The primary focus of ODOT's asset management efforts is the safety and preservation of the state's existing transportation infrastructure. ODOT's objective is to manage the transportation system as effectively as possible within an environment of growing system needs and constrained financial resources. ODOT's asset management vision and purpose is summarized in the 2011 *Integrated* Asset Management Strategic Plan:

> *ODOT makes decisions and allocates funds for stewardship of transportation infrastructure strategically, maximizing the life cycle of each component to make the best use of constrained resources. These decisions are supported by reliable data that is collected once for use by many.*

Asset management has typically been integrated with the agency's planning process, and data on asset conditions is used to make strategic funding decisions supporting maintenance, preservation, and modernization of critical assets.

History of ODOT Asset Management efforts

The preparation of a Risk-based Asset Management Plan represents the latest step in an ongoing effort by ODOT to incorporate the principles of transportation asset management into the agency's business processes and culture. The origin of ODOT's Asset Management efforts can be traced to agency policies that began in the late 1980s as part of the state's *Oregon Shines* effort. Among other things, the *Oregon Shines* effort sought to set transportation system management targets and measure performance of highway infrastructure assets. In 1992, ODOT began the process of developing management systems in accordance with provisions of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) pertaining to pavement, bridges, safety, congestion, public transportation and intermodal facilities. While federal requirements to establish management systems were rescinded in 1995, ODOT continued to develop management and performance systems for these assets.

In the 2000s, ODOT formalized an asset management approach for identifying and addressing project risks. The agency also developed a software package and a six-part documentation of the approach to identify and address risks to infrastructure projects undertaken by the agency. In 2005, ODOT conducted an organizational assessment of its performance management activities and accomplishments. A key finding of this assessment was the need to devote further and more intensive consideration to the performance and management of ODOT's transportation assets. In response to this assessment, the agency formed an asset management steering committee to guide the development and implementation of asset management as a business practice. In 2006, the agency prepared an asset management Strategic Plan, which included both an asset management Implementation Plan and an asset management Communications Plan.

In 2007, the Asset Management Integration (AMI) Section was formed in ODOT to support the development and use of asset management principles within the agency. In the same year, an Asset Management Pilot Report was prepared, aimed at determining agency knowledge and information on priority and non-priority assets and the level of effort required to gather existing or new information. Additionally, this report sought to identify best methods for initial condition assessments, resolve issues around integrating collected data, determine the best reporting methods to inform decisions, and make recommendations for broader implementation of these methods. The pilot project findings demonstrated that the agency's existing capacity for asset management was rather limited and basic asset data was generally lacking and unreliable. In areas where reliable asset data was more available and more frequently used, the assets considered have enjoyed a better level of condition. In response to pilot project findings, ODOT devoted increased attention and resources to the collection and prioritization of asset data.

Asset Management Strategic Plan

In 2011, ODOT combined the three separate documents (Strategic Plan, Implementation Plan, and Communication Plan) into one *Integrated* Asset Management Strategic Plan that superseded these three previously approved in 2006. This document serves as a blueprint to guide systematic AM efforts at ODOT. This plan set a vision and goals for asset management at ODOT and outlined objectives and actions for each of the goals, providing a step-by-step blueprint for how to achieve them. The Asset Management Strategic Plan established a three-fold purpose:

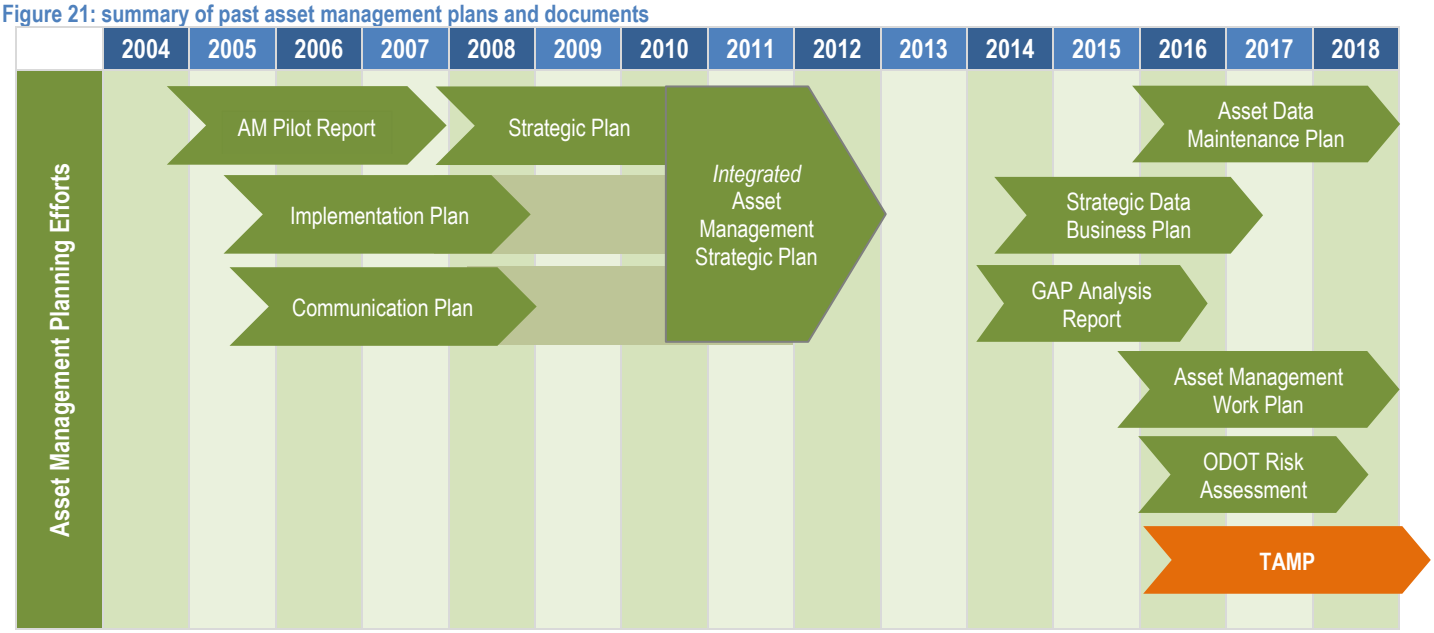
- To chart a course toward realization of Asset Management as a way of doing business;
- To provide a central, authoritative source of information about ODOT's Asset Management policies and goals; and
- To communicate these policies and goals clearly so that everyone at ODOT is able to work together with a common purpose.

To fulfill the established purpose, ODOT's Asset Management efforts are focused on four distinct goals:

1. **Integrated Decision-Making** – incorporation of asset management principles and strategies into the day-to-day decisions and activities.
2. **Inventory** – establishment and maintenance of a reliable statewide inventory of asset data.
3. **Integrated Data Systems** – establishment and maintenance of asset data that can easily be accessed by interested parties.
4. **Integrated Reporting and Analysis Tools** – development and use of reporting and analysis tools that transform asset data into useful information from which lessons can be learned and decisions made.

The integration of Asset Management into the agency's everyday operations and decisions continues to be a work in progress. To date, a number of accomplishments are notable: both the availability and reliability of asset data on a statewide basis continue to improve and increase. For example, the FACS-STIP Tool (Features, Attributes, and Conditions Survey – Statewide Transportation Improvement Program) continues to increase the quantity and reliability of asset inventory information, and helps inform decision-making around investments in the maintenance, preservation, and enhancement of roadway assets including bridge and pavement.

Figure 21: summary of past asset management plans and documents



2016 Asset Management Gap Analysis Report

In May 2016, the agency completed the Asset Management Gap Analysis Report, which assesses progress in integrating asset management principles, and identifies steps needed to more fully integrate asset management practices into the agency's overall efforts.

The 2016 Gap Analysis Report organized major highway assets owned by ODOT into Priority Tiers (1-4) based on a ranking that considered asset value, criticality for highway core, operations, accessibility and mobility, safety, risk and consequence, and criticality of stewardship. Because the active management, or capacity, needed for each asset usually requires a corresponding investment in data, systems, and tools, the report identified capacity needed for each asset type following a capacity/maturity model.

For each of ODOT's Tier-1 assets, either a mature lifecycle management or advanced statewide program was identified as the level of capacity (or maturity) needed:

Figure 22: Capacity/Maturity Level Needed for Tier 1 Assets

Tier 1 Asset	Capacity Needed	*Decision Characterization*	*Data Characterization*
Bridges	***Mature Lifecycle Management***	*Lifecycle cost; proactive program management advanced modelling; advanced forecasting; advanced engineering; project level decisions*	*Highly reliably engineering data, with best data quality, with defined and frequent updates by trained technical staff; precise location data*
Pavement			
Tunnels			
Culverts	***Advanced Statewide Program***	*Proactive program management; basic forecasting; basic engineering; project level decisions; may include lifecycle cost*	*Reliable engineering data with defined updates by trained staff; reliable location data, better data quality, data maintenance*
Traffic Signals			
ADA Ramps			

Asset Management Work Plan

As the maturity of ODOT's asset management systems continues to develop, and new assets are brought into the fold, the agency has developed an Asset Management Work Plan to prioritize and manage strategic investments in data collection and analysis. This work plan represents a collaborative effort, guided by a stakeholder group with representation from a wide range of ODOT business line representatives and regions, as well as from executive leadership. It is a document that provides the framework for 1) improving the method and criteria for decision-making and prioritizing potential asset management initiatives; and 2) the actions to be taken, including resources, responsibilities, milestones, risks, key dependencies, timeframes, cost, funding sources and evaluation methods. It represents a commitment by the Asset Management Executive Committee to dedicate resources and create a culture for improved asset management at all levels of the organization.

Ten-Year Data Maintenance Plan

The agency has also developed a 10-year asset data maintenance plan to capture data maintenance costs for assets. This plan ensures that each asset is receiving the correct level of funding to maintain asset location and condition information across the system.

ODOT's Bridge Management Practices

Bridge Data Collection

The monitoring of bridge conditions and associated bridge inspection activity on Oregon's public roads falls under the responsibility of the ODOT Bridge Section. Guidance for bridge inspections and monitoring is provided in the following documents:

- *Bridge Inspection Coding Guide*
- *Bridge Inspection Program Manual*
- *Bridge Inspector's Reference Manual*

Inspections of bridges are conducted at regular intervals, with each bridge on the state and local systems typically being inspected every two years. Inspection data is collected by certified bridge inspectors employed by ODOT, as well as by consultants. This data is stored in the AASHTOWare Bridge Management software (BrM). A compilation of this data is reported annually to the Federal Highway Administration.

ODOT follows the National Bridge Inspection Standards (NBIS), for inspection procedures, frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of a State Bridge Inventory. The NBIS apply to all structures defined as bridges located on all public roads.

Bridge Condition Forecasting

Currently, ODOT's future conditions projections are put together using deterioration models developed internally based on past trends in bridge condition ratings. For many of the NHS bridges stored in BrM, ODOT is fortunate to have over 20 years' worth of condition data that aids in condition forecasting and bridge management.

Bridge Program Funding Optimization

Based on this condition modeling, ODOT is able to predict the condition of bridges as represented in State (KPM) and National (PM2) performance measures based on various funding levels. This condition modeling considers various levels of funding, helps identify short-term and long-term budget needs, and informs the budget setting process.

The Bridge Program follows ODOT Highway Management Team established criteria for identifying priority bridges and optimizing bridge program funds. The strategies are listed below:

- *Ensure the protection of high value coastal, historic and major river crossings and border structures.*

- *Use Practical Design and fund only basic bridge rehabilitations and rare replacements.*
- *Focus bridge program funding on bridge work only.*
- *Give priority to maintaining Fix-It corridor bridges which incorporate the highest priority freight corridors.*
- *Continue to maximize bridge preventative maintenance (PM) treatments to extend the service life of the deck and other structural components using Major Bridge Maintenance (MBM) funding.*
- *Leverage other programs where possible to do additional bridge preservation on the system, e.g. pavements program.*
- *Continue use of bridge inspection, health monitoring and improved deterioration prediction methods to anticipate future bridge conditions.*
- *Ready additional bridge shelf projects in anticipation of program savings and/or new funding opportunities.*

Bridge Management Improvement Efforts

Future analyses aimed at condition forecasting and funding optimization will be done using the updated version of BrM (5.2.3) which was implemented at ODOT in 2018. This new software includes enhanced deterioration modeling and project/program analyses to assist in program optimization, which includes lifecycle planning and short and long-term budget needs for alternative programs. ODOT is developing processes and documentation around bridge planning as the new software is implemented.

ODOT's Pavement Management Practices

The AASHTO Pavement Management Guide defines pavement management as "…a set of tools or methods that assist decision makers in finding optimum strategies for providing, evaluating, and maintaining pavements in serviceable condition over a period of time." According to the Guide, pavement management also provides a systematic approach that enables agencies to perform the following functions:

- Assess both current and future pavement conditions
- Estimate funding needs to achieve targeted condition levels
- Identify pavement preservation and rehabilitation recommendations that optimize the use of adequate funding
- Illustrate the consequences of different investment levels and treatment strategies on both short-and long-term pavement conditions
- Justify and secure increased funding for pavement maintenance and rehabilitation
- Evaluate the long-term impacts of changes in material properties, construction practices, or design procedures, or some combination thereof, on pavement performance

One of the key elements to the success of ODOT's overall pavement strategy is the integration of Pavement Management, Pavement Design, and Pavement Materials and Construction disciplines. All of these activities are housed in the headquarters' Pavement Services Unit and the regular interactions and close working relationships of each team has led to a unified whole-life and long-term vision for identifying and selecting appropriate pavement projects, treatments and material specifications. Additionally, the Pavement Services team has fostered a strong partnership with Statewide and District Maintenance leadership through reliable high quality pavement management data and analysis. These relationships have led to an integrated approach from both the Capital and Maintenance programs to managing system conditions.

Pavement Data Collection and Storage

Corporate road inventory for Oregon's state and local NHS, including National Performance Measures-related Highway Performance Monitoring System (HPMS) data fields such as Linear Reference System identification, jurisdiction, functional classification, mileage, number of lanes, and structure type are stored in ODOT's Transinfo database. These data elements are collected and updated regularly by ODOT Transportation Development Division staff in accordance with standard operating procedures for Oregon's entire NHS including the local system. Pavement specific data such as surface type and condition data is maintained in ODOT's Pavement Management Database. All Interstate and National Highway System pavement asset data (including locally-owned NHS pavement) is collected by a single data collection vendor, under contract with ODOT, to ensure that data obtained is consistent, accurate, and reliable. This data collection contract requires the vendor to collect data in accordance with the ODOT Pavement Data Collection Manual, the HPMS Field Manual, and applicable AASHTO standards. It is also subjected to quality control / quality assurance procedures in accordance with ODOT's Pavement Data Quality Management Plan. A final copy of all 0.10 mile pavement data is archived and stored in the Pavement Management database and is used to create the HPMS pavement dataset which is processed and formatted in accordance with HPMS requirements.

Pavement Condition Measures

Oregon has been collecting pavement distress and roughness data on state jurisdiction Interstate and NHS highways for over 20 years. ODOT's Pavement Management System (PMS) uses a 0 to 100 scale Overall Condition Index based on quantity and severity of distress to categorize and report pavement condition and to manage the system. More information is available in ODOT's Pavement Condition Report. The Oregon State Legislature has identified more than two dozen transportation-related Key Performance Measures (KPMs) of which are monitored by ODOT and approved by the legislature as part of the budgeting process. The metric used for pavement is the percent of state highway miles with "fair" or better condition out of total highway miles. For the last decade, the KPM for pavement has been in the 85% to 88% range and the current legislative target

is 85%. More information about the pavement KPM for state highways is available on the Performance Management Webpage. With the passage of Keep Oregon Moving (HB2017) in 2017, the Oregon Legislature requires local agencies to report pavement conditions for paved federal-aid system roads within their respective jurisdictional responsibilities using a set of uniform condition descriptions (good, fair, and poor) which are consistent with ODOT's pavement condition categories.

There are considerable differences between the Oregon's State Pavement KPM and the National pavement measures in terms of the universe of highways sampled and the pavement condition methodologies employed that make it impossible to directly compare results from the state and national measures. Despite these differences, pavement management strategies based on Oregon's pavement condition definitions and state performance measures will also have the direct impact of managing pavement conditions according to National performance measures.

The differences in the network of highways between the state and national measures are described in Section 3 State and National Performance Measures. For the State Pavement KPM, the total reported miles used in the percent "fair" or better calculation includes the add direction mileage for all mainline state highways and also the non-add direction for interstates. Non-add mileage off the interstate, connection and frontage mileage, and gravel surfaced roads are excluded in the calculation. Slightly more than one-half of state highway mileage is designated NHS. While most of the NHS is owned and maintained by ODOT, approximately six percent of the NHS belongs to local agencies and are not state highways. While the State and National pavement condition measures are able to utilize the same data collection field survey, there are distinct differences in the condition parameters used, the thresholds defining good-fair-poor, and the data aggregation methods. Due to differing data needs and processing/reporting requirements between the two measures, separate databases are created from the same raw survey data for each purpose. The National methodology only uses only IRI (a measure of roughness), cracking, rutting and faulting to determine pavement condition while ODOT's Overall Condition Index used for the State KPM is more comprehensive and also incorporates other important distresses such as potholes, patching, weathering and raveling. In addition, the Overall Condition Index incorporates both cracking quantity and severity as opposed to just cracking quantity used in the National measure. The cracking and rutting thresholds for defining good, fair and poor pavement and the way the distresses are combined together differ. These differences are illustrated in *Table 8* and the pictures below.

State – Rut Patches (fair) National – No rut or crack (good)

State – Potholes (poor) National – No rut or crack (good)

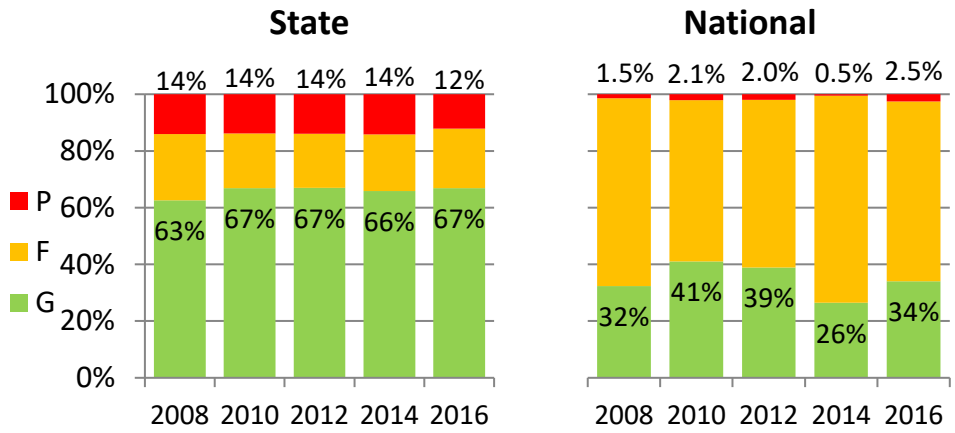
Under the National methodology, a deeply rutted pavement that is otherwise smooth and crack free would be categorized as "fair" but the State KPM methodology categorizes the same pavement as "poor" due to the negative safety impact of rutted pavement.

	AC		JCP		CRCP	
	State	National	State	National	State	National
IRI (in/mi)	Not Used	✓	Not Used	✓	Not Used	✓
Rutting (in)	Poor ≥ 0.75"	Poor > 0.4"	✓	Not Used	✓	Not Used
Cracking • Type • *Percent* • *Severity*	Wheel + Non-Wheel *Poor > 50% (low)*[18] *Severity matters*	Wheel path only *Poor > 20%* *All severities equal*	Longitude Crack & Transverse Cracks *Poor > 50% (Tcrk)*[18] *Severity matters*	Transverse Crack Only *Poor > 15%* *All sev. equal*	Longitudinal *Poor > 15%* *(low)* [18] *Severity matters*	Longitudinal *Poor > 10%* *All sev. equal*
Faulting (in)	-----	-----	Not Used	✓	-----	-----
Patching	✓	Not Used	✓	Not Used	✓	✓3
Failures • Potholes • Broken Slab • Punchouts	✓	Not Used	✓	Only if there is TCrk > ½ lane	✓	✓3
Raveling & Bleeding	✓	Not Used	-----	-----	-----	-----

Table 8: Summary of distresses used and thresholds between the State Pavement KPM and the National Pavement Measure

[18] Thresholds vary by cracking type and severity

A "by the numbers" comparison of past pavement conditions below shows that there is no direct conversion between Oregon's State KPM Measure and the new National Pavement Performance measure. The magnitude of the good and poor ranges is considerably different. Also, while the State KPM is fairly consistent year to year, the National %Good and %Poor measures vary up and down and are out of phase with the State KPM, indicating that a conversion factor for one year won't be accurate for other years. Each performance measure is unique and although each system can capture similar relative trend versus time, the actual magnitude of the numbers between the two methodologies are not directly comparable.



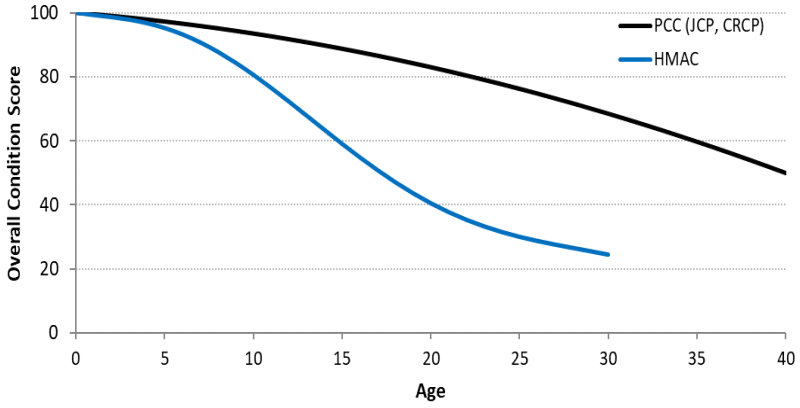
Oregon's pavement condition definitions and State KPM has a long track record of success, are more comprehensive than the National measures, and are better tools for managing pavement assets. Therefore they will continue to play the primary role for pavement performance monitoring and reporting. The National measures will be separately reported and will play a secondary role in the tracking and monitoring of the State's highway pavement system.

Pavement Forecasting

Deterioration models using ODOT's Pavement Condition methodology are considered most appropriate for network pavement management activities and are the primary means for analyzing and managing highway pavement conditions on the state highway system including the NHS. Forecast pavement conditions for each pavement management section are used to determine pavement needs, evaluate funding scenarios, trigger pavement preservation and rehabilitation projects, and determine regional funding allocations. The forecasting takes committed (e.g. programmed) projects that have an impact on pavement conditions into account when evaluating future needs.

Pavement deterioration models use a family curve approach as described in Section 5.4 to 5.6 of the AASHTO Pavement Management Guide. The family curves are condition versus age models which vary by pavement type (e.g. asphalt, concrete), most recent wearing course, pavement thickness, and traffic volume. Illustrative examples of family curves for concrete (PCC) and hot mix asphalt pavement (HMAC) are shown in *Figure 23.*

Figure 23: Examples of family cures for concrete and hot mix asphalt



The family curve is shifted to fit observed conditions to estimate the remaining number of years in fair or better condition for each pavement management section. Age based models and rutting models are also applied to the pavement management sections and the results are compared and the model with the lowest remaining number of years in fair or better condition is used for forecasting condition. These age-based models are based on the pavement design life or the best estimate of treatment life and primarily govern in the early years after a treatment is applied before there is adequate condition data to determine a reliable deterioration rate. After a few years of deterioration are reflected in conditions, the shifted family curve model is used. On routes which routinely see high wear and winter damage resulting from chain and studded tire wear, the rutting models typically govern.

Concrete pavement

Concrete pavements (JCP and CRCP) have a slow rate of deterioration and actual condition data shows that a typical Oregon state highway concrete pavement will last 40 to 50 years, and often more, before reaching a condition of "poor". Some of Oregon's earliest interstate CRCP sections constructed in the late 1960s are still in service today. Of the over 600 miles of CRCP pavement built in Oregon,

roughly 60% is still in service, 21% has been overlaid due to rut wear reasons, 16% has been overlaid due to structural reasons, and only 3% reached a condition requiring reconstruction.

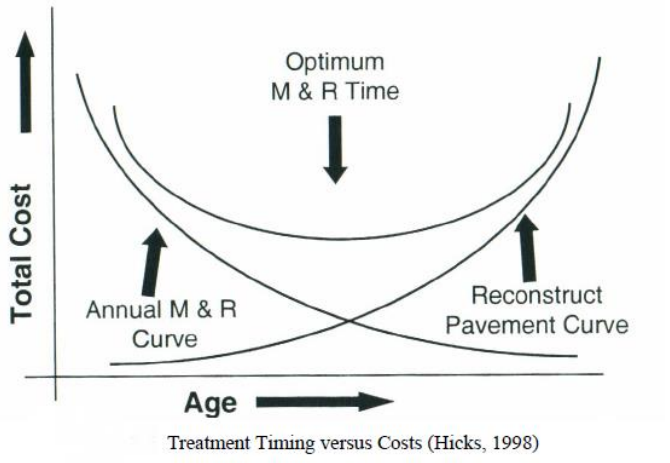
Asphalt pavement

Asphalt surfaced pavement includes a wide variety of structural pavement categories and wearing course material types. Most asphalt surfaced pavement constructed in the last 30 years has been resurfacing overlays of older bituminous pavement. Of the over 4,500 miles of asphalt surfaced interstate and NHS pavement, approximately 83% are a resurfacing of older bituminous pavement, 9% are original non-resurfaced asphalt pavement, and the remaining 8% are a composite of asphalt resurfacing over older concrete pavement. Asphalt surfaced pavement has a faster rate of deterioration than concrete pavement and also has a much wider variation in service life before reaching a condition of "poor" depending on traffic, environment, and materials used. Condition data from PMS shows that although many asphalt surfaced pavement will typically average 15 to 20 years before reaching "poor" condition, some routes with relatively high levels of studded tire and chain wear may last as little as 8 years while some lower traffic routes east of the Cascades will last 30 to 40 years or longer when good preventive maintenance practices are followed by doing crack seal and chip seal treatments before excessive deterioration sets in.

Pavement Life Cycle Strategy

The goal of the ODOT pavement preservation program is to keep highways in the best condition possible with available funding, by taking a lifecycle cost approach to preservation and maintenance. The most cost-effective strategy is applying preservation treatments to keep highways out of "poor" condition, which extends pavement life at a reduced resurfacing cost. Deferring preservation can increase whole life cycle costs well beyond what it would have cost to maintain pavement in a "fair" or "good" condition. The curve in *Figure 25* illustrates the typical cost-effectiveness relationship with respect to timing of treatment applications.[19] Reconstruction and maintenance costs rise as a pavement ages. However, if maintenance and/ or rehabilitation (M&R) is carried out too early the costs are prohibitively high. There is an optimum time at which maintenance can be performed to provide the maximum cost-effectiveness.

Figure 24: Treatment Timing versus Costs *(Hicks, 1998)*



Treatment Timing versus Costs (Hicks, 1998)

A variety of treatment options are available in the 'toolbox' to maintain pavements on the NHS highway system. The treatments range from maintenance activities such as crack sealing and minor patching to full reconstruction. These treatments are discussed in greater detail in *Section 6: Lifecycle Cost Analysis.* Pavement condition, traffic level, cost, service life, risk, and other factors are all considered to determine the most appropriate treatment on a given highway section.

Most of the pavement investments on Oregon's highway system fall into the preventive maintenance, preservation and rehabilitation work type categories. Although some reconstruction projects are programmed to repair failed pavement, they are not common and are generally confined to the interstate or other routes where a rehabilitation option is not technically feasible, usually due to grade constraints, or where alignment or capacity changes allow for correcting pavement structure deficiencies.

The Pavement Management System tracks pavement conditions as well as treatment history on state highways to evaluate the effect of these treatments on condition and service life. Cost data from pavement preservation and maintenance projects are also gathered so that service life and cost comparisons can be made between different treatment options. Pavement project and work type selection includes a cost-effectiveness component in the selection criteria in the form of dollars per lane mile-year ($/LM-year). This parameter is utilized as a benefit-cost measure and is proportional to a more traditional benefit-cost calculation using area under the performance curve; the lower the $/LM-year parameter, the higher the benefit-cost. Project selection also considers route classification, traffic level, and speed. Each of these factors impacts the benefit side of the equation when pavement projects are selected. Projects on higher classification routes and where traffic volumes and speeds are relatively higher impact more users and provide more benefit than less critical locations. These factors are considered in preservation program funding allocations and also project selection through the use of weighting factors.

Alternative treatment strategies can be compared using life cycle cost analysis (LCCA). Chapter 7 of the ODOT Pavement Design Guide provides LCCA guidance. The example below compares a preservation approach versus a no action scenario using actual pavement management data for treatment strategies, timing and cost. Both alternatives provide similar levels of service (e.g. remain in "fair" or better condition) throughout the analysis period so that both alternatives have similar benefits. A section of OR140 east of Medford from milepost 8.2 to milepost 16.0 with pavement

[19] *Hicks, R.G., Jackson D., "Benefits of Pavement Maintenance- an Update", Western Pavement Maintenance Forum, Sacramento, California, 1998.*

about mid-way through its service life was evaluated for programming a chip seal project in 2015. This particular segment was previously paved in 2006 with a rehabilitation project consisting of a 2" inlay followed by a 2" overlay. The 2014 pavement conditions, after 8 years in service, showed that the pavement entered the "fair" condition category due primarily to wheeltrack cracking, but was still smooth with minimal rutting.

As part of the decision process, the traditional "take no action" approach was compared to the "preservation" approach using a chip seal to extend the time before next resurfacing by 4 years on an equivalent uniform annual cost (EUAC) basis using a 30 year analysis and assuming a 2% discount rate. Both scenarios are compared in the tables and graphic below.

Figure 25: Lifecycle cost of traditional approach versus preservation approach:

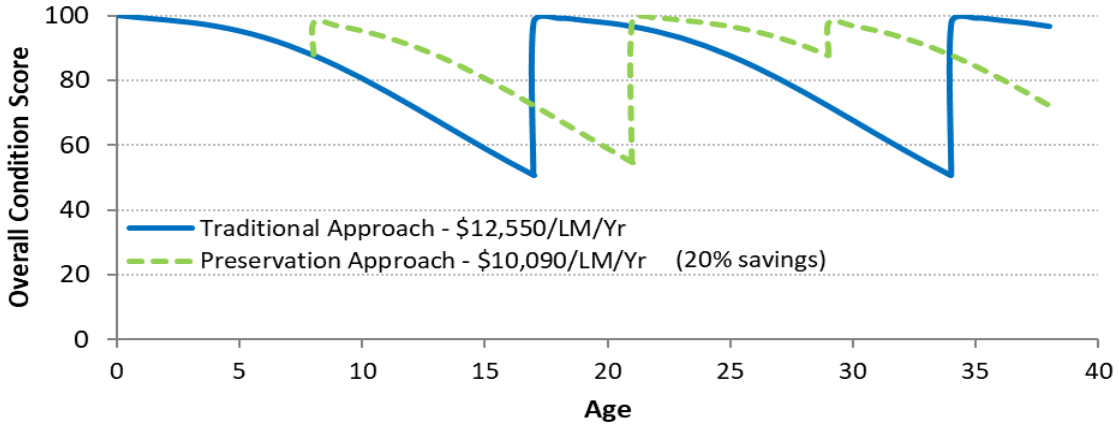
Traditional Approach – Take No Action

Yr	Age	Treatment	Cost/LM	EUAC
0	8	Do Nothing	$0	$0
5	13	Patch	$5,000	$170
9	17	Multi-lift	$270,000	$8,260
23	13	Patch	$5,000	$120
26	17	Multi-lift	$270,000	$5,900
30	4	Salvage	-$206,470	-$4,170
			Total	$12,550

Preservation Approach – Chip Seal

Yr	Age	Treatment	Cost/LM	EUAC
0	8	Chip Seal	$25,000	$910
9	17	Patch	$5,000	$150
13	21	Multi-lift	$270,000	$7,630
21	8	Chip Seal	$25,000	$600
30	17	Salvage	-$51,430	-$1,040
			Total	$10,090

(20% Savings)



Although the chip seal requires an up-front investment, the long-term effect is an overall reduction in funding needed to manage service life across

the system. The comparison above is a conservative estimate that only looks at the effect of a single chip seal inserted into the traditional rehabilitation cycle. Often, rehabilitation can be delayed even longer and/or a thinner resurfacing depth can be performed when pavement is protected with regular maintenance. This evaluation is comparable to a benefit-cost comparison because both treatment strategy alternatives provide "fair" or better pavement condition over a long term (in this case well over 30 years) but the preservation strategy has a lower $/LM-year and thus a higher benefit-cost.

Pavement Needs Assessment

As explained in *Section 4: Performance Gap Analysis* and *Section 9: Investment Strategies* the Oregon Highway Plan identifies investment strategies for funding the highway system under constrained revenue scenarios. An overall average pavement condition of 90% "fair-or-better" on all state highways was the objective of the optimal "feasible needs" investment scenario. ODOT's long-term commitment to pavement investments over the last two decades and strong asset management strategies have allowed ODOT to gradually improve the State Pavement KPM to its current level of 90% "fair" or better overall, which is consistent with the highway plan objective. The Rough Roads Ahead 2 (2017) study report considered four different investment scenarios with the highest investment level being the hypothetical *"What Would it Take" Scenario* to hold current pavement condition for the entire state-owned and operated system over the next 20 years. This investment was the basis for the OTC Investment Strategy Scenario II which would manage pavement condition to meet performance targets for pavement in fair or better condition across all state highways, rehabilitates the backlog of urban state highways that are in poor or very poor condition, and addresses mobility and accessibility needs in accordance with the Americans with Disabilities Act (ADA). For pavement, OTC Investment Scenario II was used as the basis for *desired state of good repair* since it keeps up with pavement deterioration and maintains Oregon's long-term investment in state highways. This investment scenario reflects a $200 million annual investment in the pavement program. For the purposes of the TAMP gap analysis, an additional $20 million per year must be added to capture pavement investments that are currently made by other programs ($15m from Maintenance program and $5m for Interstate signs and major maintenance) that were not accounted for under OTC Investment Scenario II.

Budget needs estimates are determined at the network level by evaluating treatment needs and costs for each pavement management section and summing up the results for the entire NHS network. Within the PMS, highway jurisdiction, route classification, traffic level, geography and climate, urban/rural, construction history, age, forecasted pavement condition, treatment cost and service life are the primary decision tree factors in determining the treatment required for each PMS section. At the network level, treatments are typically assigned using treatment categories rather than specific treatments and planning level cost estimates are determined from unit cost data for pavement projects typically on the basis of dollars per lane mile. More refined project level treatment and cost estimates are developed during scoping for priority sections (e.g. 150% list). The table below shows typical treatment categories and cost per lane mile ranges based on actual historic project costs inflated to the present. Lane-mile weighted average unit cost factors appropriate for treatment type, route (interstate/non-interstate), urban/rural, and region inflated to treatment year are used in actual needs analysis.

Work Types	Work Type Activities	Typical cost per lane mile
Maintenance	Crack sealing	$2,000 to $4,000
	Rut filling	$8,000 to $12,000
Preventive Maintenance	Chip sealing	$20,000 to $40,000
Preservation	Repaving (single layer)	$150,000 to $300,000
	Concrete grinding	$140,000 to $200,000
Rehabilitation	Repaving (multilayer)	$250,000 to $400,000
Reconstruction	Reconstruction	$1,000,000 to $5,000,000

Table 9: Typical unit cost of pavement work type activities

Cross Check – ODOT's Pavement Program operates with an understanding that every lane mile of the pavement on its network loses 1 year of life annually due to pavement deterioration over time. For the Interstate and NHS highway system, this is approximately 12,000 Lane Mile-Years of life that is lost annually. For long-term pavement health, an equivalent number of 12,000 lane mile-years of pavement repair work must be put back into the system to offset this deterioration. This is best accomplished by programming an appropriate mix of preventive pavement maintenance, preservation and rehabilitation projects. For a check on long-term needs, ODOT relies on a simple yet excellent tool that is provided on the FHWA's pavement preservation website. By using this quick checkup tool, network needs can be estimated with minimum calculations.

Based on Pavement Management data, the broad general categories shown in *Table 10* below are a good representation of the Interstate and NHS highway network to determine overall treatment needs. Implementing a program with these approximate treatment cycles would maintain a sustainable "steady state" program where each year the roads coming due for treatment would be balanced by treatments applied and there would

be no backlog. An estimated $195 million per year is needed for the NHS over the long term to make major repairs needed on routes with the worst pavement conditions, while providing for timely preventive preservation and maintenance on roads in fair-to-good condition.

Highway System	Pavement Condition	Activity	Annual Need (lane miles)	Service Life (years)	Lane Mile-Years	Annual Need
Interstate	Failed	Reconstruct / Rehab. Concrete Asphalt	 10 10	 50 20	 500 200	$20 million
	Poor	Structural Paving (multi-layers)	50	16 to 20	900	$22 million
	Fair	Non-Structural Concrete preservation Single lift paving	 10 120	 15 10 to 12	1,500	$29 million
State NHS	Failed	Major Rehabilitation	25	20	500	$20 million
	Poor	Structural Paving (multi-layers)	185	16 to 20	3,150	$50 million
	Fair	Non-Structural (single lift paving)	180	12 to 16	2,600	$32 million
	Good/Fair	Chip Seals	210	5	1,050	$7 million
Local NHS	Poor	Resurfacing	40	20	800	$15 million
All	All	Routine & Stop Gap Maintenance	300	2 to 5	800	Included in Maint. Budget
Interstate **State NHS** **Local NHS**					**12,000**	**$71 million** **$109 million** **$15 million** **$195 million**

Table 10: "Idealized" Illustration of Sustainable Pavement Program

Pavement Project Prioritization

The pavement strategy for state highways uses a tiered approach to prioritize highway routes and also includes dedicated funding programs for the most cost-effective maintenance treatments, preservation resurfacing and rehabilitation, and reactive pavement patching. State highway pavement conditions are prioritized by state highway classification into four levels, 1) Interstate highways are the highest priority, have the highest condition targets, and the highest level of investment, 2) Fix-It priority routes like US-97, OR-58, or US-26 are the next highest priority, followed by 3) remaining State level NHS routes like US-101, followed by 4) Region and district level routes like OR 99E or OR 214.

Since it is more cost-effective over the long run to do low-cost thin resurfacing and seal treatments on pavements with only minor deterioration than to employ a "worst first" approach, dedicated funding subprograms are provided to preventive maintenance and seal coat projects in both the STIP and Maintenance budgets based on needs as determined by PMS analysis. More detail about pavement funding programs is included in *Section 9: Investment Strategies*. STIP Fix-It resurfacing projects are prioritized by a cost-effectiveness weighting factor in terms of $/LM-year. Total vehicle and truck traffic volume, risks of treatment delay to maintenance and repair costs, pavement program manager priorities, and regional priorities are also accounted for in project prioritization through the use of weighting factors.

The following guiding principles are considered when making decisions about allocating pavement dollars and selecting projects:

- Prioritize pavement condition by route classification, from a state level perspective.
- Provide consistent, stable, and adequately funded allocations to preventive maintenance and seal coat treatments.
- Prioritize treatments and projects which provide higher pavement service life for funds expended (e.g. $/lane mile-year).
- Prioritize projects where poor pavement surface condition poses an increased safety risk.
- Favor projects with higher speeds and higher traffic volumes where user costs are more negatively impacted by rough road conditions
- Favor projects requiring significant maintenance expense to save on maintenance costs.
- Distribute projects across all parts of the state to balance pavement conditions geographically.
- If substantial increases in pavement funds become available, allocate a portion to rehabilitate urban and lower volume highways that are in poor to very poor condition to help reduce deferred backlog.

Section 6

LIFECYCLE PLANNING CONSIDERATIONS

- Overview
- Pavement Lifecycle Planning Practices
- Bridge Lifecycle Planning Practices
- Lifecycle Planning Improvement

Overview

Like all infrastructure, transportation assets owned by ODOT are threatened by physical deterioration over time. In addition to the ordinary wear and tear caused by hundreds of thousands of cars, trucks, buses, and other vehicles using the system every day, Oregon's roads and bridges are damaged by inclement weather, natural disaster, roadway crashes, and the chemical and physical processes of deterioration.

Maximizing the value from transportation investments is one of ODOT's major goals. Each year, the agency spends more than a billion dollars in federal and state funds constructing, operating, preserving, and maintaining the components of its transportation system. Stretching transportation revenue to get the greatest return on investment is not limited to minimizing the costs of constructing and purchasing transportation assets. Costs must be minimized at all phases of a transportation asset's lifecycle. Timely maintenance and preservation activities extend the asset's useful life and help avoid more expensive repair and replacement costs.

Value of Lifecycle Investments

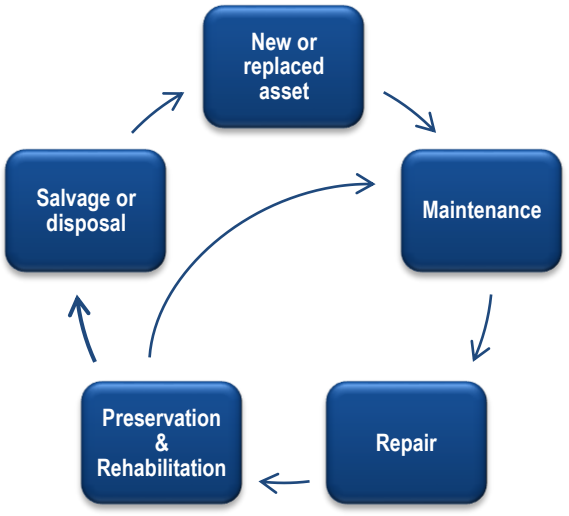
Lifecycle cost is defined by FHWA as "the cost of managing an asset class or asset sub-group for its whole life, from initial construction to its replacement."[20] By making timely investments in asset maintenance and repair, improved condition of assets can be realized, and the long-term cost of an asset can be reduced. Further, lifecycle cost strategies can keep assets in better condition at a lower cost over the long term, versus an investment strategy that defers maintenance, leading to higher cost reconstruction and replacement. Frequent investment in pavement preservation is shown to extend the life of a pavement asset, eliminating or delaying more costly rehabilitation or reconstruction while ensuring better condition over the life of an asset.

Lifecycle Planning Analysis- Key Principles

Lifecycle Planning (LCP) analysis is an engineering and economic analysis tool that focuses on the consideration of all the costs incurred during the service life of an asset. LCP provides a process for estimating the costs of managing assets over their entire life with the goal of minimizing costs while preserving or improving their condition and performance. The general phases of a typical transportation asset lifecycle are shown in the following figure:

Because the useful life of transportation assets can be extended through the timely completion of maintenance, preservation, and rehabilitation, ODOT strives to manage its transportation assets in a strategic and proactive manner. This includes:

- Planning for the construction of or purchasing assets using planning approaches that emphasize cost-effective actions and investments.
- Using state-of-the-art methods to design infrastructure assets, which reduces construction and maintenance costs while providing facilities that are longer lasting.
- Maintaining a well-trained maintenance staff that can apply well-timed maintenance activities on critical pavement and bridge assets, extending service life.
- Employing advanced technology to increase operational efficiency of existing assets and reducing uncertainty around asset condition and performance.



[20] Asset Management Plan Definitions. 23 CFR § 515.5. October 24, 2016.

A major responsibility of ODOT is to ensure that federal and state funds are managed efficiently and effectively. The use of LCP provides valuable information that enables the agency to manage transportation assets in a cost-effective and timely manner. ODOT's use of LCP begins with the development of alternatives to accomplish conditional and performance objectives for the construction or purchases of a transportation asset. A schedule of initial and future activities is established for each developed alternative, and costs of scheduled activities are estimated. The costs of scheduled activities are not only to include all construction or purchasing activities but also costs associated with any increased congestion or reduced safety experienced during project construction and maintenance. Performing an LCP analysis enables agency decision makers to identify the project alternative whose activities require the least amount of revenue expenditure.

LCP analysis is a subset of benefit-cost analysis, an economic analysis methodology that compares benefits as well as costs during the consideration of alternatives. Benefit-cost analysis is the appropriate methodology to use when construction or purchasing alternatives will produce different benefits. The successful application of LCP is based on the availability of accurate and reliable data on the lifecycle of transportation assets, schedule and impact of deterioration, and schedule and impact of repair, rehabilitation and improvement activities.

State Requirements

Oregon regulations require that Enhance projects selected for funding in the Statewide Transportation Improvement Program (STIP) "provide the greatest benefit in relation to project costs." In 2017, the Oregon Legislature adopted HB2017. A provision of the bill requires that before any *STIP Enhance* project that costs $15 million or more is included in the STIP, a rigorous benefit-cost analysis must be prepared and made publicly available. Specifically called out in this legislation are requirements to analyze future costs to the agency to preserve and maintain an undertaken project, and identify increased costs that would result from delays in the performance of routine maintenance scheduled by the agency.

Asset Management Work Types for Pavements and Bridges

The Oregon Department of Transportation categorizes asset management activities performed by the agency under five major work types: Modernization, Preservation, Bridge, Maintenance, and Operations. Descriptions of how the agency defines these five categories are summarized as follows:

Modernization

Modernization is a general term that covers construction of a new transportation asset as well as reconstruction of an existing asset or assets. Reconstruction of pavement and bridge assets usually requires the complete removal and replacement of an existing asset and is generally required when a pavement or bridge has either failed or has become functionally obsolete.

Preservation and Rehabilitation

Preservation activities focus on preserving the condition of Oregon's highways and include both regular preservation and rehabilitation activities. Preservation activities aim to extend service life though treatment activities at the most cost-effective time in the lifecycle of an asset. Pavement and bridge preservation activities restore the condition of an asset, extending its useful life without increasing its strength or capacity.

Bridge

Bridge expenditures focus on maintaining the condition of state bridges. This work type category includes multiple activities including preservation, rehabilitation, and major bridge maintenance.

Maintenance

Maintenance includes activities associated with upkeep, preserving, repairing or restoring existing transportation infrastructure. Maintenance includes both reactive activities such as responding to weather events and crashes, and proactive activities, such as pavement chip seals to extend pavement life, that reduce overall lifecycle costs.

Operations

Operations focuses on improving the efficiency and safety of the transportation system through operational improvements and enhanced system management.

Activities that take place under these five work type categories correspond closely with work types identified in the following chart. Specific work type activities can be can be categorized by whether they have the ability restore serviceability, extend useful life, increase strength, or increase capacity on an asset:

Figure 26: Work Type Guidelines

Work Type	Work Type Activity	Restore Serviceability	Extend Useful Life	Increase Strength	Increase Capacity
Maintenance	Routine maintenance	✓			
	Reactive maintenance	✓			
	Catastrophic maintenance	✓			
Preservation and Rehabilitation	Minor rehabilitation	✓	✓		
	Preventative maintenance	✓	✓		
	Major rehabilitation	✓	✓	✓	
	Structural overlays	✓	✓	✓	
Modernization	Initial construction	✓	✓	✓	✓
	Reconstruction	✓	✓	✓	✓

The following table provides a list of major work type activities for pavement and bridge assets, and ODOT's average estimated costs for performing these activities:

Asset	Work Types	Work Type Activities	Typical cost per lane mile
Pavement	Maintenance	Crack sealing	$2,000 to $4,000 *per lane mile*
		Rut filling	$8,000 to $12,000 *per lane mile*
	Preservation and Rehabilitation	Chip sealing	$20,000 to $40,000 *per lane mile*
		Concrete grinding	$140,000 to $200,000 *per lane mile*
		Repaving (single layer)	$150,000 to $300,000 *per lane mile*
		Repaving (multilayer)	$250,000 to $400,000 *per lane mile*
	Modernization	Reconstruction	$1,000,000 to $5,000,000 *per lane mile*
		New Construction	*Variable*
Bridge	Maintenance	Deck sealing	$2 *per sq ft deck area*
		Joint sealing	$20-$200 *per LF*
		Timber pile repairs	$30,000 *per EA*
	Preservation and Rehabilitation	Painting/coating	$40 *per sq ft of surface*
		Cathodic protection	$60 *per sq ft of surface*
		Stealth rail	$1200 *per LF*
		Vertical clearance	*Variable*
		Deck overlays	$4-$200 *per sq ft deck area*
		Scour mitigation	*Variable*
	Modernization	Reconstruction	$700-$1,600 *per sq ft deck area*
		New Construction	*Variable*

Table 11: Typical Unit Costs of Bridge and Pavement Work Type Activities

Lifecycle Planning Strategies for Pavement and Bridge

In order to extend the useful life of pavement and bridge assets and to optimize the performance and condition of the transportation system under a constrained revenue scenario, ODOT aims to avoid a "worst-first" approach to investing in pavement and bridge assets. ODOT's desired approach to investing in its system is to *"identify the right treatment at the right time for the right asset to maximize the performance of the asset with minimal cost"*[21] The following table summarizes the distinction between a "worst-first" approach and ODOT's desired approach in investing in its pavement and bridges:

Asset	Typical Strategies	Worst-First Approach	Desired Approach
Pavements	Periodic surface treatments: • Crack sealing • Seal Coats (eg. chip seal, microsurfacing) • Resurfacing (eg. overlay, mill/inlay) • Concrete patching • Concrete grinding	Reconstruct roadway surface after pavement deteriorates to failed condition without routine preservation	Apply periodic seal coats and thin resurface treatments to extend pavement asset life and lengthen the time before major pavement rehabilitation or replacement
Bridges	Routine inspections Proactive maintenance and preservation: ▯ Sealing or replacing leaking joints ▯ Painting/coating or overcoating structural steel ▯ Installing scour countermeasures	Reconstruct bridge after it deteriorates to poor condition without routine maintenance and preservation	Extend functional life of bridges through proactive maintenance and preservation Focus investments on extending the functional life of priority corridors, rather than just considering individual bridges

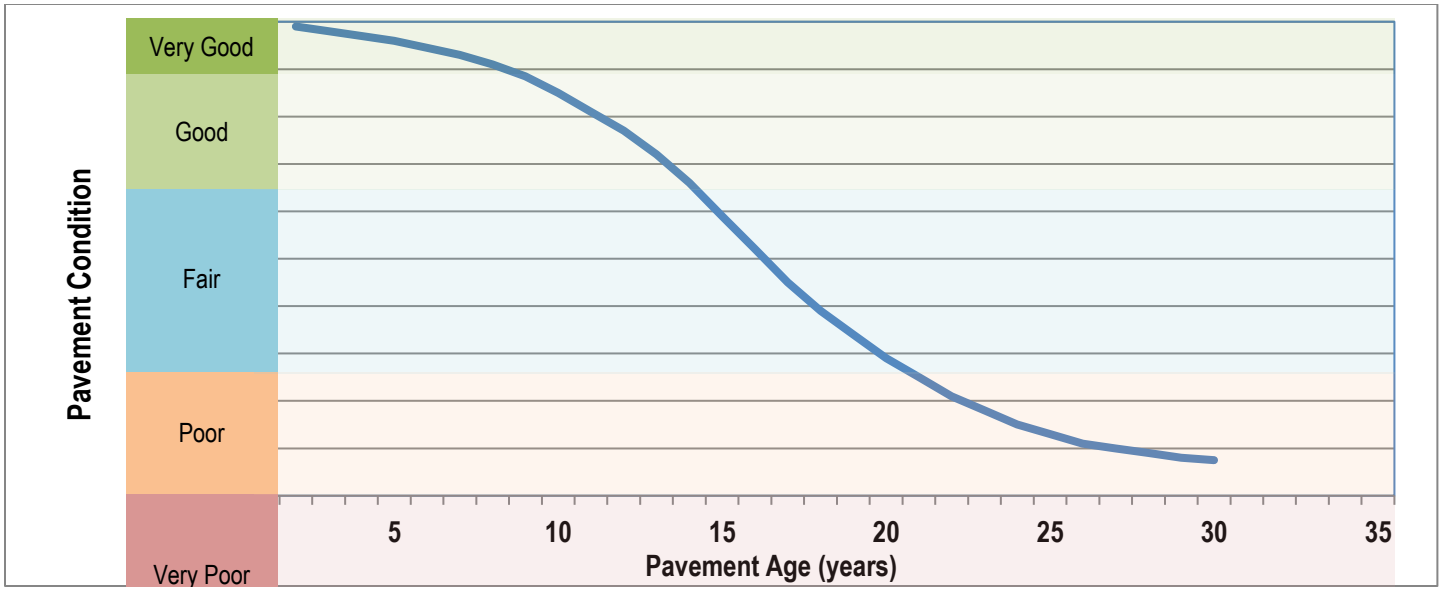
The following subsections provide further details on ODOT's approach to extending the useful life of pavement and bridge assets and employing LCA to optimize the performance and condition of the transportation system under constrained revenue.

Pavement Lifecycle

Pavements are load-carrying structures that degrade over time due to the cumulative effects of traffic, weather, and physical damage. To keep them properly maintained and out of poor condition, they must be resurfaced or rehabilitated at periodic intervals (typically every 15-20 years for asphalt and 40-50 years for concrete). As long as degradation is confined to the surfacing only, and the pavement's foundation and base layers are protected, a given pavement can be resurfaced over and over again, with occasional strengthening, but without the need for a complete replacement. However, if resurfacing is delayed for too long, the pavement structure and underlying base materials can become excessively damaged and complete replacement (e.g. reconstruction) becomes necessary at a much higher cost.

Table 12 below shows a typical pavement deterioration curve with relative costs needed to maintain or return the pavement to a serviceable condition. The graphic illustrates the importance of performing the "right treatment to the right road at the right time." During the first few years, deterioration is slow but the rate increases quickly as the pavement ages. In the later stages of a pavement's service life, deterioration occurs at an increasing rate, making it critically important not to defer preservation treatment too long. Failure to keep roads in a state of good repair has exponentially greater costs than maintaining the system properly over time. The typical cost to restore a severely damaged road is orders of magnitude higher than the cost to preserve pavement through seals and resurfacing treatments. Timely maintenance and preservation are by far the most efficient way to preserve our investment.

[21] Asset Management Gap Analysis, 2016



Typical treatment	Life	Annual cost per lane mile	Order of Magnitude
Crack Seal	2 years	$1,500	*$0.3*
Chip Seal	5 years	$5,000	*$1*
Thin Pave	14 years	$15,000	*$3*
Thick Overlay	17 years	$30,000	*$6*
Rebuild	40 years	$75,000	*$15*

Table 12: Typical Pavement Deterioration Rate and Treatment Cost:

Pavement Lifecycle Practices

ODOT's Fix-It Preservation program and Maintenance program have dedicated, steady funding streams to maintain pavement assets. Rather than following a "worst-first" philosophy, the Fix-It Preservation program applies a "mix of fixes" including preventive maintenance seal coats, resurfacing preservation projects, pavement rehabilitation, and reconstruction. Likewise, the Maintenance program has a long history and well established philosophy to proactively do crack sealing, chip seals, thin patching and overlays to keep pavements from failing. Lifecycle cost analysis techniques are considered when making decisions regarding pavement type selection and determination of appropriate pavement design or pavement rehabilitation strategies. The pavement design alternative with the lowest lifecycle cost will typically be the preferred alternative. However, when alternatives have comparable lifecycle costs, other factors may be used to base a decision. The *ODOT Pavement Design Guide*[22] establishes the agency's guidelines for the use of lifecycle cost analysis for pavement design alternatives and provides a discussion of pavement alternative selection.

New Pavements

The Pavement Design Guide requires lifecycle cost analysis to be conducted on a project where more than one mile of new roadbed will be constructed. A discussion of the cost analysis and justification for the selected alternative is to be included in the pavement design memo or report. If less than one mile of new roadbed is to be constructed, a cost analysis that compares the construction costs for each alternative should be conducted.

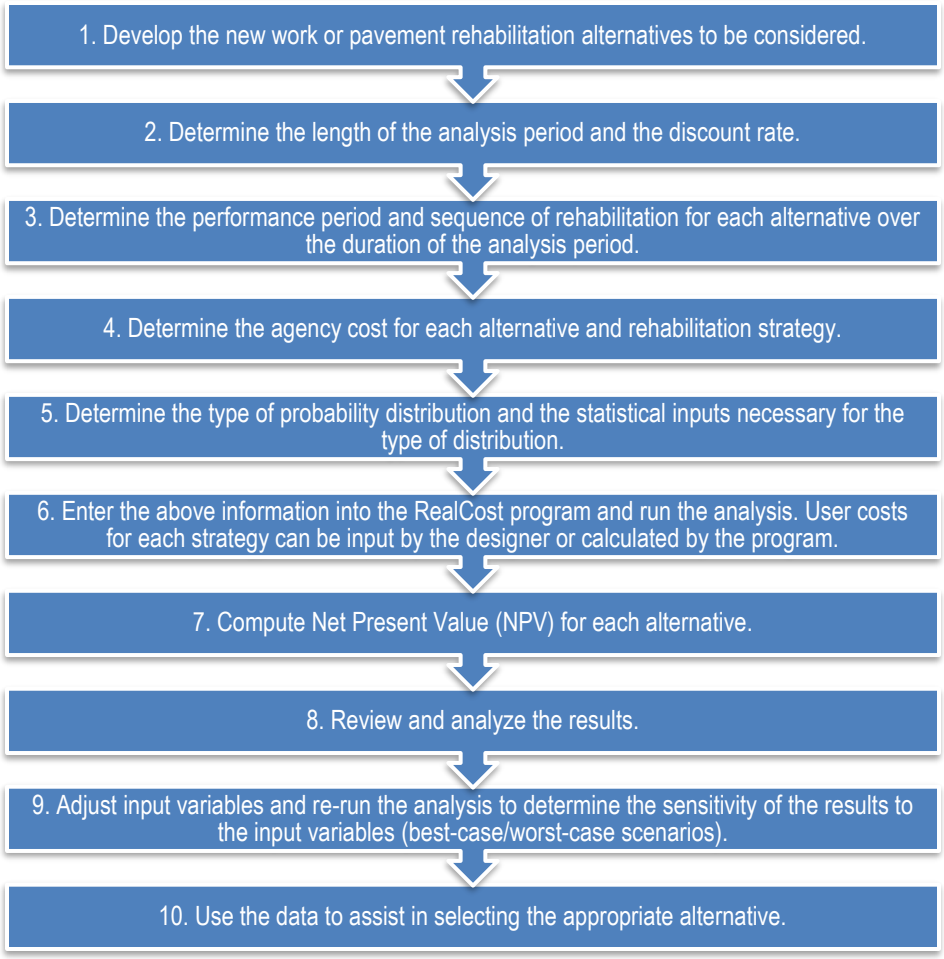
Rehabilitated or Reconstructed Pavements

For rehabilitation of existing pavements, Lifecycle cost analysis must be conducted where major rehabilitation (such as total reconstruction, rubblization, etc.) is necessary or where options of different life expectancies are being considered. Lifecycle cost analysis is also required when pavement design strategies with structural life less than the minimum standard of 15 years are being considered. Preventive maintenance treatments such as chip seals or microsurfacing treatments are not subject to the structural design life standards.

General Approach to Lifecycle Planning

ODOT's pavement design guidelines prescribe that where lifecycle cost analysis is applicable, it is to be conducted as early in the project development cycle as possible. The level of detail is to be consistent with the level of investment anticipated. The expected level of lifecycle cost analysis for an ODOT pavement project with a high level of investment is illustrated in the following steps:

[22] ODOT Pavement Design Guide: https://www.oregon.gov/ODOT/Construction/Documents/pavement_design_guide.pdf



Bridge deterioration overview

Bridges on Oregon's state and national highway systems face a number of complex deterioration factors. These include, but are not limited to, extreme events such as vehicle impacts, flooding, and earthquakes, as well as common factors such as deck deterioration from moisture, steel and surface corrosion, and traffic loading.

More than half of the bridges in the state's current inventory were built prior to 1970, and 57% will reach the end of their design lives by 2020. Each year, about 0.5% of the state's bridges (about 14 structures) deteriorate to the point of becoming structurally deficient. By 2020, that rate is expected to increase to 2.5%, or close to 70 structurally deficient bridges each year. While bridges on the NHS system are newer on than those on the total state system, NHS bridges are impacted by higher traffic volumes and heavier truck loads.

Bridge Lifecycle

Most bridges today are designed with a 75-year design life. With regular attention, the actual service life can be expected to extend to 100 years or more. Based on a service life of 100 years, a conservative approach would be to replace about 1% of all bridges every year. This would amount to roughly 18 bridges (out of 1,814) per year on the National Highway System, or 27 bridges (out of 2,737) per year on the State Highway System.

Because the number of bridges that would need to be replaced can vary greatly in size, a quick assessment of cost can be based on measurement of the system by deck area. This would amount to roughly 300,000 square feet (sf) of deck area (out of 30,000,000 sf) annually on the National Highway System, or 380,000 sf (out of 38,000,000 sf) on the State Highway System.

Keeping a bridge in fair to good condition requires routine inspections, proactive maintenance and preservation treatments. Examples of proactive maintenance are sealing or replacing leaking joints to minimize the deterioration of superstructure and substructure elements beneath the joints; painting/coating or overcoating structural steel to protect against corrosion; and/or installing scour countermeasures to protect the substructure from

undermining and failure due to scour. Timing is critical when performing the work since the longer the deterioration occurs, the more extensive/expensive the required treatment.

Special Need Bridges[23]

Many bridges on Oregon's highway system require constant attention. Of the 2,737 bridges on the State Highway System, more than 600 bridges (about 22%) fall into one of the following categories:

- Timber Bridges
- Poor Detail Bridges (*the majority over 50 years old and on high volume routes)*
- Coastal Bridges *(requiring special attention due to the extreme environment which causes corrosion)*
- Border Bridges
- Historic Bridges

Bridge Lifecycle Practices

In 2011, ODOT revised its bridge preservation strategy in response to reduced funding and the significant number of bridges reaching the end of their service life over the next several decades. ODOT has adopted seven strategies, which include:

- Protecting high value coastal, historic, major river crossings and border structures.
- Employing Practical Design guidelines and funding only basic bridge rehabilitation projects and rare replacements.
- Prioritizing maintenance on highest priority freight corridors.
- Developing a bridge preventative maintenance program aimed at extending the service life of bridge decks and other structural components based on lifecycle practices
- Raising awareness of the lack of seismic preparation.
- Addressing only significant structural problems to protect public safety on low volume bridges.
- Monitoring the health of bridges.

Bridge Inspection, Preventative Maintenance, and Major Bridge Maintenance

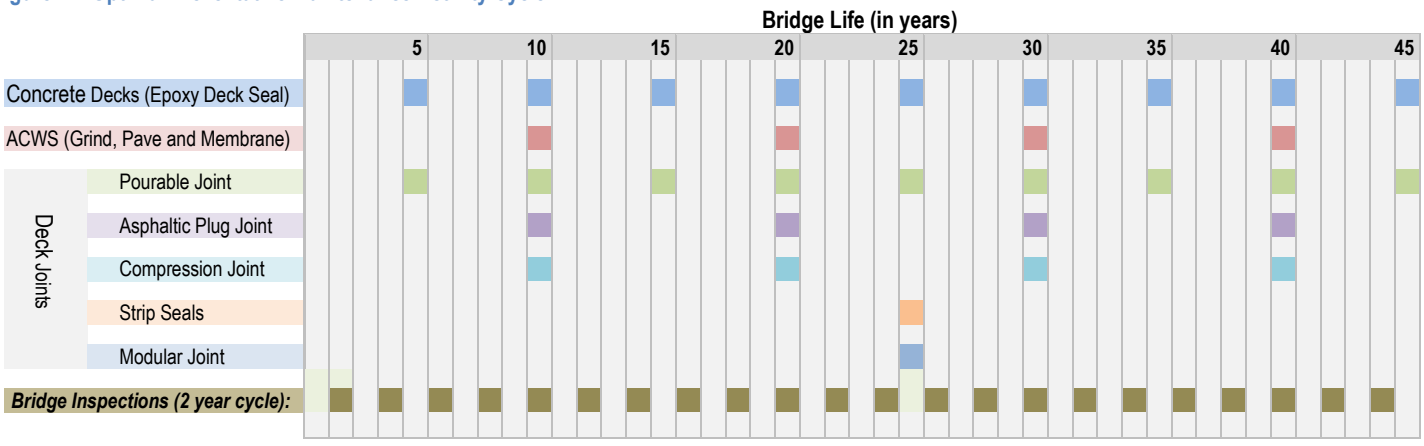
Bridge Inspection

National bridge inspection standards (NBIS) were established in 1968 to monitor existing bridge performance to ensure the safety of the traveling public. The NBIS regulations apply to all publicly owned highway bridges longer than twenty feet located on public roads. To comply with the NBIS and assess bridge conditions, ODOT manages a statewide bridge inspection program that includes both routine and specialized inspections. ODOT is responsible for inspecting over 2,700 state bridges every two years, as well as locally-owned bridges on the National Bridge Inventory. This inspection data is gathered and integrated into the BrM (Pontis) database and supports condition data and condition reporting.

Preventative Bridge Maintenance

Several preventative maintenance activities, including deck sealing and joint sealing, can be performed on a bridge throughout its lifecycle to extend its design life and avoid more costly rehabilitation and reconstruction. The following chart describes an *optimal* cycle of preventative maintenance activities. However, under a constrained revenue scenario, many of these activities must be deferred.

Figure 27: Optimal Preventative Maintenance Activity Cycle

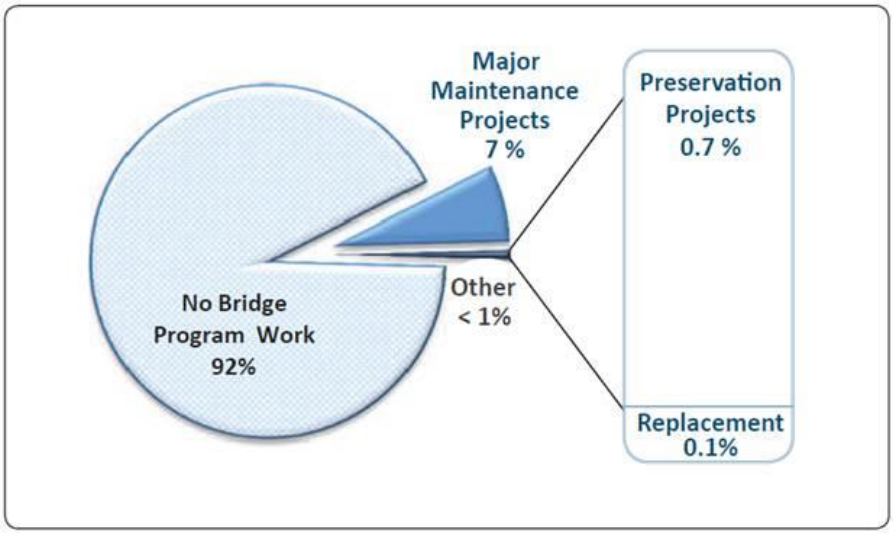


[23] Info pulled from presentation: bridge Project Section Process for the STIP_0728`17.pptx

Major Bridge Maintenance

In 1990, the state of Oregon established the Major Bridge Maintenance (MBM) Program, to specifically address major and emergency bridge repairs. These repairs are typically large enough to be outside the scope of work that can be funded at the district level, but are too small or can't wait to be included in future STIP cycles. Based on current bridge program funding, MBM projects are performed on 7% of ODOT bridges every year. Due to the nature of the work, some bridges (e.g., timber bridges) require MBM funding for major repairs on a regular basis. In addition to repairs, the MBM Program is also used to fund deck seals and waterproofing membranes to extend the life of bridge decks.

Figure 28: Percent of bridges receiving major bridge maintenance annually



Lifecycle Cost Improvement Efforts

The integration of lifecycle cost management practices that maximizes the efficiency of transportation revenue and minimizes the need for costly replacement of bridge and pavement assets is an evolving effort by the agency. The 2016 Asset Management Gap Analysis Report identified many of the agency efforts that can lead to improved lifecycle decision-making. The following table identifies business needs to improve agency lifecycle cost considerations that were identified in the 2016 Gap Analysis and actions being undertaken to improve these practices:

Improvement Needs from 2016 Asset Management Gap Analysis	Actions being undertaken
Further incorporate lifecycle cost considerations when modeling future asset condition.	ODOT's BrM bridge management software was updated in 2018. The new version of BrM will provide more robust lifecycle cost planning capacity for bridge assets.
Incorporation of lifecycle cost considerations when selecting asset management projects.	ODOT's BrM bridge management software was updated in 2018. The new version of BrM will provide more robust life-cost planning capacity for bridge assets.
Define key work activities and document their typical unit cost and ideal timing.	Effort being undertaken as part of TAMP
Determine the long-term cost implications of adding new assets (i.e., maintenance costs) and consider these costs when prioritizing network expansion activities (e.g., highway, pedestrian, or bicycle facilities).	A provision of HB2017 requires that before any project that costs $15 million or more is included in the STIP, a rigorous benefit-cost analysis must be prepared. This includes requirements to identify and analyze future costs to the agency to preserve and maintain an undertaken project.
Further document how projects are selected for construction.	Improvement efforts outlined in *Section 9: Investment Strategies*

Section 7

RISK MANAGEMENT

- Risk Management Overview
- ODOT Risk Management Assessment (2017)
- Summary of Current Risk Management Policies and Procedures
- Risk Management Improvement Efforts
- Risk Registry
- Mitigation Plans for High Priority Risks
- Facilities Requiring Repairs and Reconstruction due to Emergency Events

Risk Management Overview

Risk Management focuses on the identification, evaluation and prioritization of threats, followed by the commitment of appropriate resources to monitor them, address challenges and threats they may present, and maximize potential beneficial opportunities created by uncertainty. Effective risk management requires knowledge and understanding of important risks, an assessment of their relative priority, and a comprehensive approach to monitoring and addressing them. The management of risk is a key component of an effective transportation asset management program. Risk Management complements asset management which seeks to provide transportation assets that are safe, reliable and maintained in a state of good repair for the lowest possible costs.

ODOT's approach to risk management is to focus resources to minimize threats to the condition and operation of the state's multimodal transportation system and maximize opportunities to improve its transportation programs. This approach necessitates balancing risk across multimodal programs and across the diverse geographic areas with a focus on minimizing threats and challenges to the provision of "a safe and reliable multimodal transportation system that connects people and helps Oregon's communities and economy thrive."

The goal of the agency's approach to risk management is to make better and more informed decisions regarding existing and potential risks to its transportation assets and programs and better understand the likely outcomes and impacts of alternative actions.

ODOT Risk Management Assessment (2017)

As part of ODOT TAMP-related improvement efforts, executive and asset management staff identified the need for an agency-wide risk management assessment to better identify, prioritize and develop mitigation plans for major risks facing the agency. Consultants conducted an assessment of risks facing the agency and existing practices in responding to those risks. The consultants also made recommendations on how the agency can better identify and prioritize risks, and identified process improvements for how the agency manages risks.

Completed in December 2017, the *Oregon Risk Management Assessment White Paper* provides a broad assessment of the major risks faced by the agency, summarizes current policies and procedures related to risks, and identifies critical gaps and recommended actions for improving how ODOT manages major risks. This *White Paper* provides the framework for the Risk Management section of the TAMP. *See Appendix C.*

Summary of Current Risk Management Policies and Procedures

ODOT has a number of robust procedures and practices in place to identify, analyze, evaluate, address, and communicate risks faced by the agency. This section summarizes ODOT's existing activities, with a focus on risks relevant to the TAMP. Although the scope of risk management defined in the TAMP requirements is very broad, there are nonetheless many risks ODOT faces that are outside of the scope of this summary. The risks faced by ODOT included in this summary fall broadly into six general categories:

1. **Bridge-related Risks**
2. **Pavement-related Risks**
3. **Other Tier 1 Asset Risks**
4. **Environmental Risks**
5. **Economic and Financial Risks**
6. **Organization and Leadership Risks**

Each of the following subsections identifies the key risks and concerns in the specific area and summarizes the existing work to address the risks. Note that there is some overlap across asset groups with respect to risks they are considering. For example, seismic risk is handled by both Bridge Engineering and those working on environmental issues.

1. Bridge Risk Policies and Procedures

ODOT's Bridge Section is responsible for managing the Oregon bridge inventory and has performed extensive work to inspect the state's bridges, identify investment needs, and develop strategies for mitigating specific types of risks. Bridge conditions are summarized in *the 2018 Bridge Condition Report*. This report identifies distressed bridges, which are bridges that are in poor condition or that have deficiencies on one of the following areas:

1. Bridge Rail
2. Cathodic Protection
3. Load Capacity
4. Low Service Life
5. Movable Bridge
6. Other Geometric Clearances (Deck Geometry)
7. Paint
8. Scour
9. Timber Structures (Substructure)
10. Vertical Clearance

The Bridge Condition Report describes ODOT's process for routine bridge inspection, and its programs for bridge preservation, rehabilitation and replacement. Supplementing these activities, the Bridge Section has focused additional attention on risks related to four key areas: decks; corrosion on steel bridges and reinforced concrete bridges; fatigue cracking on steel bridges; and scour. In each of these areas, ODOT has identified bridges at increased risk and developed a mitigation plan identifying priorities for treatment. For instance, for addressing fatigue cracking, ODOT has performed supplemental bridge inspections of fatigue-prone areas on its steel bridges, and has prepared a mitigation plan based on the inspections.

To continue to assess and monitor risks in these areas, ODOT is in the process of developing a watch list of bridges that are in need of long-term oversight. The goal of this list is to have all the information about the bridges in a central location that is available to anyone who needs it. The integrated list will replace the current set of risk-specific lists maintained by individual engineers.

Another area where ODOT has made progress is in assessing seismic risk to bridges. The agency performed a complete vulnerability assessment of its bridge inventory and determined the funding necessary to address all the resiliency issues in designated lifeline routes. The 2014 *Oregon Highways Seismic Plus Report* describes the assessment, and it includes a five-phase approach for performing all the necessary retrofitting work. Because the cost of performing all of the seismic retrofit work identified in the plan would be prohibitive, the initial emphasis is on performing seismic retrofits for selected bridges to secure key lifeline routes in the event of a major earthquake.

Other potential risks to ODOT bridges identified by Bridge Section staff include:

1. Bridge hits
2. Construction defects
3. Increased deterioration due to winter maintenance
4. Increased deterioration from increases in truck sizes and weights
5. Potential for reductions in bridge maintenance and rehabilitation funding to address capacity needs
6. Potential that funding will be needed to strengthen bridges for emergency vehicles which will reduce the funding available for rehabilitation and replacements

2. Pavement Risk Policies and Procedures

ODOT's Pavement Services Unit is responsible for pavement management, pavement design and materials, and related activities. This unit has worked extensively to develop ODOT's pavement management system (PMS). Updates to condition data are performed annually on the interstate system and biannually on the non-interstate system, and this data is used to inform treatment assumptions, and deterioration rates in the system. The PMS is used to analyze future conditions and forecast impacts of different funding scenarios. One such analysis is detailed in the recent ODOT report, *Rough Roads Ahead 2: Economic Implications of Deteriorating Highway Conditions* published in February 2017.

The Pavement Services Unit attempts to address as many different risks to pavement as possible programmatically in the PMS. For instance, risks of accelerated pavement deterioration are handled through the scoping process and annual review of interstate pavement conditions and the treatment assumptions and deterioration models in the PMS.

The Pavement Services Unit also works to manage many non-programmatic risks related to pavement. One such risk is that, although the TAMP is intended to address the entire NHS, 6.6% of the NHS in Oregon is owned by other agencies besides ODOT. While the non-state-maintained portion of the NHS represents a relatively small portion of system, there is a risk that a lack of asset management on off-system NHS roads will impact the overall pavement condition and the ability of the agency to meet the targets set forth in the TAMP.

Another risk is that, despite the best efforts of ODOT staff, there is significant uncertainty in projections of future pavement conditions. While staff is fairly confident in the projection of conditions up to eight years in the future, there is less confidence in projections beyond eight years. ODOT works to mitigate this risk through biannual updates of its pavement models and modeling assumptions, as described above.

Finally, pavement faces the risk of decreased or inadequate funding and project cost escalation. Uncertainty around the funding received for pavement contributes to this risk. To the degree possible, Pavement Services mitigates this risk by developing policy statements on how money is allocated and spent within the program. There is also a working group that assesses projects and works to address issues around project costs.

3. Other Tier-1 Asset Risk Policies and Procedures

ODOT's other Tier 1 assets include culverts, tunnels, traffic signals, and ADA ramps. Tier 1 assets are the top priority assets for ODOT determined through criteria that includes: asset value, criticality for highway core operations, accessibility, safety risk and consequence, criticality of stewardship, and attention to status or condition. Although these assets are not included in the TAMP submitted to FHWA in 2019, risks related to these assets are nonetheless relevant to the TAMP to the extent resources otherwise used for pavements and bridges may be required to mitigate Tier 1 asset risks.

Risks identified by staff responsible for these assets can be classified into three basic categories:

Asset failure. Unexpected asset failures may require diversion of funds from other programs. Failures such as downed signs and rockfalls are routine occurrences and handled through day-to-day maintenance. However, increases in asset failure rates caused by factors such as aging infrastructure may require additional resources to address.

Lack of quality asset data. It can be a challenge to obtain funding needed to collect and maintain asset data. This concern extends to all of ODOT's assets, not just the Tier 1 assets. Data collection and maintenance requires sustained investment in order to prevent data from aging and becoming unusable. The lack of current, quality data can create uncertainty concerning what investments are needed, lead to inefficient decision-making, and contribute to incidence of unexpected asset failures.

Changes in standards/requirements. When design standards or other requirements for an asset change, this may result in significant cost implications for ODOT. An example of this is ODOT's recent experience with curb ramps. Many of the curb ramps on state-owned highways fail to meet current design standards. ODOT recently settled a lawsuit over this issue by committing to audit all curb ramps and pedestrian crossing signals along state highways, and then address all issues identified in the audit over the next 15 years.

4. Environmental Risk Policies and Procedures

A number of different efforts are underway in Oregon and at ODOT to address risks to the environment from the transportation system and risks to the system from environmental conditions. ODOT has assessed risks related to climate change in the ODOT *Climate Change Adaptation Strategy Report*. Risks considered in this include coastal impacts, changes in vegetation and wildlife, wildfires, extreme storm events, flooding, changes in seasonal flow rates, landslides and rockfalls, and population movement. In recent years, ODOT has performed a pilot vulnerability assessment on the north coast of Oregon to identify specific improvements needed to address risks related to climate change.

Moving forward, ODOT's Sustainability Program is charged with providing leadership, policy analysis and technical support on sustainability-related issues and is leading ODOT's climate change adaptation planning. This program is performing research related to green infrastructure techniques, coastal landslide and bluff monitoring, and landslide identification. Other efforts include mapping sea level rise, providing guidance for planning and project design teams, and documenting case studies on how communities in the state have prepared and adapted to the realities of climate change. Work relating to coastal landslide and bluff retreat monitoring and landslide identification and risk assessment is being led by ODOT Research in coordination with the Geo-environmental and Sustainability Programs.

The Geo-Environmental Section is concerned with a number of environment-related risks. This section works with stakeholders to address natural hazards statewide. Key risks that may impact the TAMP include risks of flooding and coastal erosion from storms or tsunamis. The *Oregon Natural Hazards Mitigation Plan* assesses risks to Oregon from the following natural hazards:

- Coastal Hazards
- Droughts
- Dust Storms
- Earthquakes
- Floods
- Landslides
- Tsunamis
- Volcanoes
- Wildfires
- Windstorms
- Winter Storms

5. Economic and Financial Risk Policies and Procedures

The primary economic and financial risks for the TAMP are related to uncertainty of financial forecasts. Risks are accounted for in the state and federal revenue projection and various actions have been identified to mitigate for financial uncertainty. These include the need for adding confidence intervals to the forecasts, including alternatives in the forecast, investigating the possibility of improved tools for revenue projections, and updating the agency's accounting system.

There is also concern about the allocation of funds to the NHS. Regions do not have any spending requirements on the NHS which makes it difficult to ascertain how much money is spent on the NHS statewide. The group also identified a concern about legislative mandates and the prescriptive way the legislature spells out how the agency can use certain funds.

6. Organizational and Leadership Risk Policies and Procedures

ODOT's Executive Team and Human Resources staff both identified future loss of key staff as a major organizational risk. To address this risk, Human Resources has developed a *Succession Planning Guidebook* for ODOT managers. The guidebook helps managers identify critical positions within their team, assess their team's needs, and determine both position and employee competencies. Human Resources is also performing a pilot program in competency-based performance related to this issue.

Another organization-related risk to the TAMP is that ODOT has a lean workforce, with limited capacity to meet the increasing need for project delivery and engineering. To mitigate the risk, ODOT is requesting additional project delivery staff from the legislature. The agency is in the process of expanding the transportation program to address this risk as well.

Staff also identified increased outsourcing as an organization-related risk to the TAMP. There is concern that contractors may not have the depth of knowledge or experience necessary to perform the needed work. In addition, it takes skills within ODOT to oversee contractors. Increased outsourcing also means that key knowledge now resides outside the agency and not with people on staff at ODOT.

Risk Management Responsibility

ODOT's current risk management practices assign responsibility to identify, monitor, analyze, and evaluate to asset owners and subject matter experts within these six broad risk categories. Risk management responsibility in the six identified categories can be summarized in the following chart:

Major Risk Categories	Asset Owner/Subject Matter Experts
Bridge	*Responsibility for bridge-related risk lies with the Bridge Section. Among this section's responsibilities is developing mitigation plans for specific types of distresses*
Pavement	*The Pavement Management System and risks related to pavement are managed by the Pavement Services Unit*
Other Tier-1 Assets	*Responsibility for other Tier 1 asset is shared among the different asset owners*
Environmental	*Responsibility for environment-related risks is shared among multiple stakeholders, including the Sustainability Program under the Program Implementation and Analysis Unit of the Transportation Development Division, the Geo-Environmental Section in the Highway Division, and the individual asset owners*
Economic & Financial	*The Economic and Financial Analysis Unit is responsible for developing the state revenue forecast. Staff members in the Director's Office are responsible for developing the federal revenue forecast. Staff in the Highway Program Office and Program and Funding Services are responsible for developing the expenditure projections*
Organizational & Leadership	*Responsibility for managing most organization and leadership-related risks lies with Human Resources and the Executive Team*

Risk Management Improvement Efforts

As an outcome of the agency-wide risk assessment and the TAMP development process at large, ODOT has identified four broad areas where improvements can be made in the near-term in how the agency assesses and manages risks:

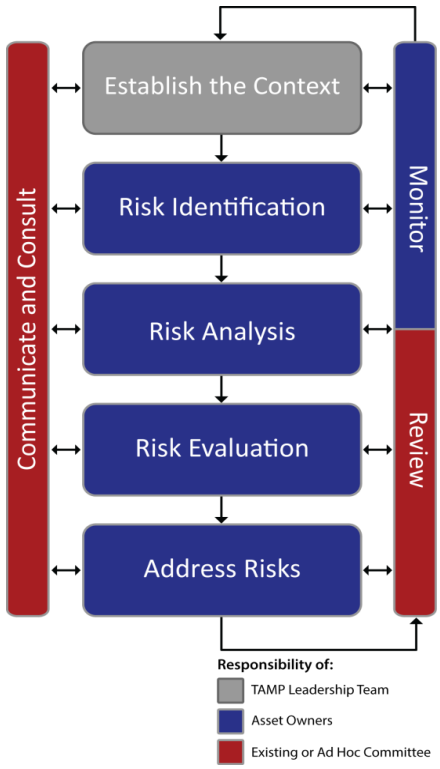
1. Identification of Risk Management Process Owners and Responsibility

The first gap that was identified in the risk assessment was the need to better identify who is responsible for the risk management process. This includes identifying asset owners who are responsible for identifying, analyzing, evaluating, and addressing risks, as well as identifying shared responsibility for monitoring and reviewing risks across multiple assets.

The initial step of better defining asset managers responsible for identifying, analyzing, evaluating, and addressing individual risks was addressed during the *Improvement of the Risk Register* process undertaken in fall 2017 (see subsection 2 below). Through this process, significant risks were identified by the agency using an updated process, and each risk was assigned a *Risk Owner*, which is primarily a unit or discipline within ODOT responsible for analyzing, evaluating, and addressing the identified risk.

The additional step of identifying responsibility for monitoring and reviewing risks across multiple assets is an effort being undertaken by ODOT's Asset Management Integration Unit Program Manager with guidance from the Asset Management Executive Committee.

Figure 29: Risk Management Responsibility



2. Improvement of the Risk Register

A draft risk register was originally developed by ODOT's Asset Management Integration (AMI) Unit to identify and track risks facing the agency across multiple assets. As part of the risk management assessment process in 2017, this original risk registry was reviewed by asset managers from across the agency. Identified risks were updated and new risks were identified to reflect current conditions and challenges faced by the agency.

In addition to updates to the content, the risk registry structure was updated to more clearly communicate risks faced by the agency and to build consensus around the likelihood and impact of identified risks and potential actions to mitigate risks identified as a priority. As a first step, each risk identified by the agency was restructured as a risk statement, which provides a description of the risk event, and a summary of its potential impact, For example:

Risk Event (if)	*If ODOT does not plan for extreme weather events,*
Potential Impact (then)	*then bridges, roadways, and structures will be damaged.*

As a result of this exercise, the ODOT risk managers developed an updated list of 44 significant risks that could directly impact Oregon's pavement and bridge system. Once this updated registry was compiled, a survey was provided to pavement and bridge asset owners as well as members of the TAMP Steering Team, AMI, and the Directors Office asking them to rank each of these 44 risks according to the *likelihood* of a risk event occurring, as well the *impact (or consequence)* that the stated risk would have on Oregon's transportation system. For ranking consistency by multiple subject matter experts, the definitions for these risk factors were defined as follows:

Likelihood* *(or frequency)* **how likely will this event occur in the TAMP 10-yr timeframe?*	**Impact*** *(or significance)* **impact to the entire system- not just an individual asset*
1- Very unlikely to occur *(or once every 50+ years)* **2- Unlikely to occur** *(or less than every 10 years)* **3- Likely to occur** *(or about every 10 years)* **4- Very likely to occur** (or *more than every 10 years)* **5- Extremely likely to occur** *(or more than every few years)*	**1- Very Low Impact** *(insignificant)* **2- Low Impact** *(minor)* **3- Medium Impact** *(moderate)* **4- High Impact** *(major)* **5- Very High Impact** *(catastrophic)*

The scores for each of these risk factors were then combined to determine a risk ranking, and in turn a prioritization of risk. In recognition that an event that is less likely to happen but would have catastrophic consequences should be prioritized over a risk that is likely to happen but would have minor or insignificant consequences, the flowing formula was used to rank risks based on likelihood and impact:

Risk Ranking= (Impact * 1.25) + (Likelihood)

The following matrix identifies the risk ranking based on this formula and identified scoring criteria:

Likelihood	Impact: Insignificant (1)	Minor (2)	Significant (3)	Major (4)	Catastrophic (5)
Very Unlikely (1)	Very Low (2.25)	Very Low (3.5)	Low (4.75)	Moderate (6)	High (7.25)
Unlikely (2)	Very Low (3.25)	Low (4.5)	Moderate (5.75)	High (7)	High (8.25)
Possible (3)	Low (4.25)	Moderate (5.5)	Moderate (6.75)	High (8)	Extreme (9.25)
Likely (4)	Moderate (5.25)	Moderate (6.5)	High (7.75)	Extreme (9)	Extreme (10.25)
Very Likely (5)	Moderate (6.25)	High (7.5)	High (8.75)	Extreme (10)	Extreme (11.25)

Scoring Criteria: *Very Low: 0-4, Low: 4-5, Moderate: 5-7, High: 7-8, Extreme: 9+*

The risks and corresponding risk statements identified in this process, as well as impact scores, likelihood scores, and cumulative risk rankings are documented in *Table 13: Risk Register*.

3. Identification of Top Priority Risks and Mitigation Actions

Based on the rankings of risks identified in the risk registry, the TAMP Steering Team determined that any risks that were ranked as HIGH (7+) or EXTREME (9+) should be identified as priority risks for the purposes of developing and documenting mitigations plans within the TAMP. In total, ten of the 44 risks were identified as High or Extreme:

1. **Fuel Efficient and Alternative Fuel Vehicles:**
   If there are improvements in fuel efficiency and proliferation of alternative fuel vehicles, then future available funds may be reduced.
2. **Knowledge Transfer:**
   If we lack appropriate knowledge management and succession planning, then future staff may not have sufficient knowledge to perform needed work.
3. **Cascadia Subduction Zone Earthquake:**
   If there is a Cascadia Subduction Zone Earthquake, this would result in large-scale injuries and fatalities, tsunami and landslide risk, major road and bridge damage, and adverse impacts to the movement of people and freight.
4. **Technical Skills Development:**
   If complex design and engineering work is heavily outsourced to consultants, then the agency may not be able to develop and retain a workforce with necessary technical skills and ability to manage consultant work.
5. **Winter Maintenance- Rock Salts:**
   If rock salt is used during the winter, then this may cause increased deterioration of pavement and bridges.
6. **Prioritizing Capacity Projects:**
   If capacity projects are prioritized for funding, then money is diverted from maintenance, preservation and rehabilitation work.
7. **Bridge Scour:**
   If bridge scour needs are not addressed, then bridges could fail as a result of scour.
8. **Economic Recession:**
   If the state experiences an economic recession, this may result in a reduction in the effective level of funding.
9. **Underfunded Maintenance:**
   If maintenance is continually underfunded, then this may cause accelerated asset deterioration.
10. **Increases in Material Costs:**
    If there are unexpected cost increases in pavement and bridge materials (aggregate, steel, etc.), construction and maintenance cost could increase drastically.

A summary of these "High Priority Risks" and their corresponding mitigation potential, strategy, and actions are documented in *Table 14: Mitigation Plans for High Priority Risks*

4. Documentation of Risk Management Activities

ODOT is already engaged in a number of risk management activities, and in many cases has already identified and is addressing high priority risks that may impact achieving the goals of the TAMP. In order to better manage and communicate the many risks impacting Oregon's pavement and bridge assets, ODOT will continue to document and update the major risks through the asset management program and the ongoing TAMP development process. This documentation and communication effort will draw upon the many plans and studies developed by the agency to manage major risks, including but not limited to:

- *The Oregon Highways Seismic Plus Report* (October 2014)
- *Seismic Lifelines Evaluation, Vulnerability Synthesis, and Identification* (May 2012)
- *Nondestructive Evaluation of Bridge Decks using Infrared Thermography (IR) and Ground Penetrating Rader (GPR)* (September 2016)
- *Tsunami Inundation Scenarios for Oregon* (2013)
- *Cathodic Protection Evaluation* (June 2014)
- *Rough Roads Ahead 2* (February 2017)
- *Climate Change Vulnerability Assessment and Adaptation Options Study* (December 2014)
- *ODOT's Climate Change Adaptation Strategy Report* (April 2012)
- *Oregon Statewide Transportation Strategy* (March 2013)
- *ODOT's Succession Planning Guide* (May 2017)
- *Strategic Business Plan* (April 2018)

Further details on these risk-related plans and studies is included in the *TAMP Index of Plans, Publications and Reports.*

Table 13: Risk Register

ID	Category	Description	Risk Statement	Potential Impacts Relevant to TAMP					Current Controls	Owner	Risk Matrix Score		
				Targets in the TAMP may not be met	Bridge & pavement program funding could decrease	Acceleration of pavement and bridge deterioration	Damage to roads or bridges requiring diversion of funds	Suboptimal or inefficient use of revenue			**Likelihood** (or Frequency)	**Impact** (or Consequence)	Score and Ranking
1	Asset Performance	Bridge Scour	If bridge scour needs are not addressed, then bridges could fail as a result of scour.	X					Bridge Engineering identifies, analyzes, evaluates, and mitigates this ongoing risk.	Bridge Engineering	3.0	3.7	HIGH
2	Asset Performance	Corrosion	If corrosion on steel bridges and reinforced concrete bridges is not addressed, then bridges could fail as a result of corrosion.	X					Bridge Engineering identifies, analyzes, evaluates, and mitigates this ongoing risk.	Bridge Engineering	2.7	3.0	MODERATE
3	Asset Performance	Fatigue Cracking	If fatigue cracking on steel bridges is not addressed, then bridges could fail as a result of fatigue cracking.	X					Bridge Engineering identifies, analyzes, evaluates, and mitigates this ongoing risk.	Bridge Engineering	3.0	3.0	MODERATE
4	Asset Performance	Winter Maintenance-Rock Salt	If rock salt is used during the winter, then this may cause increased deterioration of pavement and bridges.	X					Performed a study to determine the impact of rock salt use on roads. Planning seal and overlay work in anticipation of rock salt use in winter	Bridge Engineering/ Pavement Services Unit	4.3	2.8	HIGH
5	Asset Performance	Truck Volume/Weights	If truck traffic and/or weights increase at a greater rate than anticipated, this may cause accelerated pavement and bridge deterioration.	X						Bridge Engineering/ Pavement Services Unit	2.3	3.0	MODERATE
6	Asset Performance	Non-State NHS Pavement and Bridges	If non-state NHS pavement and bridge assets are not maintained with asset management principles, then the agency may not meet condition targets.	X				X		Bridge Engineering/ Pavement Services Unit	2.0	1.8	LOW
7	Asset Performance	Non-State NHS Pavement and Bridges	If non-state NHS pavement and bridge assets are in poor condition, funds to fix local NHS assets may need to be diverted from higher-priority state highway NHS roads.	X				X			1.5	2.0	LOW
8	Asset Performance	Other Tier 1 Assets	If other Tier 1 assets (aside from pavement and bridge) fail, then increased funds may be needed for these assets.		X					Tier 1 Asset Owners	3.0	2.8	MODERATE
9	Asset Performance	Prioritizing Capacity Projects	If capacity projects are prioritized for funding, then money is diverted from maintenance, preservation and rehabilitation work.			X					3.3	3.5	HIGH
10	Asset Performance	Worst-First Asset Investments	If poor condition assets are prioritized for funding, then money is diverted from preservation projects that keep good condition assets from falling into fair condition and fair condition assets from falling into poor condition.	X		X			Asset management investment decisions seek to strike the right balance between preservation and rehabilitation to meet long-term condition targets	Bridge Engineering/ Pavement Services Unit	2.5	3.0	MODERATE

11	Asset Performance	PM2 Minimum Conditions	If minimum condition requirements pertaining to interstate pavement and bridges in poor condition (PM2s) are not met, funds may need to be diverted from preservation and preventative maintenance.					X			1.8	3.3	MODERATE
12	Highway Safety	Construction Defects	If there are construction defects on bridges, then additional safety investments may be required.		X					Bridge Engineering/Construction Section	2.0	2.0	LOW
13	Highway Safety	Design Standards	If assets do not meet current design standards for traffic and safety features, then additional investments may be required.		X					Other Tier 1 Asset Owners	3.3	2.8	MODERATE
14	Highway Safety	Bridge Railing	If deficient bridge railing is not addressed, then this may cause injuries and fatalities.		X					Bridge Engineering	2.7	2.0	MODERATE
15	Highway Safety	Automated and Connected Vehicles	If the deployment of automated and connected vehicles impact highway safety feature needs and priorities, this may result in suboptimal near-term decisions around safety investments that have long-term impact.					X		Bridge Engineering/ ODOT Research	1.5	2.0	LOW
16	External Threats	Litigation	If there are lawsuits regarding assets, then this may require diversion of funds.		X						3.3	2.8	MODERATE
17	External Threats	Earthquakes *(non-Cascadia subduction)*	If there is a (non-Cascadia subduction) earthquake, then this may result in injuries and fatalities, road and bridge damage, and adverse impacts to the movement of people and freight.				X		Performed a vulnerability assessment. Conducting triage studies to increase mobility.	Geo-Environmental Section/ Bridge Engineering	2.3	2.0	LOW
18	External Threats	Cascadia Subduction Zone Earthquake	If there is a Cascadia Subduction Earthquake, this would result in large-scale injuries and fatalities, tsunami and landslide risk, major road and bridge damage, and adverse impacts to the movement of people and freight.								2.3	5.0	HIGH
18	External Threats	Flooding	If there is severe flooding, then this may result in injuries and fatalities, damaged roadways, and adversely impact the movement of people and freight.				X		Developing flood and sea level rise risk mapping.	Geo-Environmental Section/ Bridge Engineering; Transportation Development Division	3.0	2.7	MODERATE
19	External Threats	Fires	If there are severe fires, then this may result in injuries and fatalities, damaged roadways, and adverse impacts to the movement of people and freight.				X			Geo-Environmental Section/ Bridge Engineering	3.0	2.0	MODERATE
20	External Threats	Tsunami	If there is a tsunami, then this may result in injuries and fatalities, damaged roadways, and adverse impacts to the movement of people and freight.				X			Geo-Environmental Section/ Bridge Engineering	1.7	4.0	MODERATE
21	External Threats	Landslides	Is there is a landslide, then this may result in injuries and fatalities, damaged roadways, and adverse impacts to the movement of people and freight.				X		Developing landslide risk mapping; costal landslide and bluff monitoring research.	Geo-Environmental Section	3.3	2.3	MODERATE
22	External Threats	Storm Damage	If there is an increasing number of storms due to climate change, then this may result in injuries and fatalities, damaged roadways, and adverse impacts to the movement of people and freight.			X	X		Maintenance resource optimization; hazard tree removal program; performing coastal resilience pilot studies; assess vulnerabilities and risks from storms.	Maintenance and Ops; Geo-Environmental Section; Transportation Development Division	3.3	2.7	MODERATE
23	External Threats	Crash Damage	If there is vehicle crash damage (bridge hits, spills, etc.), then the damage will need to be repaired.			X	X			Bridge Engineering/ Pavement Services Unit	3.8	2.0	MODERATE

24	External Threats	Terrorism or Sabotage	If there is terrorism or sabotage, this may result in injuries and fatalities, damaged roadways, and adverse impacts to the movement of people and freight.				X				1.0	2.7	LOW
25	Finances	Funding Uncertainty	If there is uncertainty of future funds, then the agency may face challenges in making optimized tradeoff decisions.					X	Federal revenue projections take a conservative approach, assume a 10% reduction.	Program and Funding Services/ Economic & Financial Analysis	3.0	2.3	MODERATE
26	Finances	Demographic Changes *(impacting revenue)*	If there is uncertainty in funding caused by demographic changes (i.e. aging population, urbanization, vehicle automation), then the agency may face challenges in making optimized tradeoff decisions.					X		Program and Funding Services	2.0	2.0	LOW
27	Finances	Underfunding Maintenance	If maintenance is continually underfunded, then this may cause accelerated asset deterioration.			X				Highway Budget Office	3.0	3.3	HIGH
28	Finances	Inaccurate Revenue Projections	If state or federal revenue projections are inaccurate, then this may result in suboptimal decisions concerning what work to perform.					X	Federal revenue projections take a conservative approach, assume a 10% reduction. State projections updated every 6 months.	Program and Funding Services/Economic & Financial Analysis	2.3	2.5	MODERATE
29	Finances	Inflation	If inflation increases at a greater rate than predicted, then this may result in reduction in the effective level of funding.			X			Financial and revenue projections are updated every 6 months, and OTP provides guidance on investment under constrained revenue scenario.	Program and Funding Services/Economic & Financial Analysis	3.0	3.0	MODERATE
30	Finances	Economic recession	If the state experiences an economic recession, this may result in a reduction in the effective level of funding.			X			Financial and revenue projections are updated every 6 months, and OTP provides guidance on investment under constrained revenue scenario.	Program and Funding Services/Economic & Financial Analysis	3.5	3.0	HIGH
31	Finances	Fuel Efficiency and Alternative Fuel Vehicles	If there are improvements in fuel efficiency and proliferation of alternative fuel vehicles, then future available funds may be reduced.			X			Financial and revenue projections are updated every 6 months, and OTP provides guidance on investment under constrained revenue scenario.	Program and Funding Services/Economic & Financial Analysis	4.0	3.5	HIGH
32	Finances	Funding for Data Collection and Maintenance	If there is not sufficient funding for data collection and data maintenance, then asset inventories will be incomplete and unreliable.					X		Program and Funding Services/ Asset Management Integration	2.3	2.5	MODERATE
33	Finances	Dedicated Funding for Other Tier 1 Assets	If the Tier 1 assets (excluding pavement and bridge) lack dedicated funding, then this may reduce available funding for pavement and bridge work.		X					Program and Funding Services	2.5	2.3	MODERATE
34	Finances	Dedicated Funding for NHS	If there is a lack of dedicated funding for NHS assets, then it may be difficult to estimate the total spending on the NHS.	X						Program and Funding Services	2.0	2.0	LOW
35	Finances	Impacts Of Debt Servicing	If the debt servicing costs increase, then funding for asset management may be reduced.			X			Debt service requirements are monitored on an ongoing basis.	Program and Funding Services	2.8	2.8	MODERATE

36	Information & Decisions	Performance and Analysis Models	If we do not have reliable asset performance and analysis models, then we may not correctly predict future conditions.			X		X		Bridge Engineering/ Pavement Services Unit/ Other Asset Owners	2.3	2.8	MODERATE
37	Information & Decisions	Quality Of Asset Inventory and Condition Data	If we have incomplete or poor quality data on asset inventory and/or condition, then we may not correctly predict future conditions and needed work.			X		X	Working on updating asset inventory for culverts, curb ramps, traffic signals, and rockfall/landslide mitigation features.	Bridge Engineering/ Pavement Services Unit/ Other Asset Owners	2.3	2.8	MODERATE
38	Information & Decisions	Data Management Software Upgrades	If new data management software is needed or required, this may divert revenue and staff and/or cause current asset inventory systems to fail.					X	Strategic Data Business Plan developing recommendations on how to better upgrade and manage data systems.		2.5	2.0	MODERATE
39	Information & Decisions	Demographic Changes *(impacting system demand)*	If there is uncertainty in system demand caused by demographic and technology changes (i.e. aging population, urbanization, vehicle automation), then this may result in suboptimal decisions concerning system investment.			X		X		Planning	2.0	2.0	LOW
40	Business Operations	Knowledge Transfer	If we lack appropriate knowledge management and succession planning, then future staff may not have sufficient knowledge to perform needed work.					X	Succession Planning Workbook. Competency-based performance system.	Human Resources	3.8	3.5	HIGH
41	Business Operations	Technical Skills Development	If complex design and engineering work is heavily outsourced to consultants, then the agency may not be able to develop and retain a workforce with necessary technical skills and ability to manage consultant work.					X			3.8	3.3	HIGH
42	Business Operations	Lack of Project Delivery and Engineering Staff	If we lack experienced project delivery and engineering staff, then we may not be able to perform needed work.					X		Human Resources	3.3	2.8	MODERATE
43	Business Operations	Contractor Capacity	If contractors lack the capacity to perform the needed volume of certain types of work, then we may not be able to perform the needed work.					X		Human Resources	2.0	2.5	MODERATE
44	Business Operations	Changes In Regulations/ Legislative Mandates	If there are future changes to regulations or legislative mandates, then this may result in diversion of funds.		X					Office of the Director	3.3	2.8	MODERATE

Additional Risks- identified after agency-wide risk scoring process:

45	*Finances*	*Increases in Material Costs*	*If there are unexpected cost increases in pavement and bridge materials (aggregate, steel, etc.), construction and maintenance cost could increase drastically.*		*X*					*Program and Funding Services/Economic & Financial Analysis*	*n/a*	*HIGH*[24]
46	*Asset Performance*	*Investment in strengthening bridges for emergency vehicles*	*If the agency invests substantially in ensuring bridges are strengthened to accommodate heavy emergency vehicles, limited revenue could be diverted away from preserving, rehabilitating and replacing bridges at the appropriate time in their service life*			*X*		*X*		Bridge Engineering;	*n/a*	*n/a*

[24] *Risk #45 (Increases in Material Costs) was a risk identified by AMEC and added to the risk register after completion of the agency-wide risk likelihood/impact scoring process. This risk therefore did not go through the same scoring process as other agency risks, but was determined by executive leadership to be a high-priority risk.*

Figure 30: Summary of Risk Matrix Scores

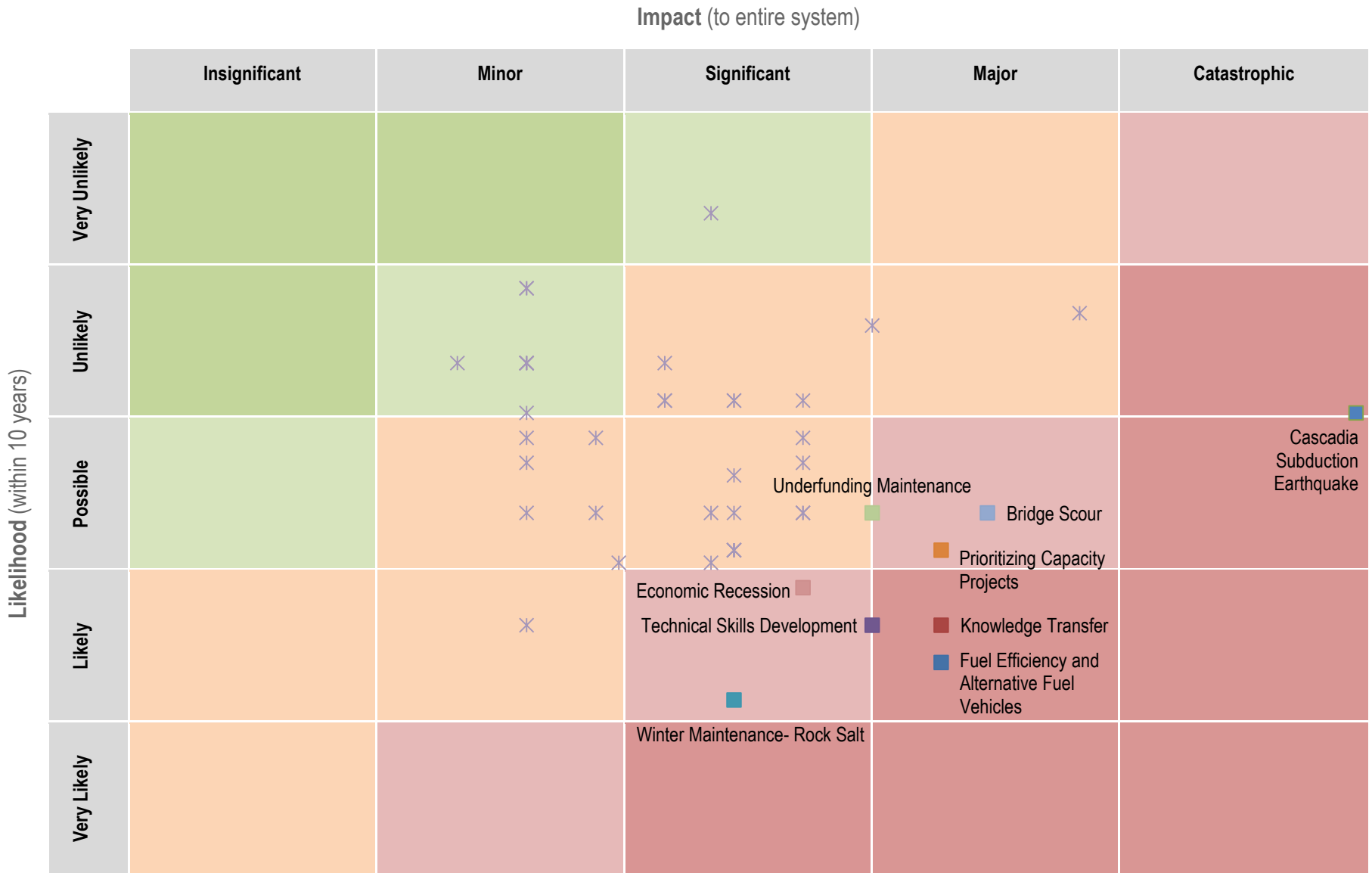


Table 14: Mitigation Plans for High Priority Risks

The following table identifies the items from the previous Risk Register that were identified as "High Risk" and assesses their mitigation potential as well as potential mitigation strategies and actions:

ID	Category	Description	Likelihood	Impact	Score	Mitigation Potential	Mitigation Strategy	Mitigation Actions
18	External Threats	Cascadia Subduction Earthquake	2.3	5.0	8.58	Major impacts from a Cascadia Subduction Earthquake cannot be prevented, but investments in bridge and landslide resiliency along critical corridors can drastically reduce casualties, support emergency response and expedite recovery efforts.	Develop and implement resiliency plans and programs including the Seismic Plus Program. https://www.oregon.gov/ODOT/Bridge/Docs_Seismic/Seismic-Plus-Report_2014.pdf Adopt project design changes that increase asset resiliency. http://www.oregon.gov/ODOT/Bridge/Pages/Seismic.aspx	Implement Seismic Plus Program on priority transportation life-line corridors. Stockpile supplies and equipment in key locations that can support road and bridge repair and recovery efforts.
31	Finances	Fuel Efficiency and Alternative Fuel Vehicles	4.0	3.5	8.38	Financial risks can be mitigated through monitoring trends and adjustments to tax rates and revenue sources that are tied to fuel consumption.	Complete cost responsibility studies and implement findings. Maintain ongoing communication on financial risks with state legislators and other policymakers.	Propose adjustments to gas tax rates. Propose adjustments to alternative fuel vehicle registration and other fees. Implement Mileage-based user charges.
40	Business Operations	Knowledge Transfer	3.8	3.5	8.13	Loss of experience and institutional knowledge can be reduced through expanded mentorship and cross-training programs.	Develop and implement knowledge transfer programs and transition plans.	Develop a Succession Planning Workbook. Establish a competency-based performance system.
41	Business Operations	Technical Skills Development	3.8	3.3	7.81	Impacts of diminished technical competency of agency staff can be mitigated through the provision of ongoing opportunities and requirements for maintaining and improving technical skill.	Ensure proper balance of outsourced versus in-house work to ensure adequate staff technical skills development.	Implement workforce development strategies to ensure prevalence of technical competency among agency staff, and provide ongoing opportunities to improve non-technical skills.
4	Asset Performance	Winter Maintenance-Rock Salts	4.3	2.8	7.69	Impacts of rock salts on pavement and bridge condition can be mitigated through limiting its use to areas where the need is critical, and impacts on asset condition is lower.	ODOT's Rock Salt Pilot Program will help the agency determine how to use solid salt, in combination with the snow fighting tools already in use, to improve highway safety and mobility while attempting to minimize impact to the environment. http://www.oregon.gov/ODOT/Maintenance/Pages/Salt-Pilot.aspx	ODOT is concerned about the impact of salt on the environment, infrastructure and vehicles. ODOT will continue to implement best practices for storing and using salt, and will pursue appropriate research to inform effective decision making.
9	Asset Performance	Prioritizing Capacity Projects	3.3	3.5	7.63	Impacts can be mitigated through ensuring that maintenance and preservation of assets continues to be prioritized above projects that increase capacity.	Maintain ongoing communication with policymakers and other decision-makers on the need to prioritize maintenance and preservation funding over projects that increase capacity.	Limit undertaking capacity projects to only those that complete the legislatively required benefit-cost analysis and are found to be most consistent with ODOT goals and objectives.

1	Asset Condition and Performance	Bridge Scour	**3.0**	**3.7**	**7.58**	Bridge scour can be mitigated on new bridges through adequate design. Impacts to existing bridges can be managed through routine inspections.	Manage risk through adequate design of new bridges and routine inspection of existing bridges.	Manage risk through adequate design of new bridges and routine inspection of existing bridges.
30	Finances	Economic recession	**3.5**	**3.0**	**7.25**	Risk of economic recession cannot be prevented but it can be somewhat constrained through management of agency expenditures and a shift toward more stable funding sources.	Identify stable funding sources that are adequate to meet asset maintenance and preservation needs during periods of economic recession.	Monitor federal and state economic conditions and expectations. If needed adjust agency expenditures to minimize adverse impacts on the condition and performance of bridge and pavement assets.
27	Finances	Underfunding Maintenance	**3.0**	**3.3**	**7.06**	Underfunded maintenance can be mitigated through adequate dedication of financial resources.	Ensure that new revenue allocations such as HB2017 adequately fund maintenance needs.	Monitor programmed and planned agency maintenance expenditures, adjust actual expenditures to meet agency maintenance goals and objectives.
45	Finances	Increases in Material Costs	***n/a***[25]		**[high]**	ODOT has little control over the fluctuation of materials costs on the regional or national marketplace. However, the agency can take proactive steps to safeguard itself from the impact of these major market fluctuations.	Monitor and track market trends and fluctuations in material costs. Identify cost savings strategies.	Employ cost-effective construction materials and practices. Ensure the agency maintains affordable access to essential construction materials including aggregates.

[25] *Risk #45 (Increases in Material Costs) was a risk identified by AMEC and added to the risk register after completion of the agency-wide risk likelihood/impact scoring process. This risk therefore did not go through the same scoring process as other agency risks, but was determined by AMEC to be a high-priority risk.*

Facilities Requiring Repair and Reconstruction Due to Emergency Events

Part 667 of the Final Rule for the development and implementation of a risk-based asset management plan requires State DOTs to conduct periodic evaluation of transportation infrastructure to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction on two or more occasions due to emergency events. An 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 reoccurring 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 heath and the human and natural environment; and
3. Meet transportation needs as described in relevant and applicable federal, state, local and tribal plans and programs. Relevant and applicable plans and programs include the Long-Range Statewide Transportation Plan, Statewide Transportation Improvement Program (STIP), Metropolitan Transportation Plan(s), and Metropolitan Transportation Improvement Program (s) TIP.

Not later than November 23, 2018, State DOTs are to complete a statewide evaluation for all NHS roads, highways and bridges. The State DOT is to update the evaluation after every emergency event that requires the repair and reconstruction of a highway or bridge as a result of a previous emergency event. The entire statewide evaluation is to be reviewed and updated at least every four years. Not later than November 23, 2020, State DOTs are to include in the statewide evaluation all roads, highways and bridges not on the NHS that have required repair and reconstruction as a result of emergency events.

State DOTs are to consider the results of the evaluation of highways and bridges repaired and reconstructed as a result of two or more emergency events when developing projects. State DOTs and MPOs are encouraged to include evaluations during the development of transportation plans and programs. Among the information to be produced as part of the risk management analysis section of a state's asset management plan is "a summary of the evaluation of facilities repeatedly damaged by emergency events."

As background, the Oregon Division Office of FHWA provided ODOT with a summary of awarded funding for emergency event repairs beginning with the year 1962. Over the course of the last 57 years, ER funding received by the state totals just over $353 million in year of expenditure dollars and just under $565 million in 2018 dollars. As shown in the following table, the emergency funding for the repair and reconstruction of NHS highways and bridges over the course of the last 21 years has totaled $118.5 million in year of expenditure dollars and $138.3 million in 2018 dollars.

Table 15: Oregon Emergency Relief Program Funding 1997-2018

Year	Current Dollars	2018 Dollars
2018	$ 36,870,916	$ 36,870,916
2017	$ 39,848,418	$ 41,093,791
2016		
2015		
2014	$ 2,137,727	$ 2,340,444
2013		
2012	$ 990,618	$ 1,121,851
2011	$ 225,398	$ 250,960
2010		
2009	$ 767,177	$ 914,109
2008		
2007		
2006	$ 4,615,831	$ 5,800,694
2005		
2004		
2003		
2002		
2001	$ 2,029,440	$ 2,887,176
2000	$ 6,200,357	$ 9,022,031
1999		
1998		
1997	$ 24,846,410	$ 37,979,390
Total	**$ 118,532,292**	**$ 138,280,362**

The nature of Oregon's location, topography and geology subjects the state to an increased likelihood that pavements and bridges in certain locations will be subject to extreme weather and/or seismic damage. The western portion of the state is located over one of the most seismically active regions in the world and demonstrates a history of strong earthquakes. Oregon's coast and Cascade Mountains have always been susceptible to extreme weather events and erosion.

ODOT has long recognized the vulnerability of transportation infrastructure to extreme weather and emergency events and the risks they present to the condition and performance of pavements and bridges. Weather-induced landslides and rockfalls have been ongoing challenges for the agency since its initial founding. In the late 1990s, the agency established an Unstable Slopes Management Program, and initiated an effort to inventory and rate all known landslide and rockfall locations along the state's highways. In 2007, the inventory of landslide and rockfall sites totaled nearly 3,700 with an estimated repair cost exceeding $2.7 billion[26].

Extreme weather accelerates asset deterioration and requires the use of differing preservation and maintenance measures. Lower costs solutions which contribute to reduced lifecycle costs include various actions presented in Oregon's Climate Change Adaption Framework and ODOT's Climate Change Adaptation Strategy Report including: enhanced monitoring and maintenance of slopes, embankments, and drainage systems; installation of groundwater piping systems; and minor realignment/elevation increase of pavement and bridge infrastructure.

Table 16 presents instances where portions of NHS routes within specific counties have experienced damage from more than one emergency event during the 21-year period January 1, 1997 through December 31, 2018. A process has been established that provides for a determination if an emergency event damaged highway or bridge required repairs or reconstruction due to a previous emergency event. Highway and bridges found to have required previous repairs will be evaluated by engineering staff and others to determine if there are reasonable and cost-effective alternatives that would mitigate, or partially or fully resolve the root cause of reoccurring damage.

Table 16: NHS Infrastructure Damaged by More than One Emergency Event (1997-2018)

NHS Route	County	Start MP	End MP	Type of Damage	Number of Events
I-84	Multnomah	18.00	42.00	Storm debris, mud slides, rockfall	3
US20	Lincoln	2.20	20.00	Storm debris, slide, shoulder, sink, culvert	6
	Linn	56.10	65.00	Storm debris, slide, sink, washout, landslide	4
US26	Clatsop	0.00	28.00	Storm debris, slide, sink, guardrail	4
	Washington	37.00	41.14	Storm debris, slide, sunken grade	3
	Clackamas	61.00	62.75	Storm debris, slide	2
US30	Multnomah	6.40	11.60	Storm debris, slide, culvert, landslide	3
	Columbia	34.00	67.00	Storm debris, rockfall, slide and culvert	5
US101	Clatsop	0.00	37.10	Storm debris, slide	4
	Tillamook	37.00	103.00	Storm debris, slide, washout, guardrail, culvert	7
	Lincoln	128.94	167.60	Storm debris, slide, sink, landslide,	7
	Lane	172.00	190.84	Storm debris, slide, scour, landslide	6
	Douglas	198.56	213.00	Storm debris, slide, slope failure	5
	Coos	233.50	248.50	Storm debris, slide, shoulder damage	4
	Curry	292.00	350.40	Storm debris, slide, sink	6
US395	Grant	3.50	15.00	Storm washout, unstable slope, wildfire damage	2
OR18	Lincoln	2.00	10.40	Storm debris, slide, shoulder, guardrail	6
	Tillamook	10.10	14.00	Storm debris, slide, shoulder, guardrail	5
	Polk	14.90	23.24	Storm debris, slide, sink, washout, culvert, guardrail	2
OR22	Polk	12.72	26.18	Storm debris, Landslide, washout	5
	Marion	30.00	46.20	Storm debris, slide, washout, scour, culvert	5
OR38	Douglas	0.00	49.00	Storm debris, slide, shoulder, culvert	5
OR42	Douglas	14.70	49.00	Storm debris, rockfall, slide, culvert	4
	Coos	34.00	44.00	Storm debris, slide, roadway collapse	4
OR47	Columbia	0.00	11.00	Storm debris, multiple slides,	2
OR126	Lane	15.00	22.50	Storm debris, slide, shoulder, culvert	5

[26] Landslide & Rockfall Program, *2010-2013 Statewide Transportation Improvement Report*, Unstable Slopes Program Needs, Oregon Department of Transportation, 2007

Section 8

FINANCIAL PLAN

- Overview of TAMP Financial Plan
- Revenue Sources
- Revenue Trends, Risks, and Assumptions
- Revenue Projections
- Revenue Uses
- Forecasted Revenue Use Scenarios
- Asset Value and Investment Scenario to Maintain Value

Overview of TAMP Financial Plan

Oregon pays for the construction, preservation, maintenance, and operation of the highway system with revenues derived from a variety of state and federal sources. The majority of state and federal revenues are derived from fuel taxes and other taxes and fees on vehicles.

The development of ODOT's financial plan and investment strategies is influenced by a wide variety of factors including demographic and revenue trends, federal and state regulations, system physical conditions, technological innovations, environmental conditions, and public input. The actions and priorities adopted by the agency seek to balance investments in preserving and improving the condition and performance of the transportation system with investments in safety, multimodal transportation and other projects that enhance Oregon's economic competiveness and quality of life.

Growth in revenues available for the preservation and improvement of Oregon's transportation infrastructure has been outpaced by the growth in the funding needs for an aging system of highways and bridges. As a result, there is an increased importance in identifying investment opportunities that maximize condition performance and safety of the transportation system for the least cost possible. Timely investments in preservation and maintenance treatments not only help increase the service life of transportation assets but also reduce lifecycle costs.

This chapter presents the TAMP financial plan and investment strategies, summarizes federal and state requirements, revenue sources and uses, revenue trends and projections, and highlights investment levels and strategies proposed for State and National Highway System bridges and pavement. The processes employed in the development of the financial plan and investment strategies use established procedures for financial decision-making and analysis. The processes highlight the use of information from proven management systems, involve input from across the agency, reflect coordination with agency short-term and long-term planning efforts, and are guided by the transportation policies and priorities of the Oregon Transportation Commission, the Oregon State Legislature, and the Oregon Transportation Plan.

TAMP Financial Plan Requirements

Federal statute requires every State DOT to develop a financial plan as part of the TAMP that encompasses at least 10 years and identifies the revenues and costs associated with preserving and improving the condition and performance of the transportation assets included in its asset management plan. The financial plan is to include a summary of financial resources and needs for achieving established performance targets and asset management objectives.

Federal regulations require that a State DOT establish processes for developing its financial plan. Specific requirements for these processes are listed below:

Financial Plan Process Requirements

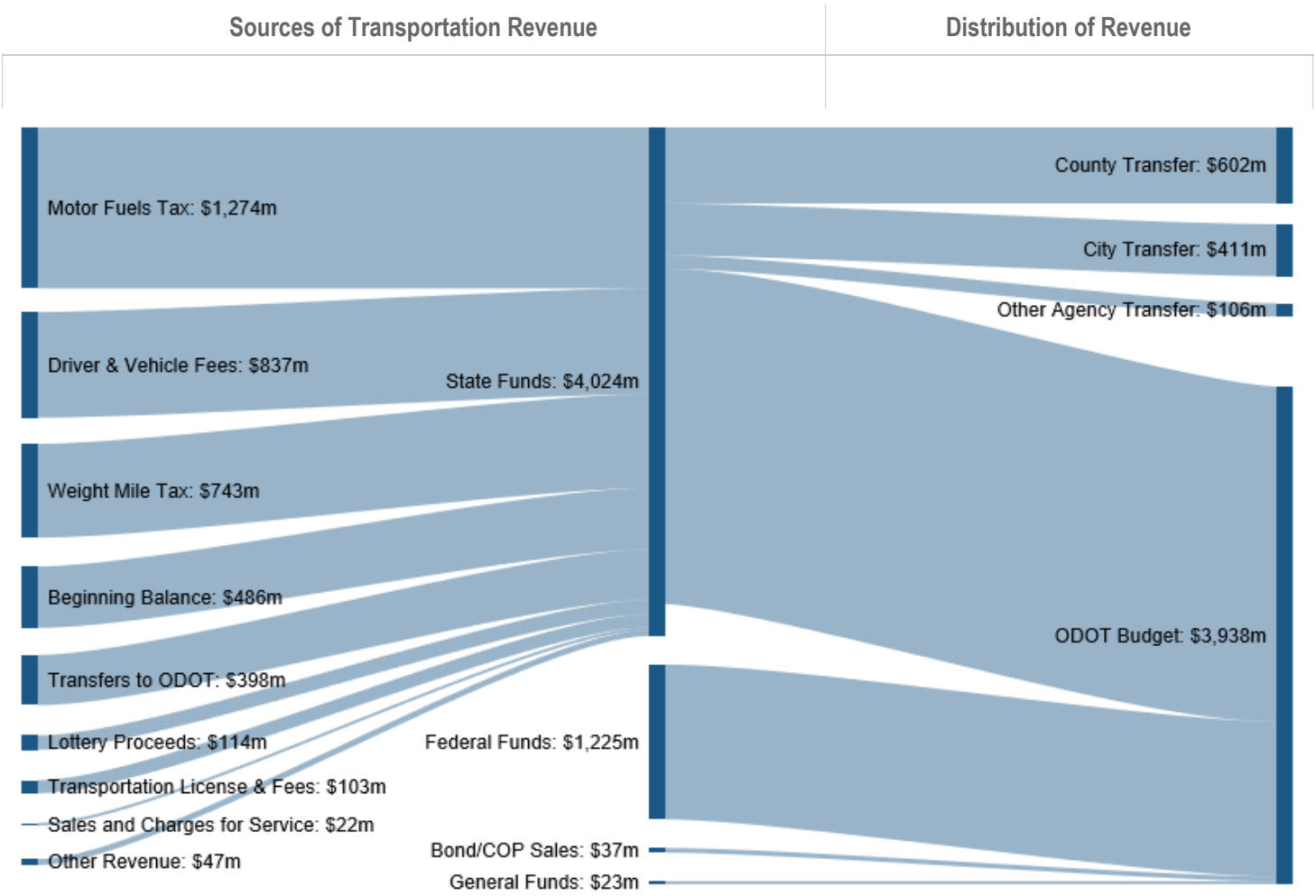
- *Estimate the expected future work to implement investment strategies contained in the asset management plan, by state fiscal year and work type;*
- *Estimate the funding levels that are expected to be reasonably available, by state fiscal year, to address the costs of future work types;*
- *Identify anticipated funding sources; and*
- *Estimate the value of the agency's NHS pavement and bridge assets and the needed investment on an annual basis that is needed to maintain the value of these assets*

Revenue Sources

ODOT receives revenue from a variety of federal and state sources. The primary sources of both federal and state revenues are taxes and fees associated with the ownership and operation of motor vehicles.

The state of Oregon has a two-year budget cycle that begins July 1 of odd-numbered years. The budget development process has three major phases: the Agency Requested Budget, the Governor's Recommended Budget and the Legislatively Adopted Budget. ODOT's Legislatively Adopted Budget identifies sources of state and federal transportation funds and how these funds are distributed between ODOT and local agencies An overview of ODOT sources of transportation funds and distributions to counties, cities, MPOs, and other agencies is provided in *Figure 35: ODOT Sources and Distribution of Revenue: 2017-2019 Legislatively Adopted Budget.*

Figure 31: ODOT Sources and Distribution of Revenue: 2017-2019 Legislatively Adopted Budget



Federal Highway Revenue

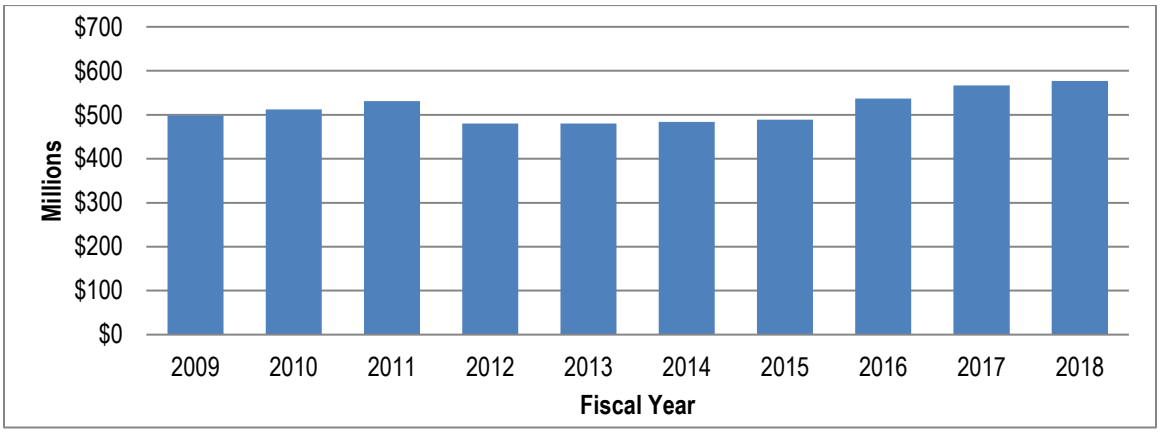
The federal funds received by the state for preserving and improving the state's transportation system are provided through a number of federal programs. The primary source of federal transportation revenues are federal fuel taxes and other truck fees. Federal fuel taxes have not increased since 1993. Since then, purchasing power of a dollar has decreased by more than 40%.

Federal funding for highway projects and activities is provided through the Highway Account of the Highway Trust Fund. As established, expenditures from the account are to be determined by the transportation revenues deposited in the account. However, in the absence of transportation revenue increases to match adopted expenditure levels, Congress has increasingly made General Fund deposits to Highway Trust Fund to ensure solvency of the fund.

The total federal funding states receive in a year is determined largely by formulas written into surface transportation bills. The latest bill was adopted on December 4, 2015 and covers federal fiscal years (Oct 1-Sep 30) 2016-2020. Commonly known as the FAST Act (Fixing America's Surface Transportation Act), it replaces the Moving Ahead for Progress in the 21st Century Act (MAP-21) of 2012.

The following chart presents the federal highway funding Oregon has received over the course of the last 10 years. The funding is shown in terms of obligation limitation, which represents the total federal funding reimbursed to the state in a state fiscal year.

Figure 32: Total Federal Highway Revenue

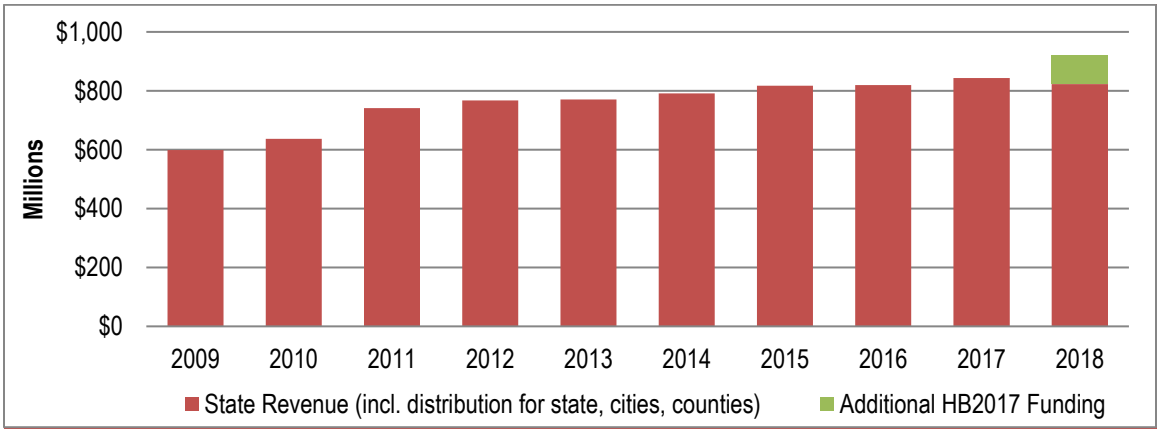


State Highway Revenue

Oregon's fuel taxes, combined with weight-mile taxes for trucks, account for the majority of the state's annual transportation revenue. Fuel taxes, license and vehicle fees and bond proceeds collected by the state are shared with Oregon cities and counties. In accordance with Section 3a, Article 9 of Oregon's Constitution, revenue from these sources are to *"be used exclusively for the construction, reconstruction, improvement, repair, maintenance, operations and use of public highways, roads, streets, and roadside rest areas in this state."*

The following chart presents state funding for the past 10 state fiscal years (2009-2018). In 2017, the Oregon Legislature adopted HB2017, providing ODOT and local jurisdictions with a series of staged increases in transportation funding. Along with historic state funding levels, additional state highway revenue available in 2018 as a result of HB2017 is identified.

Figure 33: Total State Highway Revenue



Revenue Trends, Risks, and Assumptions

In 1919, Oregon became the first state in the nation to adopt a statewide tax on gasoline, generating revenue for a network of roads and bridges across the state aimed to "Get Oregon out of the Mud." Since then, Oregon has made ongoing investments in improving and preserving its system of highways and bridges. Over the course of the last two decades, Oregon has made additional investments in all modes of transportation. Using funds from the Oregon Transportation Investment Acts (OTIA I, II, III), the Jobs and Transportation Act (JTA) and the Keep Oregon Moving Act (HB2017), the state has invested several billion dollars to preserve and improve the condition and performance of Oregon highways and bridges.

Despite the success of these investments in state and federal funding, a number of inescapable infrastructure and financial realities remain unresolved. Funding for Oregon highways and bridges is declining in real terms and is insufficient to preserve and maintain the existing system. At current funding levels, the condition of the state's highways and bridges will continue to decline. The following subsection outlines some of the major risks and assumptions impacting the state's financial outlook.

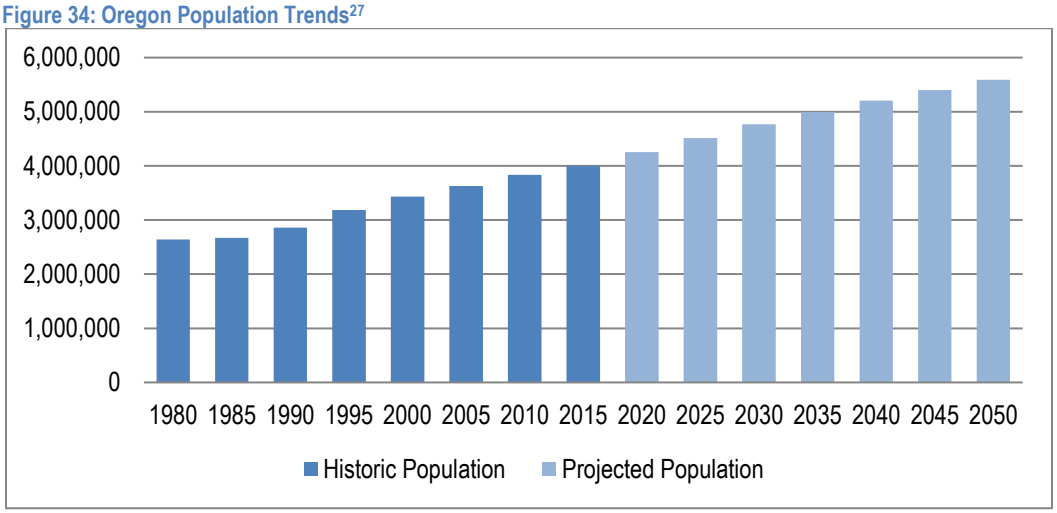
Financial Risks

As outlined in *Section 7: Risk Management,* the Oregon Department of Transportation faces a host of risks when it comes to preserving and maintaining the transportation system. Among these risks are those that create uncertainty around future funding that is available for the agency to implement its asset management strategies. As ODOT embarks on strategic investments over the next decades that aim to maintain and preserve the transportation system in the best condition possible at the least cost, the following risks must be factored into its planning and management efforts:

1. Growing population

Oregon's population is currently growing rapidly and this trend is projected to continue over the next 30 years. By 2035, the state's population is projected to be 25% larger than it was in 2015. This growing population will result in increased demand on Oregon's multimodal transportation assets, just as many of the state's bridges and other major transportation assets are reaching the end of their design life.

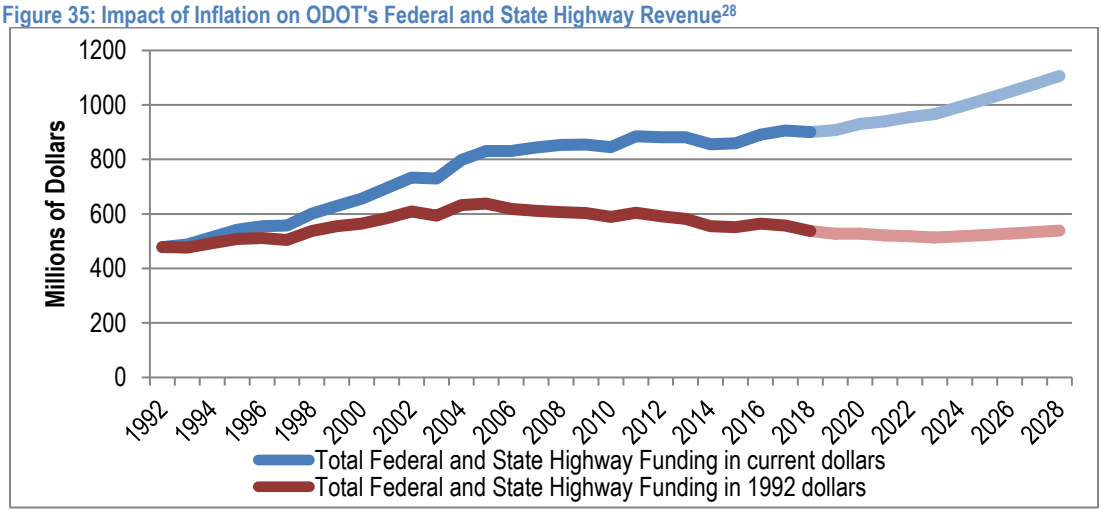
Figure 34: Oregon Population Trends[27]



2. Inflation

Revenue from fuel taxes and vehicle-related fees are the foundation for the Federal Highway Trust Fund and Oregon's State Highway Fund. Because these revenue sources are not responsive to inflation the same way as property, income, or sales taxes, each year their capacity to maintain and improve the transportation system is further diminished. While episodic increases in state fuel tax rates and vehicle user fees (such as the 2009 Jobs and Transportation Act and House Bill 2017) have provided additional revenue for the State Highway Fund, federal fuel taxes and user fees have remained unchanged since 1993. Over the course of the last 25 years, total federal and state highway funds have nearly doubled. However, these funding increases have been overshadowed by the cumulative impact of inflation. The following chart demonstrates the impact of inflation on past and future revenue available for preserving and improving Oregon's transportation system:

Figure 35: Impact of Inflation on ODOT's Federal and State Highway Revenue[28]



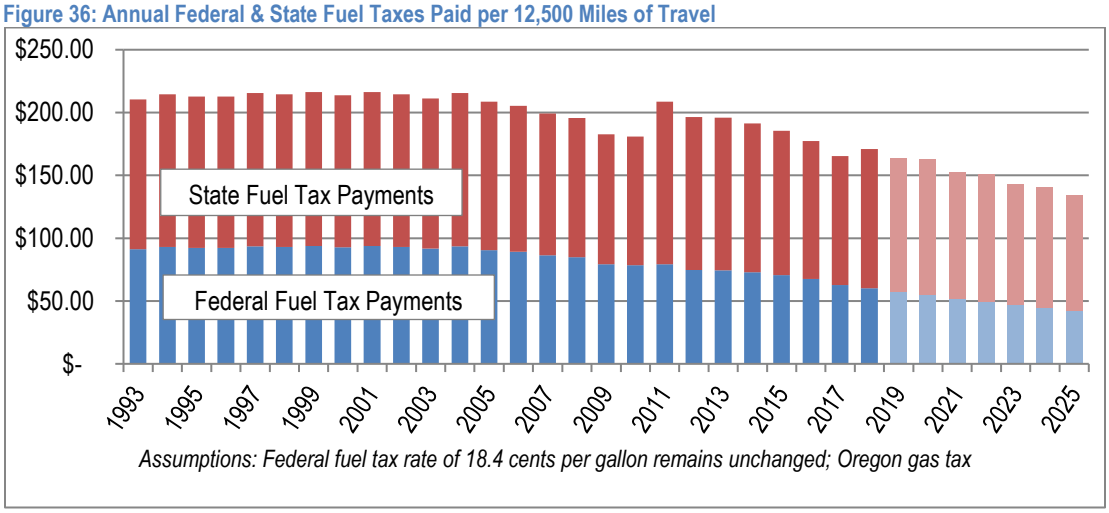
[27] *Forecasts of Oregon's County Populations and Components of Change, 2010 - 2050 Prepared by Office of Economic Analysis, Department of Administrative Services, State of Oregon*

[28] *FHWA and ODOT funding reports and estimates, BEA Implicit Price Deflator series adjusted by IHS Insights 2015 expectations for inflation growth*

3. Vehicle fuel economy

Increases in the fuel economy of motor vehicles, along with shifts in transportation behavior, present a risk to the mid-term and long-term financial stability of Oregon's roadway and bridge system. Roughly half of Oregon's State Highway Fund and three-quarters of the Federal Highway Trust Fund are derived from motor fuels taxes. As the fleet of vehicles on Oregon's roads becomes more fuel efficient, and electric vehicles increase market share, they will have a diminishing impact on the state's ability to fund highway projects and programs through fuel taxes. Under current Corporate Average Fuel Economy (CAFE) Standards, automakers are to raise the average fuel efficiency of new light-duty cars and trucks to 54.5 miles per gallon by 2025. The following chart illustrates the impact on federal and state fuel tax payments as fuel efficiency increases:

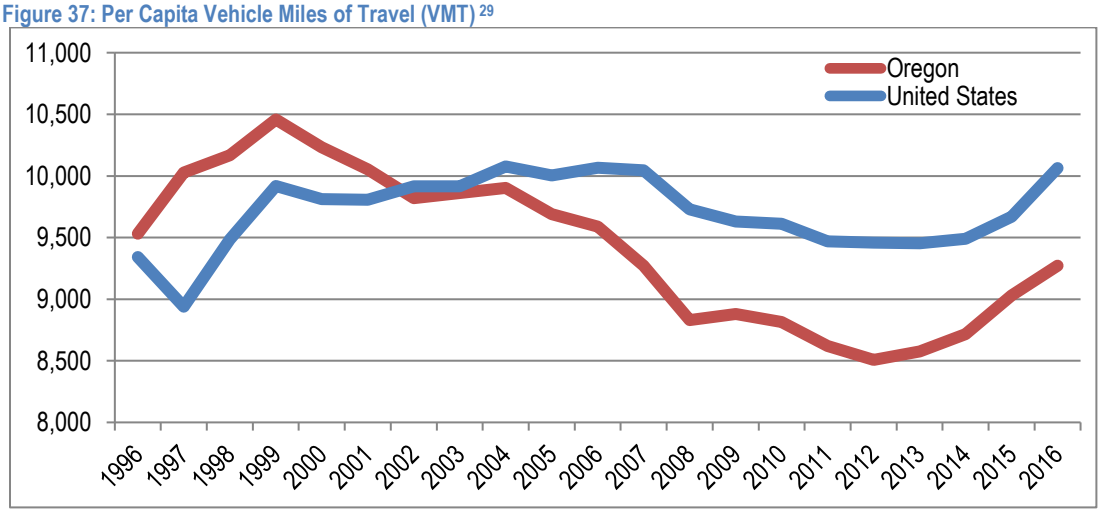
Figure 36: Annual Federal & State Fuel Taxes Paid per 12,500 Miles of Travel



4. Future Vehicle Miles Traveled

While Oregon's rebounding economy has led to a near-term increase in vehicle miles traveled in the state, there is a great deal of uncertainty around future vehicle miles traveled and rates of car ownership by Oregonians. Nationally, there has been a major reduction in the vehicle miles traveled and car ownership rates among the millennial generation. At the same time, Oregon's population is becoming increasingly urban, with greater reliance on transit and active transportation to meet mobility needs. Oregon also has a growing senior population, with the number of Oregonians 65 and above expected to increase from 15% to 20% by 2035. Oregon's aging population adds to future uncertainly around VMT as seniors may rely increasingly on transit service or other forms of transportation. The emergence of connected and automated vehicles, as well as the growing use of ride-hailing services, adds an additional layer of uncertainty to future projections of vehicle miles traveled and its impact on system demand.

Figure 37: Per Capita Vehicle Miles of Travel (VMT) [29]

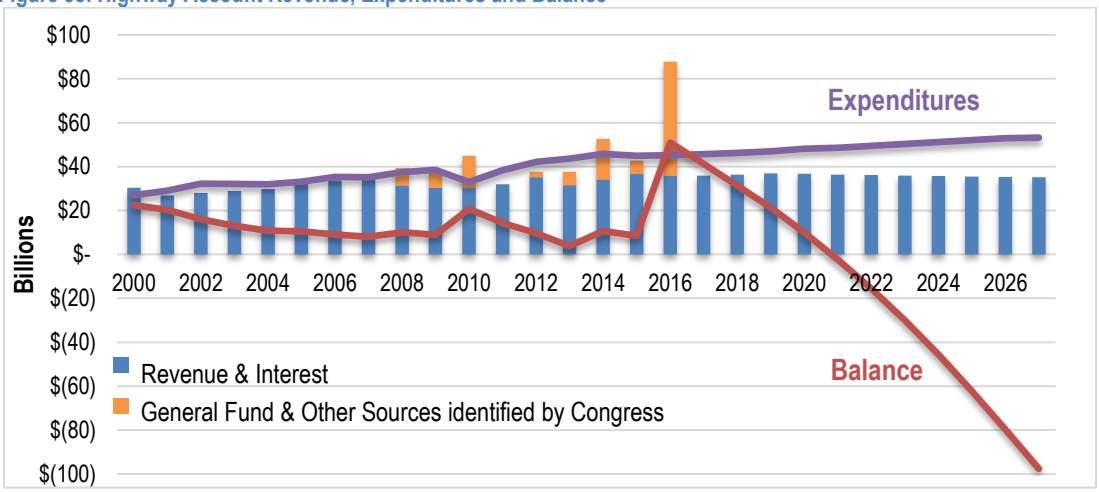


[29] *Highway Statistics, Tables VM-2, VM-3 and DL-1B, PS-1*

5. Uncertain future federal funding

Most states, including Oregon, depend on federal funds for a significant portion of their highway revenue. Oregon's legislatively adopted budget for the state highway system in the 2017-2019 biennium consisted of 77% state revenue and 23% federal revenue. While the 2015 Fixing America's Surface Transportation Act (FAST ACT) provided stability to federal transportation revenue dedicated to Oregon through 2020, the Federal Highway Trust Fund faces long-term insolvency. Federal fuel taxes have not been increased since 1993, requiring Congress to transfer General Fund resources into the Highway Trust Fund to avoid major funding cuts. If Congress does not find additional resources for the transportation program, federal surface transportation funding risks being cut in the long-term, forcing ODOT to eliminate or delay many of the projects included in the Statewide Transportation Improvement Program (STIP).

Figure 38: Highway Account Revenue, Expenditures and Balance[30]



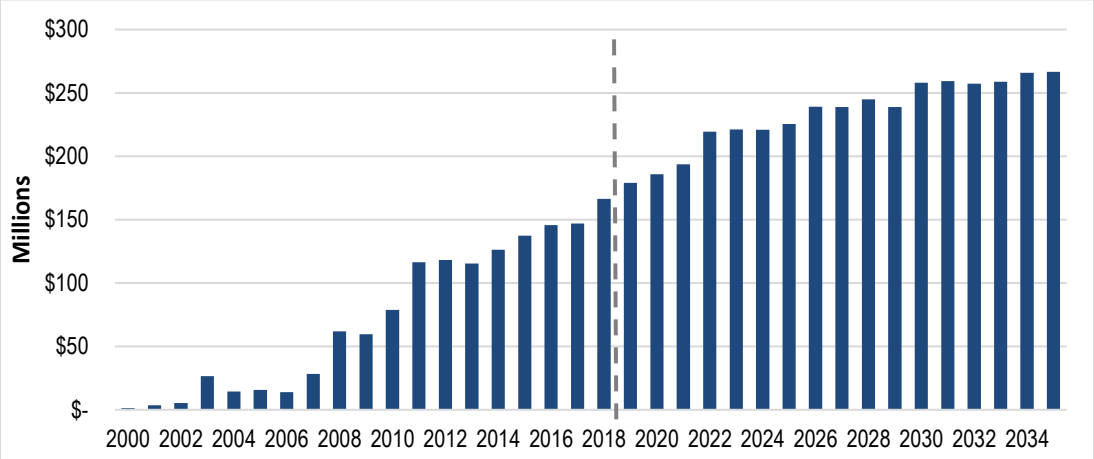
Under current spending levels, the federal Highway Trust Fund's Highway Account is projected to run out of money early in 2021, and the Mass Transit Account is projected to do so a few months later. If future expenditures from the Trust Fund are limited to revenues from fuel taxes and vehicle related fees, Oregon and other states could see a 25% to 33% reduction in annual federal highway funding after 2020.

6. Debt Service Payments

Until 2000, ODOT capital projects were primarily funded by transportation user fees from state and federal sources. In 2001, the department began selling bonds for projects funded under installments of the Oregon Transportation Investment Act (OTIA). Bonding for major capital projects continued in 2009 with passage of the Jobs and Transportation Act (JTA). Over the course of the next few years, ODOT will sell bonds to complete projects identified under HB 2017. Bond funding provides one-time infusions of spending, allowing for completion of a large number of improvement projects in a short period of time. Debt service payments have become an increasing significant annual expenditure and will remain so for the next 15-20 years. Since 2001, debt service payments have steadily increased, and will continue to represent an annual commitment of $200 to $250 million of ODOT's Highway Trust Fund revenue over the next 15-20 years. This annual expenditure will equate to over 25% of ODOT's State Highway Revenue going toward debt service over the next ten years.

[30] *SOURCE: U.S. Department of Transportation; Congressional Budget Office projections of Highway Trust Fund Accounts*

Figure 39: ODOT's State Highway Revenue Going to Debt Service Payment[31]



Revenue Projections

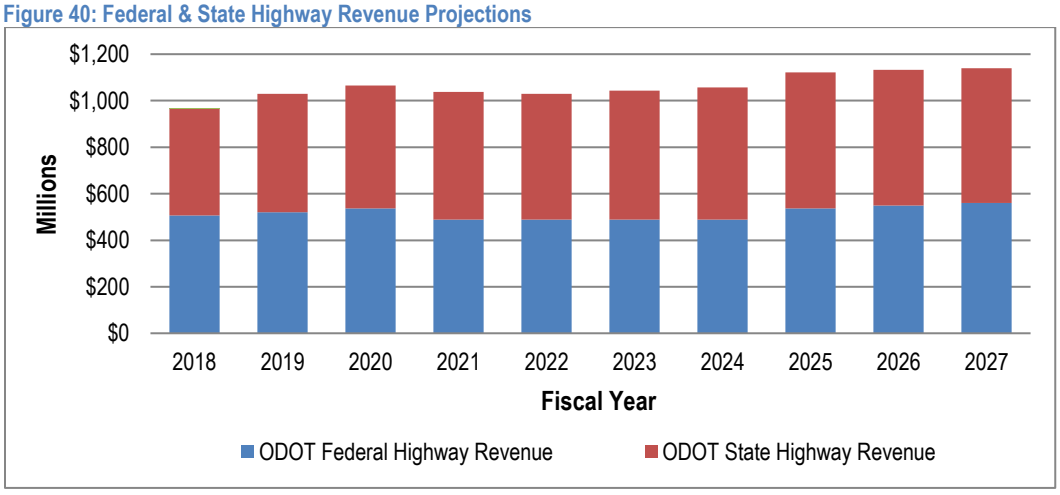
Future projections of revenue available to maintain and enhance Oregon's transportation must account for the myriad of financial risks and assumptions outlined above, as well as the major risks outlined in *Section 7: Risk Management*. Revenue projections from state and federal sources are constantly updated by ODOT staff, and their projections reflect current economic and demographic trends and consider a multitude of risks and uncertainties. The following projections represent a snapshot in time and serve as a starting point for identifying optimal investments that maintain, preserve, and enhance Oregon's major transportation assets.

Figure 40 presents a 10-year summary of Oregon's expected transportation funding from federal and state sources. The federal funding shown represents expected Federal-aid Highway Program formula obligation limitation. It does not include funding expected under allocated or discretionary programs. Federal revenue estimates were prepared based on assumptions that a new transportation authorization bill would not be adopted prior to the 2020 expiration of the FAST Act. In this scenario, Oregon's funding is expected to decrease by 10% in 2021 and remain stagnate for a few years thereafter. Funding would then return to the 2020 level and increase at a modest annual rate (following expiration of SAFETEA-LU example). As a strategic alternative, years following 2020 were increased at the annual rate of growth experienced under the FAST Act. The state revenue identified represents ODOT's expected share of transportation funding deposited in the State Highway Fund. *Table 17* presents a breakdown of federal and state funding over the 10-year period of the TAMP.

Federal revenue projections are based on staff estimates provided by ODOT's Office of the Director, and state revenue projections are based on staff estimates from the agency's Financial and Economic Analysis Section. Staff providing these estimates are responsible for preparing the federal and state funding projections used in preparing agency and division budgets as well as short and long-term plans and programs. For a discussion of assumptions used in the preparation of state revenue estimates, see the latest edition of the ODOT's Revenue Forecast:

http://www.oregon.gov/ODOT/Data/Pages/Revenue-Forecasts.aspx

Figure 40: Federal & State Highway Revenue Projections



[31] *SOURCE: ODOT Debt and Cost Analysis Section. Does not include debt service payments for Lottery Revenue Bond Program*

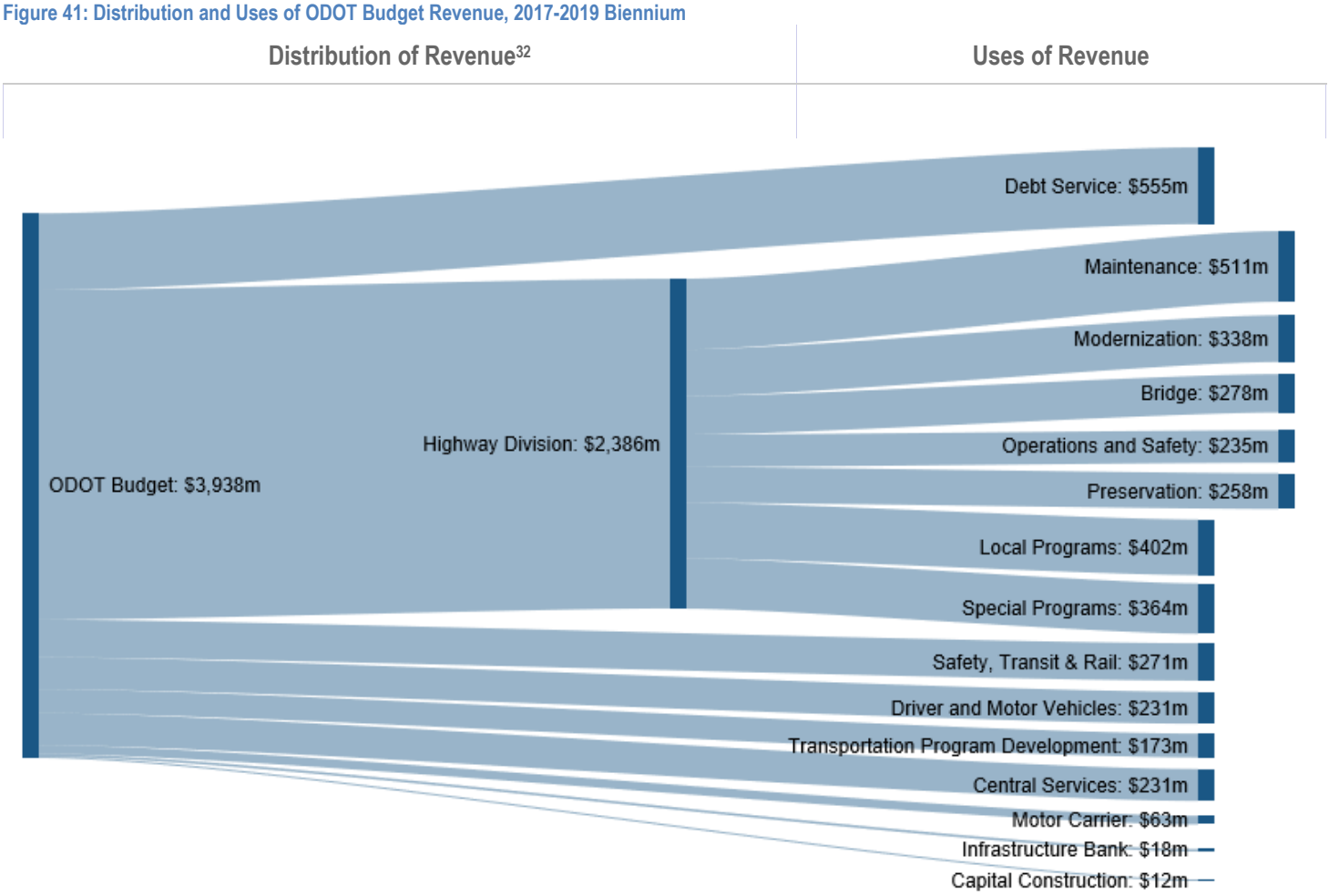
Table 17: Federal and State Highway Revenue Projections *($ Millions)*

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	*Total 2018-2027*
Federal Revenue											
National Highway Performance Program	$280	$287	$289	$263	$263	$263	$263	$289	$295	$302	*$2,795*
Surface Transportation Block Grant Program	$133	$136	$138	$125	$125	$125	$125	$138	$141	$145	*$1,331*
Other Federal Programs	$73	$79	$90	$81	$81	$81	$81	$90	$93	$95	*$844*
Redistribution	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	*$200*
ODOT Federal Highway Revenue	**$506**	**$521**	**$537**	**$489**	**$489**	**$489**	**$489**	**$537**	**$550**	**$561**	***$5,170***
State Revenue											
State Gas Tax	$584	$636	$656	$680	$702	$724	$744	$765	$765	$764	*$7,020*
State License & Registration Fees	$380	$418	$442	$469	$478	$487	$492	$494	$495	$496	*$4,650*
State Weight-mile Tax	$384	$435	$449	$460	$478	$499	$514	$529	$535	$540	*$4,825*
Bond Bills Revenue (OTIA, JTA, HB2017)	$556	$676	$731	$787	$833	$882	$919	$957	$961	$966	*$8,269*
Revenue Subtotal	**$1,904**	**$2,166**	**$2,278**	**$2,396**	**$2,492**	**$2,592**	**$2,669**	**$2,745**	**$2,756**	**$2,765**	***$24,763***
Revenue Adjustments											
State Collection Costs & Transfers	$(717)	$(847)	$(911)	$(968)	$(1,013)	$(1,067)	$(1,112)	$(1,155)	$(1,169)	$(1,178)	*$(10,136)*
State Bond Bills Debt Service	$(198)	$(211)	$(213)	$(218)	$(246)	$(252)	$(252)	$(257)	$(270)	$(270)	*$(2,386)*
State Set-asides	$(75)	$(77)	$(75)	$(79)	$(97)	$(109)	$(112)	$(107)	$(94)	$(95)	*$(922)*
Adjustments Subtotal	**$(990)**	**$(1,135)**	**$(1,199)**	**$(1,265)**	**$(1,355)**	**$(1,429)**	**$(1,476)**	**$(1,518)**	**$(1,533)**	**$(1,543)**	***$(13,443)***
Local Distributions											
Net County Highway Revenue	$(267)	$(304)	$(323)	$(341)	$(348)	$(355)	$(364)	$(374)	$(373)	$(377)	*$(3,425)*
Net City Highway Revenue	$(182)	$(207)	$(219)	$(231)	$(238)	$(244)	$(250)	$(257)	$(257)	$(257)	*$(2,342)*
Special County/City Transfers	$(6)	$(11)	$(11)	$(11)	$(11)	$(11)	$(11)	$(11)	$(11)	$(11)	*$(103)*
Local Distribution Subtotal	**$(455)**	**$(523)**	**$(552)**	**$(582)**	**$(597)**	**$(609)**	**$(624)**	**$(642)**	**$(641)**	**$(645)**	***$(5,869)***
ODOT State Highway Revenue	**$459**	**$508**	**$528**	**$549**	**$540**	**$554**	**$568**	**$585**	**$582**	**$578**	***$5,451***
Total ODOT Federal & State Revenue	**$965**	**$1,029**	**$1,065**	**$1,038**	**$1,029**	**$1,044**	**$1,058**	**$1,122**	**$1,132**	**$1,139**	***$10,621***

Revenue Uses

In addition to sources of revenue, the Legislatively Adopted Budget identifies how expected transportation funding is to be spent during the two years covered by the budget, along with proposing how revenue should be spent for several years thereafter. *ODOT's 2017-2019 Legislatively Adopted Program Budget* dedicates roughly 60 percent of the overall agency budget to the Highway Division. This Highway Division revenue is divided into seven major categories: Modernization, Preservation, Bridge, Maintenance, Operations, Special Programs, and Local Programs:

Figure 41: Distribution and Uses of ODOT Budget Revenue, 2017-2019 Biennium

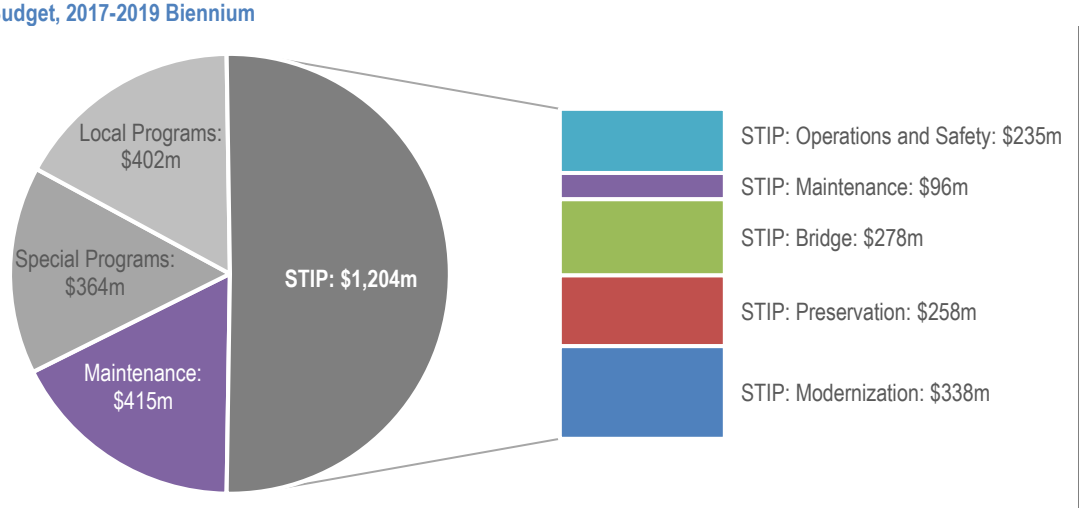


Revenue Available for Asset Management Activities

Revenue available to improve or preserve pavement and bridge assets is a component of funding budgeted for the department's Highway Division. The Highway Division supports the ODOT mission by planning, developing, maintaining and operating a safe and efficient highway system in context with the natural environment that provides economic opportunities for Oregonians. Overall more than 60 percent of ODOT funding is devoted to Highway Division programs and activities. Highway Division revenue that can be used for asset management activities focusing on the condition of pavement and bridge assets is primarily contained in Statewide Transportation Improvement Program (STIP) categories for Modernization, Preservation, and Bridge. Some funding under the STIP categories for Maintenance and Operations and Safety, as well as some dedicated amounts such as funding for bridge inspections included in the budget for the Transportation Development Division can also be used for asset management activities.

[32] *Note: Some inconsistencies appear between ODOT Revenue Projections (Figure 40) and ODOT Budget Revenue (Figure 41) due to local transfers and set-asides*

Figure 42: ODOT Highway Division Budget, 2017-2019 Biennium



The amounts and distributions of funding available for programs and projects of the STIP are determined under the direction and guidance of the OTC and developed through the coordinated participation of various ODOT units, federal agencies, Oregon Legislature, local governments, tribal governments, metropolitan planning organizations and other local jurisdictions, advisory groups, port districts, transit districts and the public. Dollar amounts identified for the preservation and improvement of ODOT pavement and bridge assets reflect investment strategies adopted by the OTC and recommended by the Oregon Transportation Plan, estimations of available future funding and work type costs, results of pavement and bridge management systems, consideration of life cycle planning analyses, outcomes of gap analysis evaluations and risk analysis of expected performance and condition impacts of alternative investment strategy expenditures.

The five major Highway Division Budget categories that support the preservation and improvement of Oregon's National Highway System assets are summarized as follows:

Modernization[33]

Modernization is a general term that covers construction of a new transportation asset as well as reconstruction of an existing asset or assets. ODOT's use of the work type to signify initial construction or reconstruction of a pavement or bridge was established in instruction documentation for developing transportation improvement programs in 1984.[34]

Preservation

Preservation activities focus on preserving the condition and extending the service life of pavements though treatment activities at the most cost-effective time in the lifecycle of the asset. Preservation, as used by ODOT, encompasses three general treatment activities, thin overlays, major resurfacing that does not require and roadway substructure improvement (normal preservation) and rehabilitation work that combines resurfacing with repairs to roadway substructures. Like modernization, preservation has been used as a specific work type since 1984.

Bridge

Bridge expenditures focus on maintaining the condition of state bridges and include preservation, rehabilitation, and major maintenance activities. ODOT has routinely used the term as a specific work type since 1991.

Maintenance

Maintenance program expenditures maintain, repair and extend the service-life of the components of the state's highway system. Maintenance includes both reactive activities such as responding to weather events and crashes, and proactive activities, such as pavement chip seals and minor bridge painting to extend asset service life, that reduce overall lifecycle costs and enhanced maintenance of unstable slope areas. Like modernization and preservation, maintenance has been used as a specific work type since 1984.

Operations

Operations focuses on improving the efficiency and safety of the transportation system through operational improvements, landslide and rock fall mitigation and enhanced system management. Like bridge, operations has routinely been used by ODOT as a specific work type since 1991.

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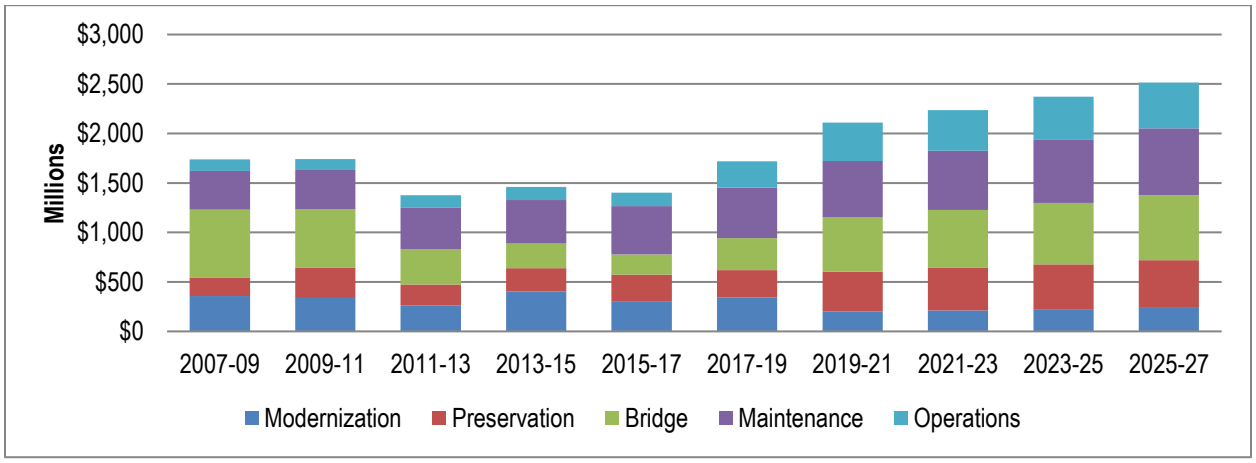
[33] *Note: a major percentage of the modernization budget category includes new construction projects identified through legislation and are outside the agency's ability to make asset management tradeoff decisions.*

[34] Manual for Six-Year Highway Improvement Program 1987-1992, Program Section, Oregon Highway Division, October, 1984.ij

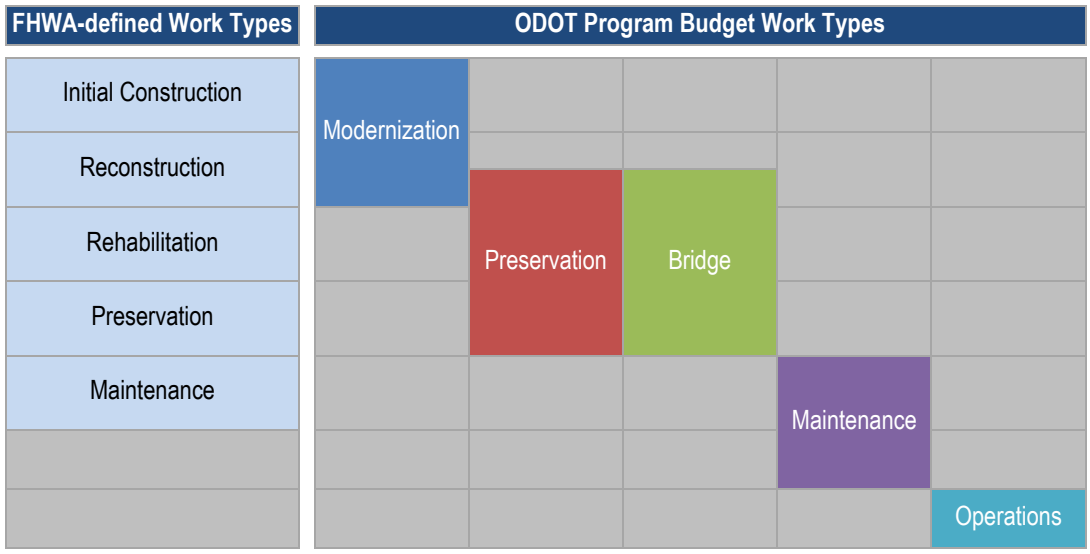
ODOT's past and projected expenditure amounts in budget categories dedicated to improving or preserving pavement and bridge assets are presented in *Figure 43*. This chart is based on the budget categories the agency uses to identify expected expenditures during a biennium.

Figure 43: ODOT Program Budget Expenditure Amounts (Past and Future Projections)



While separate budget categories are provided for Bridges and Pavements (Preservation), expenditures for NHS pavements and bridges are not distinguished from other non-NHS pavement and bridge expenditures. Moreover, ODOT Program Budget work types are distinct from FHWA-defined work types (initial construction, reconstruction, rehabilitation, preservation, and maintenance) in a number of respects. ODOT combines initial construction and reconstruction under a *Modernization* budget category. Additionally, ODOT combines preservation and rehabilitation activities under a *Preservation* budget category. Finally, ODOT's *Maintenance* budget category includes preventative and routine maintenance as well as emergency relief activities. Figure 44 provides a high-level overview of how the work types defined by FHWA compare to ODOT Program Budget work types.

Figure 44: Crosswalk comparing FHWA-defined work types with ODOT Program Budget work types



Decisions guiding the levels of investments in individual work type categories are made through an application of asset management principles, management system analyses, OTP and OTC policy guidance, and decision processes used in the development of the Statewide Transportation Improvement Program and agency program budgets. Further details on theses decision-making processes are outlined in *Section 9: Investment Strategies.*

Forecasted Revenue Use Scenarios by Asset Management Work Type

The following subsection presents analyses comparing expected available funding for TAMP work types with optimal work type funding levels under various investment strategies. The investment strategies considered are:

1. Optimized investment in ODOT NHS Pavements and Bridges based on current revenue forecasts (baseline)
2. Achieve and Maintain a State of Good Repair for Condition and Performance of ODOT NHS Pavements and Bridges (SOGR)
3. Maintain Current ODOT NHS Pavement and Bridge Conditions, and Achieve 4-year State Targets over ten years (MCC)

The strategies considered reflect approaches by ODOT in making progress toward achieving State targets for asset condition and performance, and ones required by federal regulations aimed at achieving national goals identified in section 150 (d) of title 23. The impact of these investment strategies on bridge and pavement conditions over the next ten years is analyzed in further detail in *Section 4: Performance Gap Analysis.*

1. Optimized investment in ODOT NHS Pavement and Bridges based on current revenue forecasts

Identifying optimized investment levels between work types for NHS Pavements and Bridges began by estimating the portion of total funding dedicated to the NHS. The funding made available to improve and preserve NHS pavement and bridge assets is a component of the overall funding made available in the STIP and maintenance budget for highways and bridges. In the absence of separate expenditure records for NHS assets, annual expected expenditures for NHS pavements and bridges were calculated based on a five year history of annual expenditures for ODOT pavement and bridge projects. Of annual pavement modernization, preservation, and rehabilitation expenditures, an average of 81 percent were for NHS pavement projects. Of annual bridge program modernization, preservation, and rehabilitation expenditures, 90 percent were for NHS bridge projects. The high percentage of overall bridge and pavement program funding dedicated to the NHS is reflective of a constrained revenue scenario where limited resources are dedicated to high-priority transportation corridors (see *Section 9: Investment Strategies*).

The annual funding made available for the modernization, preservation, rehabilitation, and maintenance of the department's pavements and bridges reflect asset management principles, management system analyses, OTP and OTC policy guidance, and decision processes used in the development and implementation of department budgets and the STIP.

The estimated annual revenue available to maintain or improve the condition and performance of ODOT's pavement and bridge assets for the 2018-2027 time period is presented in *Table 18*. Not included is funding set aside for new highway routes, funding reserved for local projects and programs, safety and operations projects and programs, revenues reserved for mitigation activities associated with unstable slopes or the repair and maintenance of culverts, or the major portion of maintenance funding devoted to activities which are considered normal and routine state responsibilities. Presented are annual anticipated expenditures to improve and preserve ODOT NHS highways and bridges based on work types identified for use in asset management regulations. The breakdown of funding amounts among asset management required work types were based on recommendations by pavement and bridge engineers.

Table 18: Asset Management Expenditures by TAMP Work Type (Feb '19 Forecast Estimate)

($ millions)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Pavements										
State Highway Pavements[35]	$ 125	$ 120	$ 127	$ 137	$ 135	$ 135	$ 135	$ 145	$ 145	$ 145
ODOT NHS Pavements Total	*$ 115*	*$ 104*	*$ 107*	*$ 115*	*$ 108*	*$ 108*	*$ 108*	*$ 115*	*$ 115*	*$ 115*
Modernization	*$ -*	*$ -*	*$ 5*	*$ 32*	*$ 18*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*
Rehabilitation	*$ 62*	*$ 56*	*$ 55*	*$ 44*	*$ 47*	*$ 58*	*$ 58*	*$ 62*	*$ 62*	*$ 62*
Preservation	*$ 46*	*$ 41*	*$ 40*	*$ 32*	*$ 35*	*$ 43*	*$ 43*	*$ 46*	*$ 46*	*$ 46*
Preventative Maintenance (chip seals)	*$ 7*	*$ 7*	*$ 7*	*$ 7*	*$ 7*	*$ 7*	*$ 7*	*$ 7*	*$ 7*	*$ 7*
Bridges										
State Highway Bridges	$ 128	$ 128	$ 128	$ 128	$ 112	$ 112	$ 112	$ 144	$ 144	$ 144
ODOT NHS Bridges Total	*$ 115*	*$ 115*	*$ 115*	*$ 115*	*$ 101*	*$ 101*	*$ 101*	*$ 130*	*$ 130*	*$ 130*
Modernization	*$ 14*	*$ 14*	*$ 14*	*$ 14*	*$ 16*	*$ 16*	*$ 16*	*$ 16*	*$ 16*	*$ 16*
Rehabilitation	*$ 60*	*$ 60*	*$ 60*	*$ 60*	*$ 41*	*$ 41*	*$ 32*	*$ 68*	*$ 68*	*$ 68*
Preservation	*$ 42*	*$ 42*	*$ 42*	*$ 42*	*$ 44*	*$ 44*	*$ 53*	*$ 46*	*$ 46*	*$ 46*
Routine Maintenance										
State Highway Surface (Pavements)	$ 39	$ 42	$ 44	$ 47	$ 50	$ 53	$ 56	$ 59	$ 63	$ 66
NHS Surface (Pavements)	*$ 8*	*$ 8*	*$ 9*	*$ 9*	*$ 10*	*$ 10*	*$ 11*	*$ 12*	*$ 12*	*$ 13*
State Highway Structures (Bridges)	$ 7	$ 8	$ 8	$ 8	$ 9	$ 9	$ 9	$ 10	$ 10	$ 11
NHS Structures (Bridges)	*$ 4*	*$ 4*	*$ 4*	*$ 5*	*$ 5*	*$ 5*	*$ 5*	*$ 5*	*$ 6*	*$ 6*

[35] *Includes some additional culvert work*

2. Achieve and Maintain a State of Good Repair for ODOT NHS Pavements and Bridges (SOGR)

The State of Good Repair (SOGR) scenario for pavements and bridges, which is described in greater detail in *Section 4: Performance Gap Analysis,* invests in pavement condition of agency highways and bridges over the next 10 years at a level that would ensure that state highway bridge and pavement condition and performance meets a "state of good repair" as defined by the OTC. This more ambitious SOGR investment scenario would ensure that both NHS and non-NHS pavements and bridges see significantly improved asset conditions above the forecast conditions baseline, while also addressing mobility and accessibility needs such as satisfying Americans with Disabilities Act (ADA) and improving the seismic resiliency of life-line route pavements and bridges. However, this investment scenario would see a greater portion of total bridge revenue dedicated to non-NHS bridges assets due to the fact that it would address a backlog of lower-priority state highway bridges that are not a part of the NHS system. The SOGR annual investment level over the 10 year period of the asset management plan would be $180 million for ODOT NHS pavements and $339 million for ODOT NHS bridges- a significant increase in investment over the forecast revenue available for NHS Pavement and Bridge assets.

Table 19 presents the annual expected work type expenditures associated with NHS pavement and bridge SOGR investment levels compared to projected levels of annually available work type funding under the current revenue forecast.

The amounts presented for annual pavement work type expenditure needs to meet a SOGR as well as available funding are based on FHWA's pavement preservation quick checkup tool and reflect a distribution most reflective of the life cycle characteristics and risks associated with Oregon NHS pavement and bridge assets. The amounts presented for annual bridge work type expenditure to meet a SOGR are based on an assessment of the costs of addressing a backlog of preservation activities (e.g., major bridge maintenance, cathodic protection, painting, and deck paving), addressing bridge rehabilitation needs, and addressing seismic needs as part of bridge modernization and reconstruction.

3. Maintain Current Condition of ODOT NHS Pavements & Bridges and Achieve Targets (MCC)

Achieving and maintaining state targets for the condition and performance of Oregon highways and bridges has been a departmental objective for more than 20 years. The establishment of national performance management goals and targets for the condition and performance of National Highway System assets is consistent with Oregon's performance-driven approach to investment in its highway system (see *Section 3: State and National Performance Measures* for further details). The Maintain Current Condition (MCC) scenario considers the investment levels that would be needed to ensure that current (2018) bridge and pavement conditions are maintained over the next 10 years. This MCC investment scenario also ensures the achievement of established two-year and four-year performance targets for NHS pavement and bridge assets over a 10-year time horizon. Because the two-year and four-year targets condition targets for NSH pavements and bridges have been set slightly below current conditions, investments levels that ensure that current conditions are maintained would also be sufficient to ensure that these targets continue to be met beyond four years.

Table 19 presents the annual expected work type expenditures needed to maintain current conditions and achieve performance measure targets established for ODOT's NHS highways and bridges. Because the current conditions of NHS Pavements already meets a State of Good Repair, the total investment levels as well as work type splits under this MCC scenario is consistent with the SOGR scenario. By contrast, current conditions of NHS Bridges are slightly below a desired SOGR, and therefore current conditions could be maintained with an investment level of roughly $219 million per year. This level of investment in NHS Bridges would be significantly less than a SOGR investment scenario, but significantly greater than current revenue forecasts.

Table 19: NHS Bridge and Pavement Investment Scenarios by Work Type

ODOT NHS Pavements		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	AVG
Optimized Investment - Current Revenue Projections	*Modernization*	$ -	$ -	$ 5	$ 32	$ 18	$ -	$ -	$ -	$ -	$ -	*$ 6*
	Rehabilitation	$ 62	$ 56	$ 55	$ 44	$ 47	$ 58	$ 58	$ 62	$ 62	$ 62	*$ 56*
	Preservation	$ 46	$ 41	$ 40	$ 32	$ 35	$ 43	$ 43	$ 46	$ 46	$ 46	*$ 42*
	Preventative Maintenance (chip sealing)	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	*$ 7*
	Total	**$ 115**	**$ 104**	**$ 107**	**$ 115**	**$ 108**	**$ 108**	**$ 108**	**$ 115**	**$ 115**	**$ 115**	***$ 111***
Revenue needed to meet SOGR	*Modernization*	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	*$ 20*
	Rehabilitation	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	*$ 92*
	Preservation	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	*$ 61*
	Preventative Maintenance (chip sealing)	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	*$ 7*
	Total	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	***$ 180***
Revenue Needed to meet MCC	*Modernization*	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	*$ 20*
	Rehabilitation	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	$ 92	*$ 92*
	Preservation	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	$ 61	*$ 61*
	Preventative Maintenance (chip sealing)	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	*$ 7*
	Total	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	**$ 180**	***$ 180***
	Pavement SOGR Revenue Gap	**$ (66)**	**$ (76)**	**$ (74)**	**$ (66)**	**$ (73)**	**$ (73)**	**$ (73)**	**$ (66)**	**$ (66)**	**$ (66)**	***$ (70)***
	Pavement MCC Revenue Gap	**$ (66)**	**$ (76)**	**$ (74)**	**$ (66)**	**$ (73)**	**$ (73)**	**$ (73)**	**$ (66)**	**$ (66)**	**$ (66)**	***$ (70)***

ODOT NHS Bridges												
Optimized Investment - Current Revenue Projections	*Modernization*	$ 14	$ 14	$ 14	$ 14	$ 16	$ 16	$ 16	$ 16	$ 16	$ 16	*$ 15*
	Rehabilitation	$ 60	$ 60	$ 60	$ 60	$ 41	$ 41	$ 32	$ 68	$ 68	$ 68	*$ 56*
	Preservation	$ 42	$ 42	$ 42	$ 42	$ 44	$ 44	$ 53	$ 46	$ 46	$ 46	*$ 44*
	Total	**$ 115**	**$ 115**	**$ 115**	**$ 115**	**$ 101**	**$ 101**	**$ 101**	**$ 130**	**$ 130**	**$ 130**	***$ 115***
Revenue needed to meet SOGR	*Modernization*	$ 90	$ 90	$ 90	$ 90	$ 90	$ 90	$ 90	$ 90	$ 90	$ 90	*$ 90*
	Rehabilitation	$ 167	$ 167	$ 167	$ 167	$ 167	$ 167	$ 167	$ 167	$ 167	$ 167	*$ 167*
	Preservation	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	*$ 82*
	Total	**$ 339**	**$ 339**	**$ 339**	**$ 339**	**$ 339**	**$ 339**	**$ 339**	**$ 339**	**$ 339**	**$ 339**	***$ 339***
Revenue Needed to meet MCC	*Modernization*	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44
	Rehabilitation	$ 110	$ 110	$ 110	$ 110	$ 110	$ 110	$ 110	$ 110	$ 110	$ 110	$ 110
	Preservation	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66
	Total	**$ 219**	**$ 219**	**$ 219**	**$ 219**	**$ 219**	**$ 219**	**$ 219**	**$ 219**	**$ 219**	**$ 219**	**$ 219**
	Bridge SOGR Revenue Gap	**$ (224)**	**$ (224)**	**$ (224)**	**$ (224)**	**$ (239)**	**$ (239)**	**$ (239)**	**$ (210)**	**$ (210)**	**$ (210)**	***$(224)***
	Bridge MCC Revenue Gap	**$ (104)**	**$ (104)**	**$ (104)**	**$ (104)**	**$ (119)**	**$ (119)**	**$ (119)**	**$ (90)**	**$ (90)**	**$ (90)**	***$(104)***

NHS Routine Maintenance												
Current Revenue Projections	Surface Maintenance (pavements)[36]	$ 8	$ 8	$ 9	$ 9	$ 10	$ 10	$ 11	$ 12	$ 12	$ 13	***$ 10***
	Structures Maintenance (bridges)	$ 4	$ 4	$ 4	$ 5	$ 5	$ 5	$ 5	$ 5	$ 6	$ 6	***$ 5***

[36] *Note: Routine maintenance is largely reactive. The SORG and MCC investment scenarios assume a 25% increase in routine maintenance activities. A 25% increase in routine maintenance is consistent with investment level identified OTC Investment Strategy, Scenario II*

Asset Value and Investment Scenario to Maintain Value

The transportation system that has been built over the past century and that Oregonians enjoy today is worth billions of dollars and is central to the health of the state economy. To preserve and improve the condition and performance of the state's transportation assets, an ongoing commitment of significant financial resources is required. The following subsection attempts to determine the current value of ODOT's pavement and bridges and estimates the annual investment that is required to maintain that current value based on asset life-expectancy. This value-based annual investment is then compared to the three investment level scenarios (current forecast, SOGR, and MCC) for NHS bridge and pavement assets.

A key component of transportation asset management is determining the total value of transportation assets. There are a number of ways that asset valuation can support proper management and efficient investment in the transportation system. By effectively quantifying the value of transportation assets, investments that maintain, preserve, and enhance the transportation system can be measured to the degree to which they add value or minimize loss to the system. Valuation can also be used to determine funding needs as well as the levels of funding necessary to ensure that assets do not lose their value over time.

Asset Valuation Methodologies

Valuation of highway infrastructure traditionally follows the Government Accountability Standards Board (GASB) Statement No. 34, which requires transportation agencies to report the combined value of their transportation assets. However, GASB 34 is based on the historic value of transportation assets and is therefore effective for accounting purposes but has limited practical application in the field of asset management. For example, a bridge built 50 years ago may have been built for a fraction of the cost of a modern bridge. Even when accounting for inflation, the historic cost of this bridge does not capture the cost of replacing the bridge to meet modern design and safety requirements, or the value of the bridge to the economy at large. Furthermore, maintenance and preservation treatments that add value to the bridge by extending its functionality and usefulness are not captured by a valuation methodology that is limited to historic costs.

An alternative approach to using historic costs to determine asset value is to calculate replacement costs, or the current cost that would be incurred by replacing an asset. Calculating the replacement cost of major highway assets has several advantages over historic costs, including the ability to account for: inflation, enhanced modern design requirements, and current material and labor costs. Additionally, using a replacement cost methodology to ascertain the value of major assets can be an effective tool in demonstrating the efficacy of lower-cost investments, such as maintenance and preservation, that prolong an asset's life versus high cost replacements that are accelerated by allowing an asset's condition to degrade. However, calculating the replacement cost of major assets tells very little about the value of an existing asset based on age and condition. For example, it may be cheaper to maintain and preserve an aging bridge in poor condition than it is to replace it, but over time, as these assets degrade, efforts to maintain them can bring declining returns on investment. Furthermore, as with historic costs, replacement cost calculations do not adequately capture the value of maintenance and preservation investments.

Given the limitations on using historic costs and replacement costs to determine asset values, ODOT has developed asset valuation methodologies for its pavement and bridge assets that better capture overall values and support enhanced decision-making. The following subsections summarize these bridge and pavement asset valuation efforts and provide estimated values of bridges and pavement on the National and State Highway Systems.

Bridge Asset Values

Multiple methods were evaluated to determine meaningful ways to present the value of Oregon bridges. Analyses were patterned after the Indiana report: *A Methodology for Highway Asset Valuation in Indiana*. The report presented multiple ways to analyze bridge condition data, however, only two approaches from this report were seriously considered: Straight Line Depreciation (SLD) and Value based on Elemental Decomposition and Multi-Criteria (EDMC). A third approach developed by the ODOT Bridge Program was also evaluated based on Oregon data called the ODOT Remaining Service Life (RSL) Method. These valuation methods were also compared to the hypothetical cost of replacing all ODOT bridges at once regardless of their remaining service life.

Straight Line Depreciation

Straight line depreciation assumes that an asset loses the same percentage of its value each year based on how many years it is expected to be in service. For ODOT, the SLD analysis assumes state-owned bridges will remain in service for 80 years. This number was determined based on current projections of bridge Remaining Service Life (RSL) using the ODOT bridge utility discussed below. The mean age at end of service life was calculated at 83 years with the median at 79 years using 2017 snapshot data. This seems reasonable given the lack of funding to replace bridges. The minimum asset value was set at ten percent of the replacement cost to account for older bridges still in service. The general equation is:

SLD Value = Replacement costs – (Replacement Cost - Salvage Value)/Service Life=80 yrs)* Years in Service

Elemental Decomposition and Multi-Criteria (EDMC)

EDMC assumes that the value of an asset has multiple components. For these analyses, the two components were 1) user value which is modeled with National Bridge Inventory (NBI) ratings to capture the bridge condition and 2) asset service life which is modeled with remaining service life to represent the value to the agency.

Multiple versions of EDMC were calculated using fixed service life and ODOT bridge utility combinations. For the EDMC, unique costs are required for the deck, superstructure and substructure which are not readily available. Costs were prorated using 20% for the deck and 40% for both the super and substructure. The end results for several iterations were all close in the $22B to $25B range. The EDMC has merit: however, the data is not available to calculate a "truer" estimate than by other means.

ODOT Remaining Service Life (RSL) Method

A third approach developed by the ODOT Bridge Program was also evaluated using ODOT data. The ODOT RSL Method is an empirically derived equation that incorporates the deck, super and substructure NBI ratings to capture the overall bridge conditions along with component health indices that capture element conditions. The component NBI and Health Index (HI) values are combined into deck, super, and sub-utilities and then incorporated into one weighted bridge utility that includes loading conditions:

ODOT Bridge Utility = Deck Utility*0.10 + Super Utility*0.30 + Sub Utility*0.30 + Loading Utility*0.30

The following equation is proposed to determine the Bridge Asset Valuation based on the ODOT data:

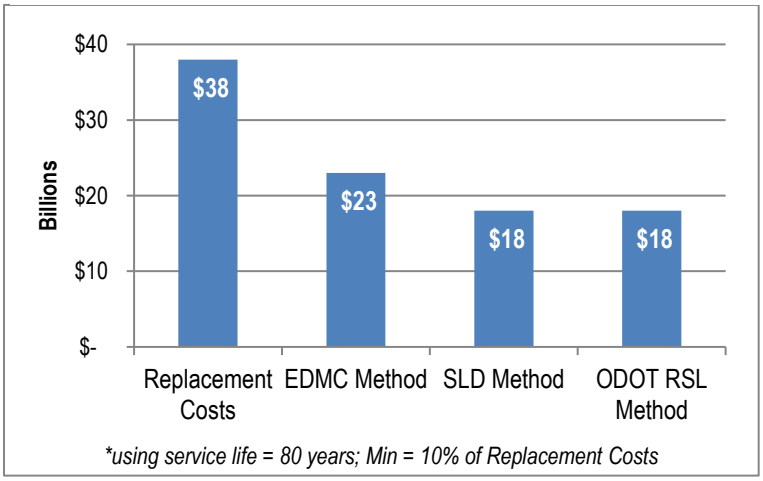
ODOT RSL Method =RSL/[RSL + Age] * Replacement Costs
*Where RSL = ODOT Bridge Utility * Design Life*

The ODOT RSL Method takes into account the design life of each bridge which provides some differentiation between bridges built before, during and after the Interstate Era. The method also captures bridge conditions down to the element level based on the health index along with any bridge loading conditions which capture the overall function of the bridge.

The ODOT RSL method will also capture the value of investments: when the posting changes, the utility value will reflect the change, and when bridge work is done even if the NBI values don't change, the change in element level data may be reflected in the utility.

A comparison of the SLD and ODOT RSL method is shown. This analysis indicates that the value of state bridges based on the ODOT RSL method is depreciating at about the same rate as the SLD analysis. The comparison essentially means the state bridges are expected to have a service life of about 80 years. An additional overall check on the numbers can be generalized by considering the age of the system. Knowing the average age of state bridges is 46 years (the median is 50 years), with a projected service life of 80 years, the value of Oregon bridges should be less than half of the replacement costs.

Figure 45: 2018 ODOT Bridge Asset Valuation



Value of Oregon Bridges

The value of Oregon Bridges is broken out by ownership by NHS bridges (ODOT, Local) and ODOT Non-NHS bridges. In the interest of practicality, the value of the Local NHS bridges is based only on the SLD method using a service life of 80 years and a minimum asset value of 10% of the replacement costs. The Local NHS bridge replacement costs are all based on one unit cost based on square feet of bridge deck. In some cases this will overestimate the replacement values for small rural bridges and in other cases underestimate the values for urban signature bridges. Further analyses could be done in the future to better estimate the replacement value of Local NHS bridges.

The value of Oregon bridges is shown in the table below.

System/Ownership	Number of bridges[37]	Total Bridge Deck Area (sf)	Replacement Cost	SLD Using Service Life = 80 Years; Min=10% of Replacement Costs	Value Based on ODOT RSL Method
ODOT NHS	1,733	28,455,620	$29,766,258,207	$14,634,848,997	$14,580,632,123
ODOT non-NHS	*1004*	*8,089,067*	*$8,170,932,118*	*$3,581,500,370*	*$3,579,105,147*
Total ODOT	**2,737**	**36,544,687**	**$37,937,190,325**	**$18,216,349,368**	**$18,159,737,269**
Local NHS[38]	81	1,729,505	$1,227,024,068	$499,409,347	$499,409,347
Total NHS	**1,814**	**30,185,125**	**$30,993,282,275**	**$15,134,258,344**	**$15,080,041,470**

Table 20: Value of Oregon Bridges

Pavement Asset Values

As part of its asset management improvement process, ODOT is working to better identify the value of its pavement assets in a manner that is supportive of asset management as a discipline. Current efforts to assign a general replacement cost per mile of pavement is severely limited by several variability factors, including terrain, geology, local climate variation, regional design requirements, and the bundled costs of parallel roadway improvements such as improved drainage, safety elements, sightline improvements, and enhanced bicycle, pedestrian, and ADA features that are included when a roadway is reconstructed.

While the cost of replacing a mile of roadway varies considerably depending on several factors, ODOT currently relies upon the methods developed by the Joint Transportation Research Program of the Indiana Department of Transportation and Purdue University. Using the Standard Linear Depreciation (SLD) Method outlined in *A Methodology for Highway Asset Valuation in Indiana*, Oregon estimates the total value of ODOT's pavement on the state system at **$19.4 billion** and the value of pavement on the National Highway System at **$11.7 billion**. This measure applies unit asset values derived from the JTRP study, applies Oregon-specific cost factors, and adjusts these values for current (2018) inflation.

SLD Total Value = Hwy lane mi * (2010 SLD unit price * resource price factor * terrain factor) * 2010 to 2018 inflation

SLD Total Value = Hwy lane mi * ($447,993 * 1.25 * 1.6) * 1.169

System/Ownership	Centerline Miles	Lane Miles	*2018 Oregon pavement SLD unit price[39] (derived from JTRP Study)*	SLD Total Value
ODOT NHS	4,052	11,195	*$1,047,437*	$11,726,057,215
ODOT non-NHS	*3,608*	*7,369*	*$1,047,437*	$7,718,563,253
Total ODOT	***7,660***	***18,566***		**$19,446,620,468**
Local NHS	263	873	*$1,047,437*	$914,412,501
Total NHS	**4,315**	**12,068**		**$12,640,469,716**

Table 21: Value of Oregon Pavements

Funding Needed to Maintain NHS Bridge and Pavement Asset Value

A robust evaluation that assesses the amount of funding needed on an annual basis to maintain Oregon's NHS bridges and pavement based on asset valuations has not yet been performed. However, a rough estimate can be made that divides the total value of an asset by its overall life-expectancy.

ODOT NHS Bridges: Assuming a 80-year life-expectancy for NHS bridges, the annual spending needed to maintain the current value of ODOT's NHS bridges would be $182 million. However, this level of annual investment is slightly below the amount needed to maintain current conditions. The rough estimate used assumes a straight line deterioration but in reality, since the bridge inventory has an average age of 46 years, many bridges will deteriorate at an accelerated, non-linear rate in the next 34 years. The resulting expected cost to maintain the current value will exceed the cost to maintain current conditions.

[37] *The TAMP was developed over several years requiring multiple analyses. Slight differences in bridge counts and deck areas exist due to the dynamic nature of the bridge inventory over time. Bridges may have been retired and/or added between the different analyses*

[38] *Current Local NHS bridge values are all based on SLD analyses*

[39] *Unit price = 2010 SLD unit price * state resource price factor * state terrain factor * 2010 to 2018 inflation*

ODOT NHS Pavements: Assuming a 30-year life-expectancy for asphalt pavements, a 50-year life-expectancy for concrete pavements, the annual spending needed to maintain the current value of ODOT's NHS pavements would be $379 million. However, this level of annual investment in Oregon's NHS pavement exceeds ODOT's estimated need to maintain a state of good repair, and is likely unnecessary because pavement projects are rarely a full-depth replacement and are generally limited to partial depth replacement and resurfacing.

A summary of hypothetical value-based annual investment in NHS Pavements and Bridges compared to the three investment scenarios in the previous subsection is summarized in the following table:

ODOT NHS Pavements	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	***AVG***
SOGR	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	*$ 180*
MCC	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	$ 180	*$ 180*
Feb '19 Forecast	$ 115	$ 104	$ 107	$ 115	$ 108	$ 108	$ 108	$ 115	$ 115	$ 115	*$ 111*
Asset Value Methodology	*$ 379*	*$ 379*	*$ 379*	*$ 379*	*$ 379*	*$ 379*	*$ 379*	*$ 379*	*$ 379*	*$ 379*	*$ 379*

ODOT NHS Bridges

SOGR	$ 339	$ 339	$ 339	$ 339	$ 339	$ 339	$ 339	$ 339	$ 339	$ 339	*$ 339*
MCC	$ 219	$ 219	$ 219	$ 219	$ 219	$ 219	$ 219	$ 219	$ 219	$ 219	*$ 219*
Feb '19 Forecast	$ 115	$ 115	$ 115	$ 115	$ 101	$ 101	$ 101	$ 130	$ 130	$ 130	*$ 115*
Asset Value Methodology	*$ 182*	*$ 182*	*$ 182*	*$ 182*	*$ 182*	*$ 182*	*$ 182*	*$ 182*	*$ 182*	*$ 182*	*$ 182*

Table 22: Asset Value Methodology Compared to Investment Scenarios

Addressing Asset Management Financial Gaps

The previous subsections assess the funding gaps facing the agency in maintaining and preserving ODOT NHS Pavements and Bridges and considers the balance of investment by work type. The gaps between the forecast revenue available for pavement and bridge preservation, rehabilitation, and modernization, and the amount needed to meet a desired state of good repair, or maintain current conditions, necessitates an investment strategy that optimizes limited resources in managing a system that faces deteriorating conditions.

The following section *(Section 9: Investment Strategies)* describes how the Oregon Transportation Plan (OTP) provides a framework for decision-making under a scenario where available revenue remains flat and is insufficient to meet system needs. The OTP specifies that under this constrained funding scenario, investment should "support Oregonians' most critical transportation needs, broadly considering return on investment and asset management." Efforts should be focused on preservation and operational improvements to maximize system capacity and safety at the least cost possible. Under this framework of constrained funding, ODOT, along with partner agencies, have undertaken a series of efforts to manage the growing gaps between available funding and funding needed to meet a desired state of good repair. These efforts include, but are not limited to:

- Securing new sources of revenue dedicated to asset management activities through a series of state legislative funding packages (OTIA I, OTIA II, OTIA III, JTA, HB2017)
- Prioritizing investment in transportation corridors that are most critical to the movement of freight, economic activity, and emergency lifelines
- Supporting research efforts dedicated to optimizing investment balances across work types
- Developing innovative methods and processes (grouping, bundling, etc.) to repair and replace hundreds of aging bridges across the state through the OTIA State Bridge Delivery Program
- Conducting ongoing research to identify pavement and bridge materials and practices with lower costs over the full lifecycle of the asset
- Identifying and adopting cost-effective solutions to mitigating transportation risks and enhancing system resiliency

The following section *(Section 9: Investment Strategies)* provides greater detail on how ODOT, along with partner agencies responsible for NHS assets, are employing these asset management approaches to stretch limited resources and working to preserve and maintain bridge and pavement assets on priority transportation corridors while balancing these investments with parallel needs including seismic resiliency, safety improvements, multimodal needs, and a backlog of ADA ramp enhancements.

Section 9

INVESTMENT STRATEGIES

- TAMP Investment Strategy Requirements
- Investment Strategy Overview
- Investment Priorities and Policy Guidance
- Asset Management Investment Strategies
  - *Work Type Investment Strategies Based on OTP and OTC Policy Guidance*
  - *Bridge and Pavement Program Management Strategies*
  - *Statewide Transportation Improvement Program Asset Management Strategies*
  - *Other Investment Strategy Improvement Efforts*
  - *Strategies for Reducing Gaps in Available Transportation Funding*

TAMP Investment Strategy Requirements

Federal statute requires every State DOT to develop both a financial plan and investment strategy as part of the TAMP that encompasses at least 10 years and identifies the revenues and costs associated with preserving and improving the condition and performance of the transportation assets included in its asset management plan. Investment strategies are to demonstrate how adopted actions improve or preserve the condition and performance of NHS infrastructure and make progress in achieving national policy goals.

Specific requirements for the development of investment strategies are listed below:

Investment Strategies
The investment strategies process is required to provide a description of how investment decisions are influenced by (at a minimum):

- *Performance gap analysis;*
- *Lifecycle planning;*
- *Risk management analysis; and*
- *Anticipated available funding and estimated costs of future work.*

Investment Strategy Overview

One of the major challenges facing Oregon's transportation system is that increases in revenue dedicated to transportation have not kept pace with the funding needed to maintain, preserve, and enhance an aging transportation system. While transportation funding for pavements and bridges has stagnated or increased incrementally with new state and federal investments, inflation and rising construction costs have substantially reduced the buying power of available resources needed for aging facilities.

ODOT's investment strategies under this constrained revenue scenario are founded on policies and objectives adopted by the OTC and presented in ODOT's Oregon Transportation Plan (OTP) and associated modal and topic plans. The investment strategies link organizational financial and management system priorities with asset management processes that consider asset conditions, performance targets, lifecycle planning, and risk analysis. The investment strategies developed by ODOT support progress towards the achievement of state and national goals and performance targets, and reflect optimal investments in a constrained funding environment.

Investment Priorities and Policy Guidance

Planning Guidance

Specific guidance around how ODOT should invest in its transportation system under a constrained funding environment is outlined through policy guidance from the Oregon Transportation Plan as well as the Oregon Highway Plan. The Oregon Transportation Plan serves as the umbrella document for Oregon's multimodal transportation system.

As part of its overall plan, the OTP identifies three investment scenarios that provide a framework for decision-making based on the amount of funding available for the transportation system. Under a scenario where available revenue remains flat and is insufficient to meet system needs, the plan identifies a policy for "Triage in the Event of Insufficient Revenue." It specifies that under this constrained funding scenario, investment should "support Oregonians' most critical transportation needs, broadly considering return on investment and asset management." Efforts should be focused on preservation and operational improvements to maximize system capacity and safety at the least cost possible.[40]

The Oregon Highway Plan (OHP), which is a modal plan that supplements the OTP, provides further guidance around investments in pavement and bridge assets under this constrained funding environment. To help meet Oregon's transportation system needs, the OHP establishes policies and scenarios used in planning and prioritizing programs at a range of potential funding levels. Under the constrained revenue scenario that Oregon currently faces, the OHP emphasizes doing as much as possible to operate the highway system safely and efficiently to preserve what is already in place.[41] Specifically, the OHP lays out the following strategy under this scenario:

> *With funding that does not increase with inflation and subject to statutory requirements and regional equity, address critical safety issues and manage and preserve existing infrastructure at 77% fair-or-better before adding capacity, as explained below:*
>
> - *Focus safety expenditures where the greatest number of people are being killed or seriously injured.*
> - *Fund modernization only to meet statutory requirements.*
> - *Preserve pavement conditions at 77% fair-or-better on all roads except for certain Regional and District Highways.*
> - *Do critical bridge rehabilitation and replace bridges only when rehabilitation is not feasible.*
> - *Fund operations to maintain existing facilities and services and extend the capacity of the system.*[42]

Oregon Transportation Commission Policy Guidance

In October of 2016, the OTC was approached by the Oregon Legislature's Joint Committee on Transportation Preservation and Modernization and asked to identify state transportation needs and strategies to address these needs. A process and strategy was established for developing an investment framework that lays out the need for investing limited resources in identified transportation areas and explained the outcomes achieved by these investments. The process brought together experts from throughout the agency who identified and quantified investment needs and outcomes, developed an initial set of findings for Commission review, and revised these findings to incorporate guidance from the OTC. The strategy looked at the short, medium, and long-term needs, strategies and outcomes.

In January 2017, the OTC formally adopted *A Strategic Investment in Transportation*. The document discusses annual investment options for 10 transportation areas. *Table 24* summarizes three investment strategies identified for highway pavements, bridges, seismic and maintenance needs, and provides a brief discussion of the consequences of different levels of investment.

Table 23: OTC Investment Scenario Descriptions

	Status Quo *Annual investment (pre-HB2017)*	**Investment Scenario I** *Moderate additional annual increase*	**Investment Scenario II** *Additional annual increase to meet total need*
Pavements	**$85 Million**	**$185 million *($100M additional)***	**$200 Million *($115M additional)***
	13% of highways are in poor or worse condition today, which will rise to 35% by 2035.	Keep pavement condition on priority (fix-it) corridors from degrading through preservation and rehabilitation.	Improve pavement condition to meet state performance targets for pavement in fair-or-better condition across all state highways.
	Deteriorating pavements will increase maintenance costs and vehicle repair costs.	Save millions in pavement maintenance and rehabilitation costs.	Save millions in maintenance and rehabilitation costs.
Bridges	**$85 Million**	**$185 Million *($100M additional)***	**$435 Million *($350M additional)***
	By 2035, 65% of Oregon's state highway bridges will be in distressed condition.	Replace and address structurally deficient bridges on key freight routes. Complete Phase I of the bridge component of ODOT's Seismic Plus Plan, replacing	Address the backlog of deferred work and the Interstate Era bridges due for replacement over the next 25 years.

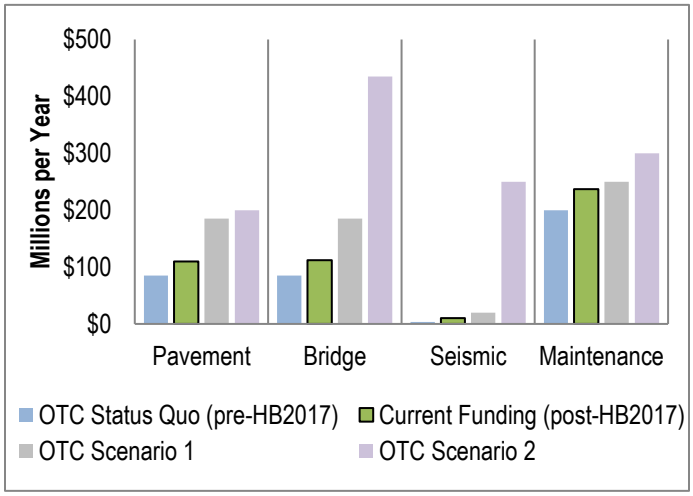
[40] *Oregon Transportation Plan, Goals, Policies, and Strategies; Policy 6.5, Page 71-72*
[41] *Oregon Highway Plan, Page 7*
[42] *Oregon Highway Plan, Page 7-8*

	At today's investment levels, it will take 900 years for ODOT to replace all its bridges.	and retrofitting bridges to be resilient to a Cascadia Subduction Zone Earthquake.	
Seismic	**$35 Million (one time)**	**$20 Million (annual)**	**$250 Million (annual)**
	One-time commitment of funding to retrofit bridges on US 97 and OR 58 as first components of ODOT's Seismic Plus plan.	Address the most critical landslides on priority routes. Address key state highway bridges on local lifeline routes.	Execute all phases of work identified in Seismic Plus Report, completing the backbone system of Lifeline Routes within 20 years.
Maintenance	**$200 Million**	**$250 million *($50M additional)***	
	There is a backlog of maintenance needs, particularly outside priority corridors. Lack of staff coverage for major storm events to help keep routes passable.	Offset increasing maintenance costs. Increase winter maintenance staff, materials and equipment. Increase number of incident responders.	Continual investment as the system ages, addressing issues early to prevent more costly fixes to the system, and keep pace with rising maintenance costs.

The strategies presented in the OTC Investment Strategy reflect the OTP and OHP policy guidance of focusing targeted cost-effective investments on high priority corridors and are aimed at achieving transportation goals for the condition and performance of ODOT's pavements and bridges.

Underlying the investment strategies is asset management information and analyses presented in other sections of the TAMP. The performance gap analysis helps identify investment needs to achieve policy goals for condition and performance of NHS pavements and bridges. Lifecycle cost considerations provide information on the costs of maintaining and improving NHS pavement and bridge assets over time. Financial plan estimates of state and federal funding permit the development of likely future conditions and performance of pavements and bridges on priority NHS routes as well as the overall state system. Risk management analysis highlights and prioritizes factors that positively or negatively impact strategies and outcomes.

Figure 46: OTC Investment Scenarios and Current Funding



Asset Management Investment Strategies

The following subsections identify actions and strategies that the agency is undertaking, and has recently undertaken, to improve how the agency employs asset management strategies to stretch limited resources, as well as strategies to reduce the gaps in funding available for transportation. These strategies are broadly categorized as follows:

- *Work Type Investment Strategies Based on OTP and OTC Policy Guidance*
- *Bridge and Pavement Program Management Strategies*
- *STIP Asset Management Strategies*
- *Other Investment Strategy Improvement Efforts*
- *Strategies for Reducing Gaps in Available Transportation Funding*

Work Type Investment Strategies Based on OTP and OTC Policy Guidance

The three major categories of investment that ODOT employs to preserve and enhance the NHS pavement and bridge system are: Modernization, Preservation, and Maintenance. Modernization activities include initial construction and reconstruction of existing assets; preservation includes both preservation activities and well as rehabilitation activities; and Maintenance includes both proactive and reactive maintenance efforts.

The Investment Strategy adopted by the OTC informs ODOT's investment approaches around each of these work type activities for pavement and bridges. The following summarizes ODOT's investment strategies as it seeks to balance investment between Modernization, Preservation, and Maintenance under a constrained revenue scenario:

Strategy 1: Target more dollars for preservation and maintenance over modernization

State law established in 1985 (ORS 366.507) requires ODOT to dedicate a minimum of $51 to $55 million each year to highway modernization efforts. Beginning with the 1998-2001 STIP, the modernization program was reduced to the minimum level required by law to allow the agency to focus investments on activities that preserve and maintain the state's existing highway system. This strategy continues focus on preservation measures to add useful life to pavement and bridge before the structures and their underlying bases are damaged and require major rehabilitation or reconstruction. Further, this strategy also places emphasis on preventative maintenance activities that can delay the need for more costly repairs.

Current funding allocations for pavement and bridge preservation and maintenance limit the decline in condition on the State and National Highway System over the next 10 years. Additional funding provided by HB2017 is designated to pavement and bridge preservation and will help delay the deterioration in conditions, but will not stop this decline from taking place. Even with prioritization of preservation and maintenance over modernization, additional revenue for pavement and bridges is necessary to meet and maintain a desired state of good repair. See Section 4: Performance Gap Analysis.

Strategy 2: Focus preservation and preventative maintenance activities on key routes and corridors

Under a constrained revenue scenario, ODOT focuses its investments on preservation and preventative maintenance activities on priority routes known as Fix-It Priority Corridors. Further detail on ODOTs Fix-it Priority Corridors is outlined later in this section.

The identification of key routes or corridors to receive priority consideration coincides with the establishment of the National Highway System under ISTEA in 1991. A key priority of the 1999 Oregon Highway Plan is to "give priority to Interstate pavement and bridge conditions and pavement and bridge conditions on other priority routes."

To maintain current pavement and bridge conditions on ODOT priority routes, additional funding for preservation and preventative maintenance of pavement and bridges is needed over the next 10 years. See Section 4: Performance Gap Analysis.

Strategy 3: Provide funding to enhance the seismic resilience of pavements and bridges

One of the foremost environmental risks facing Oregon and its transportation system is a Cascadia Subduction Zone Earthquake. The 1999 OHP, established as a priority to provide "a secure lifeline network of streets, highways, and bridges to facilitate emergency services response and to support rapid economic recovery after a disaster." Over the years, the agency has made incremental progress in developing approaches to mitigate seismic vulnerabilities of the state's highways and bridges. The Oregon Highways Seismic PLUS Report (ODOT, 2014) outlined a statewide program to address seismic vulnerability and mitigate structural deficiencies.

In March 2016, the OTC allocated $35 million for the first phase of enhancing the seismic resiliency of lifeline routes. Subsequently, additional revenue from HB2017 was dedicated for funding seismic improvements on highways and bridges.

An additional $20 million per year over the next 5-10 years would allow ODOT to increase seismic resiliency in three corridors; beyond that timeframe, an additional $20 million per year would address the most critical landslides identified in the agency's Seismic Plus Report (Investment Scenario I). To complete all phases of work identified in the Seismic Plus within 20 years would require an annual additional expenditure of $250 million (Investment Scenario II).

Strategy 4: Increase funding for pavement and bridge maintenance activities

Existing maintenance resources no longer keep pace with increasing needs arising from aging infrastructure, inflation, more frequent extreme weather events, growing population and traffic volumes. An additional $50 million per year would offset increasing maintenance costs and needs (Investment Scenario I). Completing timely maintenance activities increases the service life of pavements and bridges and reduces the need for more costly preservation, rehabilitation and replacement activities.

Common to each of the strategies is a continued gap between available funding and funding needs. To address unfunded needs, ODOT will continue to work with local government partners, transportation stakeholders, and members of the legislature to seek funding for transportation system investments at a level that meets a desired state of good repair. Additionally, the agency will explore innovative and cost-effective ways to extend service life of pavements and bridges, and investigate ways to enhance pavement and bridge management systems and improve decision-making based on these management systems.

Bridge and Pavement Program Management Strategies

ODOT's bridge and pavement management systems provide essential technical information for managing pavement and bridge assets. For technical information to have true value and meaning it must contribute to defined strategies. ODOT's pavement and bridge management systems reflect strategies that embody OTP and OHP goals and objectives. They provide valuable information for the projects and activities proposed and undertaken in priority corridors and programed in the STIP.

Bridge preservation investment strategies

The standard ODOT strategy for bridge preservation is to keep bridges in the best condition possible, at the lowest cost, by taking a preventative approach to preserve and maintain bridges. As outlined in *Section 6: Lifecycle Cost Analysis*, the most cost-effective approach is to extend the service life of bridge decks and other structural components where possible through routine preventative maintenance. This approach extends the life of bridges, reducing the frequency and need of costly bridge replacement.

In 2011, ODOT's Highway Leadership Team developed a System Preservation Strategy Work Plan for bridges on the state system. This work plan identified a bundle of strategies aimed at reducing the number of high value bridges falling into a condition where bridge rehabilitation is not an option. The strategies identified in this work plan are as follows:

1. Protection of high value coastal, historic, major river crossings, and border structures by acting before cost becomes prohibitive.
2. Use of Practical Design and funding of basic bridge rehabilitation projects and rare replacements with bridge program funding.
3. Give priority to maintaining the highest priority freight corridors.
4. Develop bridge preventative maintenance (PM) program that will extend the service life of bridge decks and other structural components.
5. Continue to raise awareness of the lack of seismic preparation.
6. Bring Structurally Deficient (SD) bridges to a Fair condition using a partial rehabilitation scope of work.
7. Leverage other programs where possible to do additional bridge preservation on the system.
8. Continue use of bridge inspection, health monitoring and improved deterioration prediction.

Pavement Preservation Investment Strategies

ODOT has developed and implemented a pavement strategy that makes the best use of available funds incorporating Pavement Management System data and analyses into the process. The pavement strategy uses a tiered approach to prioritize highway routes and also includes dedicated funding programs for the most cost-effective maintenance treatments, preservation resurfacing and rehabilitation, and reactive pavement patching.

State highway pavement preservation investments prioritize pavement conditions by state highway classification into four levels:

1) Interstate highways (highest priority, highest condition targets, and highest level of investment)
2) Fix-It priority Routes (e.g., US-97, OR-58, or US-26)
3) Remaining State level NHS routes (e.g., US-101)
4) Region and district level routes (e.g., OR 99E or OR214)

ODOT's pavement investment strategy is overseen by a longstanding interdisciplinary Pavement Committee steering team that includes the State Pavement Engineer and Pavement Management Engineer, State Traffic/Roadway Engineer, State Construction Engineer, a Region and Area Manager, a Maintenance and Operations Manager, and District Managers who are lead Pavement Preservation efforts in each region. This steering team meets regularly and sets the overall strategy and policy direction for the pavement programs. The team manages the financial plans for the Interstate preservation program, the HB2017 funded preservation program, and the chip seal program, and also determines funding allocations to the interstate and regional paving and chip seal programs. More detail about pavement prioritization is included in *Section 5 ODOT Asset Management Practices*.

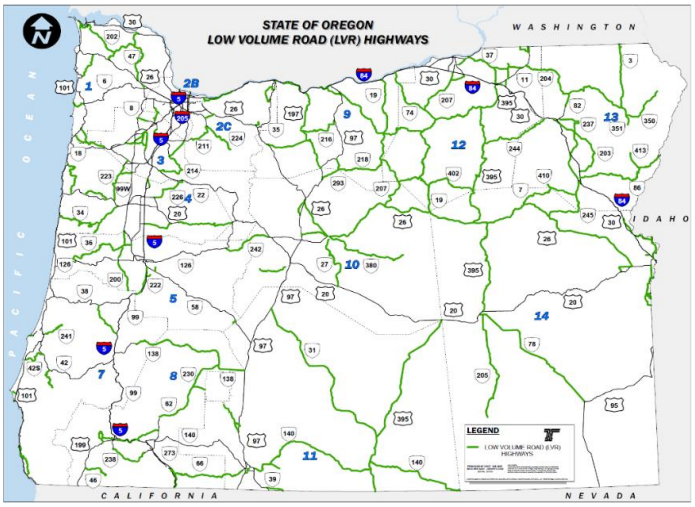
Funding for ODOT's pavement program comes from two sources, the STIP Fix-It Preservation Program and the Maintenance Program. By policy, the state highway network is broken up by traffic volume and truck traffic loading so that the Interstate and most of the NHS pavement projects are delivered with STIP funds through the Fix-It Preservation Program while projects on lower traffic volumes state highways are delivered with Maintenance funds. Funding levels for each program rely on PMS data and analysis to set funding levels and identify priority projects.

STIP Fix-It Preservation - The Fix-It Preservation program invests primarily in pavement resurfacing and rehabilitation projects on the Interstate and state highways with relatively higher traffic volumes. As part of Fix-It Preservation projects, roadside safety feature and accessibility deficiencies on walkways abutting repaving projects are corrected where required. Overall funding levels for the Fix-It Preservation program are established for each STIP update cycle (typically every 3 years) at ODOT's executive level and are informed by the PMS which forecasts the impacts of different investment levels on pavement conditions. Approximately one-third to one-half of total program funds are allocated to Interstate preservation projects depending on overall funding level and pavement needs as determined by the PMS. Approximately $5 million per year goes to sign replacement and

local pavement repair projects on the Interstate. Approximately $5 million of Fix-It Preservation funds are annually dedicated to a Chip Seal subprogram with funding levels and project priorities as determined from the PMS. The remaining funds are allocated to pavement projects on the rest of the state highway system, mostly on the NHS.

Maintenance - There are two dedicated pavement funding line items within the Maintenance budget – Low Volume and Pave Patch. Funding levels and district allocations for both of these programs are established each biennium (2 year cycle) within Maintenance as part of their normal budgeting process and are informed by PMS data. The Low Volume Program invests primarily in pavement crack seals, chip seals, and limited preservation resurfacing on state highway routes with an average daily traffic (ADT) of less than 5,000 vehicles and 20-year equivalent single axle truck loads (ESALs) of less than 3 million, as shown in *Figure 47: ODOT Maintenance Program Low Volume Routes*. Although some of the state NHS highway system is part of the Low Volume Highway network, the majority of these routes are non-NHS. The Low Volume Program is budgeted to hold pavement conditions on low volume state highways with mostly chip seals and patching. Budget levels are periodically adjusted based on pavement condition trends. Funds are allocated to the districts in proportion to lane-miles. Starting with the 19-21 biennium, the budget was increased by about 15% to apply resurfacing overlays to priority locations with extensive deterioration and/or high risk of failure. The budget increase was supported by the PMS. Pave Patch funding applies corrective maintenance on deferred highways and occasionally does maintenance preservation projects to extend pavement service life. The overall budget for Pave Patch is informed by the PMS by monitoring historic and forecast pavement conditions, and adjusting as needed. The Pave Patch district splits are based on a formula incorporating lane miles, pavement condition, and traffic level.

Figure 47: ODOT Maintenance Program Low Volume Routes



Statewide Transportation Investment Program Asset Management Strategies

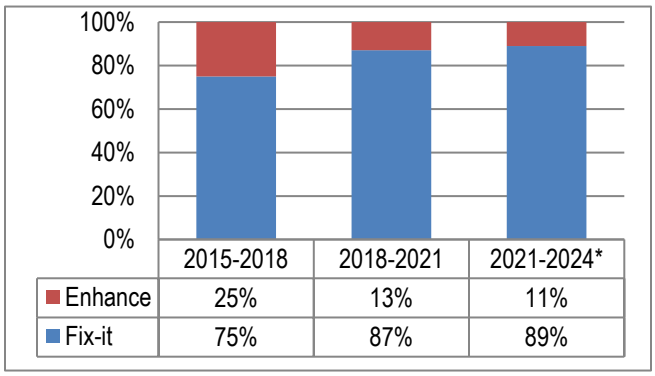
Dedication of STIP Funding Toward Fix-it Projects

The investment strategies outlined in the sections above are largely implemented through Oregon's STIP. In 2012, the OTC and ODOT changed how the STIP is structured. The STIP is no longer developed as a collection of projects for specific pools of funding dedicated to specific transportation modes or specialty programs. Instead the STIP primarily divides funding into two broad categories: ***Fix-It*** and ***Enhance***.

> **Enhance:** *Activities that enhance, expand, or improve the transportation system.*
>
> **Fix-it:** *Activities that maintain and preserve the transportation system.*

The process of organizing the STIP around Enhance and Fix-it categories was a significant change and reflects ODOT's goal of becoming a more multimodal agency and making investment decisions based on the system as a whole, not for each mode or project type separately. The agency has requested assistance from local partners in developing the STIP and identifying those projects that assist in moving people and goods through the transportation system safely and efficiently.

Figure 48: STIP Cycle Funding Split



	2015-2018	2018-2021	2021-2024*
Enhance	25%	13%	11%
Fix-it	75%	87%	89%

The process for selecting Fix-It projects within the STIPs relies heavily on data-driven project identification and selection driven through ODOT management systems that help identify needs based on technical information and condition data for assets including pavement and bridges.

Since its inception, the division of STIP funding between Enhance and Fix-it has trended toward an increased share of revenue dedicated to Fix-it projects. This shift is consistent with OTP policy guidance which stipulates an increased focus on maintaining and improving the existing transportation system under a constrained revenue scenario. Furthermore, it is emblematic of a transformation in agency focus toward data-driven project identification and selection that is built on asset management principles.[43]

[43] *STIP Cycle funding splits for 2021-2014 are based on estimates and policy direction from the OTC. The final 2021-2024 STIP will be completed in June 2020.*

Prioritization of Fix-it Corridors in the STIP

To preserve movement of freight and economic activity under a constrained funding environment, ODOT employs a "corridor approach" that prioritizes resources to keep key freight corridors open to truck traffic and maintain critical connections across the state. ODOT has designated the main routes of the state highway system connecting most of the state's communities and carrying most freight and automobile traffic as "Fix-It priority corridors" and focuses scarce resources on maintaining bridge and pavement conditions on these routes.

Fix-It priority corridors include all the routes in the Interstate System, Seismic Phase 1 and 2 Lifeline Routes, and Priority Routes identified by the ODOT Highway Management Team. As demonstrated in *Figure 54*, the Fix-it priority corridors are all part of the State Highway System and the National Highway System.

The designation of Fix-it Priority Corridors ensures that the constrained revenue needed to repair and maintain Oregon's transportation system is focused on critical corridors in the system. Furthermore, because these corridors are all part of the ODOT-owned National Highway System, dollars invested in these corridors are directly aimed at improving *state* and *national* performance measure conditions.

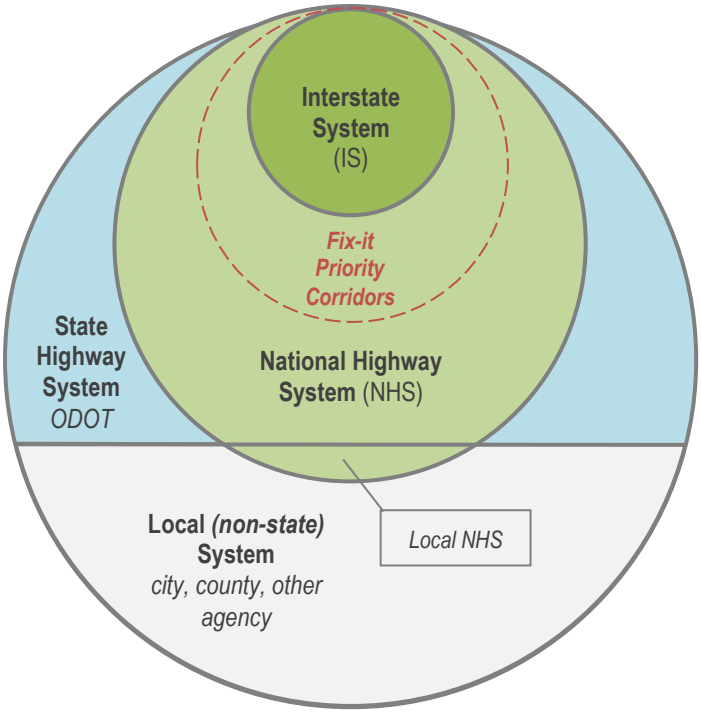


Figure 49: Fix-it Priority Corridors and Highway System Networks

STIP Fix-it Project Identification and Selection Process Coordination

Currently, the process to identify and select STIP Fix-it projects involves multiple agency units and multiple areas of decision-making. The Central Office typically prepares an initial list of proposed projects along with corresponding financial estimates. For bridges, this initial list is developed by professional staff from the ODOT Bridge Technical Services Unit and utilizing the BrM (Pontis) management system. For pavements, this initial list is developed by the ODOT Pavement Services Unit, utilizing its pavement management system. These initial lists are provided to ODOT's five Region Offices for desk scoping, and a 3-month period of field scoping. The Central Office then generates refined lists based on these findings. In the most recent STIP cycles, the agency has sought to more closely coordinate the STIP decision-making processes across assets and between regions. Through the STIP Fix-it Coordination Committee, the agency has sought to ensure that investment decisions are made with close coordination among asset managers, that they are informed by reliable data, and that they are closely aligned with agency priorities.

Other Investment Strategy Improvement Efforts

ODOT is continuously seeking ways to improve the process for identifying, developing, and selecting projects in the Statewide Transportation Improvement Program with the objective of optimizing the state's investment in its transportation system under a constrained revenue scenario. The following identifies process improvements the agency is undertaking to improve how it invests in capital assets, including through its STIP program. These improvement efforts draw heavily on asset management strategies, including data-driven decision-making, lifecycle management, and risk management.

Strategic Business Plan

In April 2018, the OTC adopted a strategic business plan for the agency called *One ODOT: Positioned for the Future*. This strategic business plan identified four ODOT Strategic Priorities:

- Unify & Align ODOT Operational Governance
- Optimize & Modernize Technology & Data
- Build a Qualified & Diverse Workforce for Today & the Future
- Strengthen Strategic Investment Decision Making

The agency priority to *strengthen strategic investment decision making* aims to "better link long-range plans and objectives to shorter-term transportation agency investments." The anticipated outcome of this effort is designed to lead to more informed and efficient investments and management of trade-offs, support investment decisions that are clearly linked to plans, goals and policies, and improve the agency's ability to explain the rationale for investment choices and trade-offs.[44]

Ongoing ODOT research efforts supporting strategic investment

ODOT's Research Unit, in partnership with FHWA, other transportation agencies and research universities, support efforts that provide better and more useful decision-making information and enhance the service life of transportation assets at the least practical cost. These efforts include conducting research to identify bridge and pavement materials with lower costs over the full lifecycle of an asset, as well as efforts dedicated to optimizing balances of investment across work types.

A noteworthy example was a 2004 Oregon State University engineering study of ODOT bridges. Facing a rapid increase in the number of structurally deficient bridges across the state, the Oregon Legislature enacted a 2003 transportation funding package of which $1.3 billion was earmarked for improving state bridges. Using conventional approaches to bridge analysis and evaluation, ODOT initially identified 365 bridges as needing repair or replacement. The department approached Oregon State University to see if they could find a better way of assessing bridge conditions and determining bridge repair needs. Results of the OSU study enabled the department to more accurately determine individual bridge repair and replacement needs and identify the most appropriate and cost-effective repair or replacement option. Moreover, study results allowed the department to stay within its original estimated budget in the face of rapidly increasing construction material costs, thereby avoiding what would have been a half-billion shortfall in needed funding.

Bridge Work Type	**Planned Approach**	**Revised Approach** (OSU Study)
Modernization	*280 bridges*	*169 bridges*
Preservation	*85 bridges*	*123 bridges*
Maintenance	*0 bridges*	*73 bridges*
Total	**365 bridges**	**365 bridges**
Updated Total Cost:	***$ 2.1 Billion***	***$ 1.6 Billion***

Table 24: OTIA Bridge Replacement Program Revision

Asset Management Initiative Prioritization Efforts

Currently, ODOT makes a large biennial investment in asset management technology initiatives aimed at improving asset information and informing capital investment decisions. In recent years the pace of highway asset data gathering technologies and data tools has accelerated along with a demand for reliable and up to date asset information that can improve management of the transportation system. In an effort to deal with the growing number of asset management initiatives under constrained resources, ODOT's asset management program has worked to identify agency priorities for undertaking new initiatives, ensure that new proposals are in strategic alignment with the agency, and that these new initiatives have appropriate justifications and achieve expected benefits. This asset management initiative prioritization effort has brought together asset program managers, business units, and regional representative to analyze and support decisions around which initiatives and programs should be advanced, and how resources and funding should be allocated to high-priority asset management initiatives.

New Capital Project Benefit-Cost Analysis Efforts

Oregon regulations require that Enhance projects selected for funding in the STIP "provide the greatest benefit in relation to project costs." In 2017, the Oregon Legislature adopted HB2017. A provision of the bill requires that before any STIP Enhance project that costs $15 million or more is included in the STIP, a rigorous benefit-cost analysis must be prepared and made publicly available. Specifically called out in this legislation are requirements to analyze future costs to the agency to preserve and maintain an undertaken project, and identify increased costs that would result from delays in the performance of routine maintenance scheduled by the agency.

Long-Range Fix-it Strategy

Asset Management and associated data tools provide critical support to STIP Fix-it program managers for developing and prioritizing their program of projects. The agency recognizes that there is an opportunity to take greater advantage of increasingly sophisticated data and data systems/tools to inform its investment decisions, particularly when it comes to cross-asset investment decisions made in coordination with the OTC. Additionally, while performance measures and condition ratings serve as important benchmarks to ensure that investments are being made effectively, the agency recognizes that it can improve how performance management as well as risk management is integrated with investment decision-making in order to demonstrate clear and transparent trade-offs between capital investment scenarios.

[44] See *One ODOT: Positioned for the Future*, pg. 23

In recognition of the potential improvements, the agency has launched a Long-Range Fix-it Strategy assessment. This assessment will identify potential improvements in how the agency integrates asset management, performance management, and risk management in support of the STIP development process.

Strategies for Reducing Gaps in Available Funding

Past efforts to dedicate additional revenue to Oregon's state and local transportation systems have been successful in helping preserve and maintain the condition and performance of Oregon NHS Bridge and Pavement assets. These investment efforts have included, but are not limited to, the Oregon Transportation Investment Acts (OTIA I, II, III), the 2009 Jobs and Transportation Act (JTA) and the 2017 Keep Oregon Moving Act (HB2017). These state investment packages have supported the funding of essential asset management activities on critical transportation corridors across the state and have helped mitigate many of the costly consequences and risks associated with deferred maintenance and preservation of Oregon's pavements and bridges.

Despite these critical investments, Oregon Department of Transportation faces on ongoing funding gap between revenue available to maintain and preserve bridge and pavement assets, and the revenue needed to maintain asset conditions and meet a desired state of good repair over a ten-year time horizon. These funding gaps are summarized in *Section 4: Performance Gap Analysis* with further detail provided in *Section 8: Financial Plan*.

State Funding

There are a number of strategies available for reducing funding gaps on the state level. These funding strategies are a part of ongoing discussions taking place among state policymakers, including the Oregon State Legislature and OTC. For example, the *2016 Governor's Transportation Vision Panel Final Report*[45] identified a "menu of options" available for Oregon state policymakers to consider as part of a funding strategy to address unmet transportation funding needs. *Table 26* provides a brief summary of state funding options identified in report that were recognized as having the potential to provide significant additional transportation revenue, along their per-unit impacts based on 2016 estimates.

Revenue Source	Potential funding increase
State Fuel Tax Increase	Every 1-cent increase generates $28.3 million each year*
Registration Fee Increase	Every $10 increase generates $57.9 million each year*
Existing Title Fee Increase	Every $10 increase generates $11.5 million each year*
Class C License Fee Increase	Every $10 increase generates $5.8 million each year*
Supplemental Title Fees on New Vehicles	Every $10 increments generates $3.6 million per year*

Table 25: Potential revenue sources identified by the Transportation Vision Panel
**(note: revenue impacts are based on 2016 estimates)*

Federal Funding

Most states, including Oregon, depend on federal funds for a significant portion of their highway revenue. Oregon's legislatively adopted budget for the state highway system in the 2017-2019 biennium consisted of 77% state revenue and 23% federal revenue. While the 2015 Fixing America's Surface Transportation Act (FAST ACT) provided stability to federal transportation revenue dedicated to Oregon through 2020, the Federal Highway Trust Fund faces long-term insolvency. Federal fuel taxes have not been increased since 1993, requiring Congress to transfer General Fund resources into the Highway Trust Fund to avoid major funding cuts.

As a result of uncertainty in federal funding, the TAMP's ten-year financial forecast assumes a 10% reduction in available funding from the Highway Trust Fund after 2020. However, if federal funding were increased beyond 2020 at an annual rate of 2.2% per year, the gap between the available funding for NHS Bridge and Pavements, and the funding needed to meet a state of good repair would be significantly reduced. Further, ODOT estimates that for each $1 billion increase in National Highway Performance Program funding, Oregon would see upwards of an additional $13 million in annual federal funding available for the preservation and improvement of Oregon's NHS pavements and bridges.

Based on these projections of potential sources of additional revenue, three mitigation strategies are considered that would help close the gap in available funding for NHS pavements and bridges:

- *Strategy 1: Expected federal funding beyond 2020 increases at an annual rate of 2.2%*
- *Strategy 2: Expected federal funding beyond 2020 increases at an annual rate of 2.2%, and state fuel taxes are increased by 15 cents in 2020*
- *Strategy 3: Expected federal funding beyond 2020 increases at an annual rate of 2.2%, and state fuel taxes are increased by 25 cents in 2020*

The following table summarizes the impact of these investment strategies on the overall gap in NHS Bridge and Pavement funding:

[45] https://visionpanel.files.wordpress.com/2016/05/one-oregon-final-report-print-version2.pdf

(Millions of Dollars)

	Avg. Annual Funding Need	Feb '19 Forecast		Mitigation Strategies					
				Strategy 1		Strategy 2		Strategy 3	
		Avg. Annual Available Funding	Avg. Annual GAP	Avg. Annual Available Funding	Avg. Annual GAP	Avg. Annual Available Funding	Avg. Annual GAP	Avg. Annual Available Funding	Avg. Annual GAP
ODOT NHS Pavements									
State of Good Repair	**$ 180**	$ 111	*$ (69)*	$ 135	*$ (45)*	$ 180	*$ -*	$ 180	*$ -*
Maintain Conditions & Achieve Targets	**$ 180**	$ 111	*$ (69)*	$ 135	*$ (45)*	$ 180	*$ -*	$ 180	*$ -*
ODOT NHS Bridges									
State of Good Repair	**$ 339**	$ 115	*$ (224)*	$ 140	*$ (199)*	$ 252	*$ (87)*	$ 357	*$ 18*
Maintain Conditions & Achieve Targets	**$ 219**	$ 115	*$ (104)*	$ 140	*$ (79)*	$ 252	*$ 33*	$ 357	*$ 138*
ODOT NHS Pavements & Bridges									
State of Good Repair	**$ 519**	$ 226	*$ (293)*	$ 275	*$ (244)*	$ 432	*$ (87)*	$ 537	*$ 18*
Maintain Conditions & Achieve Targets	**$ 399**	$ 226	*$ (173)*	$ 275	*$ (124)*	$ 432	*$ 33*	$ 537	*$ 138*

Table 26: Impact of Mitigation Strategies on NHS Pavement and Bridge Funding Gaps

A further breakdown of how the impacts of these investment strategies would reduce the gaps in available funding for NHS pavements and bridges is provided in *Appendix H: Gap Funding Strategies*

Investment Strategies Contribution to Achievement of National Goals

The investment strategies and financial plan presented in this document focus on preserving and improving the condition and performance of Oregon's NHS highway and bridges. Recent revenue increases and requirements adopted by the Oregon Legislature increase the availability of funding for activities that promote transportation safety and support progress in achieving a state of good repair for ODOT NHS pavements and bridges.

A safe and reliable transportation system is fundamental to the economic vitality and livability of Oregon and the nation at large. As the physical condition of highways and bridges deteriorates, the ability of people and commerce to move safely and efficiently declines. Well maintained roadways and bridges ensure better connections between transportation modes and enhance mobility across the state. Progress in achieving a state of good repair of Oregon pavements and bridges supports the safe and efficient movement of people and freight between areas and improves the ability of rural areas to access markets and supports regional economic development.

Efforts to achieve a state of good repair for the condition of Oregon highways and bridges is built on the use of gap analysis, lifecycle planning, risk analysis and other asset management principles. The asset management practices that ODOT employs support the achievement of goals beyond strictly preserving or improving infrastructure condition. For example, risk analysis of the potential impact of climate change has identified steps for the state to take in preparing for extreme storms, seal level rise, flooding and landslides. Coastal resilience studies have investigated alternative mitigation activities and strategies to protect coastal highways and identified measures that enhance resiliency to extreme weather events and climate change risks. Lifecycle planning promotes the use of cost-effective construction best practices that not only save money but encourage recycling, minimize waste and emissions, and promote more environmentally friendly construction practices. Additionally, lifecycle planning practices aim to reduce maintenance costs and enhance environmental sustainability through such things as use of best practices for storing and using road salt.

As the state of Oregon looks to the future and seeks to provide a safe and reliable multimodal transportation system that connect people and helps Oregon's communities and economy thrive, it will continue to employ asset management practices, including gap analysis, lifecycle planning, and risk analysis, which aim to deliver an optimal transportation system at minimal costs.

Oregon
Kate Brown, Governor

Department of Transportation
Highway and Transportation Development Divisions
355 Capitol St NE
Salem, OR 97301-3871
Phone: (503) 986-3452
Fax: (503) 986-3432

FILE CODE:

August 22, 2019

Phil Ditzler
Oregon Division Administrator
Federal Highway Administration
530 Center Street NE, Suite 420
Salem, OR 97301

Dear Mr. Ditzler,

Code of federal regulations CFR 23 515.11(a)(2) requires State Departments of Transportation (DOTs) to submit a state-approved asset management plan meeting all requirements of 23 U.S.C. 119, together with documentation demonstrating the implementation of the asset management plan, no later than June 30, 2019.

Using the submitted materials, "the FHWA will determine whether the State DOT's plan and implementation documentation meet the requirements of 23 U.S.C. 119 and CFR 23 515.13(a)." On June 19, 2019, Oregon Department of Transportation (ODOT) staff submitted the Oregon Transportation Asset Management Plan (TAMP) and implementation documentation to your office.

On August 8, 2019, Nikki Nowack, Sam Haffner, and John Baker met with Tim Rogers and Jasmine Harris to review and discuss findings of FHWA's formal review and evaluation of the Oregon TAMP and plan implementation materials. The formal review and evaluation identified four element issues that needed further discussion and documentation:

1. How system enhancements (adding assets) are addressed in gap analysis.
2. How risk analysis ties into NHS bridge investment strategy and finance plan, and how risks are increased, decreased or stay the same based on investment strategy.
3. How ODOT is using information in the TAMP at this time, to change historic funding levels, etc.
4. Provide documentation comparing actual with planned expenditures for 2018 by FHWA established work types. *(Letter signed by ODOT leadership that planning and programming of funds over the course of the last year followed TAMP investment strategies satisfies consistency requirement for this year, but interest is in what will be our approach to documenting a comparison of actual expenditure information to planned expenditures next year.)*

After discussing thoughts about and responses to the element issues, a decision was made that an acceptable approach would be to prepare an addendum to the TAMP that would address the four issues. The enclosed TAMP addendum, which will be included as part of the publicly available

TAMP, provides additional discussion and documentation addressing the four element issues raised by the formal FHWA review and evaluation.

If you have any questions, please feel free to contact John Baker at 503-386-3445 or john.j.baker@odot.state.or.us.

Sincerely,

Kris Strickler
Highway Division Administrator

Jerri Bohard
Transportation Development Division Administrator

TAMP Addendum I

August 2019 Addendum to the TAMP

Overview and Purpose of TAMP Addendum

On June 18, 2019, the Oregon Department of Transportation (ODOT) submitted the Oregon Transportation Asset Management Plan together with documentation demonstrating its implementation to the FHWA Division Office for final review. The TAMP and consistency documentation were reviewed by FHWA Division Office and Resource Center Staff following FHWA guidance on TAMP certification and consistency determination. On July 24, 2019, the FHWA Division Office provided ODOT with comments pertaining to their initial review of the 2019 TAMP and consistency documentation. These comments primarily pertained to 4 key topic areas and are summarized as follows:

1. *How system enhancements (adding assets) are addressed in gap analysis*
2. *How risk analysis ties into ODOT's investment strategy and finance plan and how risks are increased, decreased or stay the same based on investment strategy*
3. *How Oregon DOT are using information in the TAMP, at this time, to change historic funding levels, etc.*
4. *Provide documentation comparing actual with planned expenditures for 2018 by FHWA established work types*

The following subsections provide further detail to address questions raised by FHWA in these comments. These responses provide further detail where appropriate as well as referencing relevant TAMP sections

1. How system enhancements (adding assets) are addressed in gap analysis.

Due to ODOT's investment strategy under multiple funding scenarios that overwhelmingly emphasize maintaining and preserving existing pavement and bridge assets, the TAMP did not focus heavily on the gap analysis impacts of major construction of new assets or new highway routes. Major *Enhance* projects that have been identified within Oregon's STIP (such as enhancements to I-5 Rose Quarter and I-205 widening) consist of improvements and reconstruction of assets on existing corridors, and have a marginal impact on the total volume of NHS bridge and pavement assets ODOT is responsible for preserving and maintaining long-term.

Furthermore, *Enhance* projects identified in the STIP are largely driven by the Oregon Transportation Commission, the Oregon State Legislature, and local Area Commissions on Transportation. As a result there is limited capacity to precisely predict the degree to which various funding scenarios increase or decrease the relative dedication of investment to *Enhance* projects. These limitations and the impact of political decisions in asset management tradeoffs are identified in multiple items within the TAMP *Risk Register* (pg. 58), including *Risk #9: Prioritizing Capacity Projects* and *Risk #44: Changes in Legislative Mandates*.

While there are limitations in the ability to address system enhancement and new assets within the TAMP gap analysis, Oregon has made major steps forward in assessing the long-term preservation and maintenance impacts of major investments including the construction of new assets as well as reconstruction or replacement of existing assets. In 2017, the Oregon Legislature adopted HB2017 which provides significant state transportation funding. Among the bill's provisions was the requirement that Enhance projects selected for funding in the STIP "provide the greatest benefit in relation to project costs." The bill requires that before any STIP Enhance project that costs $15 million or more is included in the STIP, a rigorous benefit-cost analysis must be prepared and made publicly available. Specifically called out in this legislation are requirements to analyze future costs to the agency to preserve and maintain an undertaken project, and identify increased costs that would result from delays in the performance of routine maintenance scheduled by the agency.

2. How risk analysis ties into ODOT's investment strategy and finance plan and how risks are increased, decreased or stay the same based on investment strategy.

In addition to the 46 risks and eleven "priority risks" identified in *Section 7: Risk Management*, the TAMP Financial Plan (Section 8) identifies several risks that create uncertainty around future funding that is available for the agency to implement its asset management strategies. These financial risks include:

- A growing population
- Inflation
- Vehicle fuel economy
- Future vehicle miles traveled
- Uncertain future federal funding
- Debt service payments

These risks demonstrate the uncertainty around future funding and lay the groundwork for an investment strategy that considers multiple funding scenarios.

To demonstrate the relation between ODOT risk analysis and investment strategies, the following matrix has been prepared that shows the relation between the 11 high priority risks identified in the TAMP Risk Register and the three major funding scenarios outlined in the TAMP Gap Analysis and Financial Plan. This matrix aims to both demonstrate how risks are addressed at different funding levels, as well as how these funding levels impact risk. While this matrix attempts to paint as complete a picture as possible, several of these high-priority risks cannot be mitigated through increases in available revenue.

High Priority Risks *(see pg. 63)*		**Current Funding Scenario** *(see pg. 76)*	**Maintain Current Conditions Funding Scenario (MCC)** *(see pg. 77)*	**State of Good Repair Scenario (SOGR)** *(see pg. 77)*
ID	***Description***			
18	**Cascadia Subduction Earthquake**	*Under the current funding scenario, ODOT is addressing the highway corridors identified as most critical in the Seismic Plus Report. This includes bridges and unstable slopes identified as key to evacuation and emergency response*	*Increased revenue under a MCC scenario would allow the agency to go beyond the highways deemed most critical to disaster response and address state highway bridges on non-NHS lifeline routes.*	*Under a SOGR scenario, ODOT would execute all phases of work identified in the Seismic Plus Report, completing the backbone system of Lifeline Routes within 20 years.*
31	**Fuel Efficiency and Alternative Fuel Vehicles**	*Under the current funding scenario, ODOT is addressing the financial impacts on greater fuel efficiency through maintain ongoing communication on financial risks with state legislators and other policymakers, as well as through studying and piloting alternative revenue approaches such as the mileage-based user charge (OReGO)*	*Funding at the MCC level would reflect a scenario in which this risk has been partially mitigated (at least in the near-term) either through increased gas tax revenue or through new forms of transportation revenue. Under this scenario, ODOT would continue to monitor the long-term impacts of fuel efficiency on transportation revenue, and identify alternatives and long-term solutions as needed.*	*Funding at the SOGR level would reflect a scenario in which this risk has been significantly mitigated (at least in the near-term) either through increased gas tax revenue or through new forms of transportation revenue. Under this scenario, ODOT would continue to monitor the long-term impacts of fuel efficiency on transportation revenue, and identify alternatives and long-term solutions as needed.*
40	**Knowledge Transfer**	*Under the current funding scenario, ODOT is developing and implementing knowledge transfer programs and transition plans to address loss of experience and institutional knowledge through retirement*	*A MCC funding scenario would have little impact on this risk which is largely driven by workforce retirements. ODOT would continue developing and implementing knowledge transfer programs and transition plans*	*A SOGR funding scenario would have little impact on this risk which is largely driven by workforce retirements. ODOT would continue developing and implementing knowledge transfer programs and transition plans*
41	**Technical Skills Development**	*Under the current funding scenario, ODOT can mitigate this risk through provision of ongoing opportunities and requirements for maintaining and improving technical skills, as well as ensuring proper balance of outsourced versus in-house work to support adequate staff technical skills development.*	*A MCC funding scenario would likely have a slight mitigating effect on this risk by helping ensure there are ongoing opportunities for improving technical skills development*	*A MCC funding scenario would likely have a significant mitigating effect on this risk by helping ensure there are ongoing opportunities for improving technical skills development*
4	**Winter Maintenance-Rock Salts**	*Under the current funding scenario, ODOT is implementing the Rock Salt Pilot Program*	*NA: funding increases would have little impact on ODOT's approach to mitigating this risk*	*NA: funding increases would have little impact on ODOT's approach to mitigating this risk*

9	**Prioritizing Capacity Projects**	*Under the current funding scenario, ODOT is maintain ongoing communication with policymakers and other decision-makers on the need to prioritize maintenance and preservation funding over projects that increase capacity. Additionally, capacity projects are limited to those determined to be essential through legislatively required benefit-cost analysis.*	*Under an MCC funding scenario, the political risk of money earmarked for preservation and maintenance (in order to maintain current conditions) being diverted to capacity expanding projects would potentially increase. This would increase the importance of ODOT communicating with policymakers and other decision-makers on the need to prioritize maintenance and preservation funding over projects that increase capacity.*	*Under a SOGR funding scenario, the political risk of money earmarked to address the backlog of deteriorating roads and bridges being diverted to capacity expanding projects would potentially increase. This would increase the importance of ODOT communicating with policymakers, as well as using the legislatively required benefit-cost analysis as an essential tool to ensure that capacity projects are limited to those determined to have a net-benefit.*
1	**Bridge Scour**	*Under the current funding scenario, ODOT is managing this risk through adequate design of new bridges and routine inspection of existing bridges.*	*Under a MCC funding scenario, this risk can be slightly mitigated through an increased rate at which deteriorated bridges are replaced by new bridges with design adequate to limit scour*	*Under a SOGR funding scenario, this risk can be significantly mitigated through an increased rate at which deteriorated bridges are replaced by new bridges with design adequate to limit scour*
30	**Economic recession**	*Under the current funding scenario, the impact of this risk on highway revenue is managed though identifying stable funding sources that are adequate to meet asset maintenance and preservation needs during periods of economic recession.*	*A MCC funding scenario would improve the highway revenue outlook, thereby reducing the net impact of an economic recession. However the agency would continue to work to identify stable funding sources that are less susceptible to impact of a recession*	*A SOGR funding scenario would significantly improve the highway revenue outlook, thereby reducing the net impact of an economic recession. However the agency would continue to work to identify stable funding sources that are less susceptible to impact of a recession*
27	**Underfunding Maintenance**	*Under the current funding scenario, ODOT is maintain ongoing communication with policymakers and other decision-makers on the need to prioritize maintenance funding, and working to ensure that revenue allocations such as HB2017 adequately fund a backlog of maintenance needs.*	*Under an MCC funding scenario, the political risk of money earmarked for maintenance (in order to maintain current conditions) being diverted to capacity expanding projects would potentially increase. This would increase the importance of ODOT communicating with policymakers and other decision-makers on the need to continue prioritizing maintenance funding.*	*Under an SOGR funding scenario, the political risk of money earmarked for maintenance (in order to maintain current conditions) being diverted to capacity expanding projects would potentially increase. This would increase the importance of ODOT communicating with policymakers and other decision-makers on the need to continue prioritizing maintenance funding. Additionally, enhance projects and bridge reconstruction projects will need to be monitored in context of their long-term maintenance costs to the agency*
45	**Increases in Material Costs**	*ODOT has little control over the fluctuation of materials costs on the regional or national marketplace. To manage this risk, ODOT work to employ cost-effective construction materials and practices, and aims to maintain affordable access to essential construction materials including aggregates.*	*Under a MCC funding scenario, additional revenue would not impact how the agency works to manage the risks of increases in material cost. At the same time, fluctuations in material costs could change the revenue needed to meet MCC condition targets*	*Under a SOGR funding scenario, additional revenue would not impact how the agency works to manage the risks of increases in material cost. At the same time, fluctuations in material costs could change the revenue needed to meet SOGR condition targets*

3. How Oregon DOT are using information in the TAMP, at this time, to change historic funding levels, etc.

The TAMP as a whole, and the *TAMP Investment Strategies* section specifically, aims to demonstrate how ODOT, under its current revenue projections, is making the most efficient investment possible within the context of several political, legislative, legal, and regulatory constraints which drive decisions around how the agency dedicates revenue.

While the TAMP documents the myriad of way asset management is used as a discipline to make effective investments in transportation, the TAMP alone does not drive policy around how the transportation system is funded and at what levels. Instead, the Oregon Transportation Plan along with other modal plans including the Oregon Highway Plan provide a policy framework for how the system is funded and how priorities are set. The funding prioritization embedded within the Oregon Transportation Plan and modal plans draw upon the principles of asset management and performance management principles. Since the Oregon Transportation Plan

was adopted in 2007 it has recognized asset management strategies and state performance measures first developed in the 1990's. In 2018, the OTP was amended to also recognize federal performance measures and asset management strategies established under MAP-21.

While the Oregon Transportation Plan provides a policy framework for funding Oregon's transportation system, the Oregon Transportation Commission ultimately drives the agency's funding decisions, including the balance of investment across work types, and the funding splits between STIP Fix-it and STIP Enhance. Additionally, the Oregon State Legislature plays a critical role in decisions around how the state invests its transportation dollars. As is documented in the TAMP, State law established in 1985 (ORS 366.507) requires ODOT to dedicate a minimum of $51 to $55 million each year to highway modernization efforts. Beginning with the 1998-2001 STIP, the modernization program was reduced to the minimum level required by law to allow the agency to focus investments on activities that preserve and maintain the state's existing highway system. Subsequent legislation including the 2009 Jobs and Transportation Act, and HB2017 have identified specific projects and spending priority requirements.

In addition to the policy framework established through the OTP and political considerations tied to the OTC and State Legislature, ODOT faces legal and regulatory requirements that constraints how transportation funding is dedicated. Key among these is ODOT's ADA Settlement Agreement which requires a significant increase in the amount ODOT spends on curb ramps and other ADA features.

4. Provide documentation comparing actual with planned expenditures for 2018 by FHWA established work types

The focus on completing the Oregon Transportation Asset Management Plan (TAMP) and the absence of readily available expenditure information by work types identified in asset management regulations led to the inclusion of jointly signed statement by Highway Division Administrator and Transportation Development Division Administrator in the Consistency Documentation letter submitted on June 19th 2019. This letter provided a demonstration of ODOT's implementation of asset management strategies in the TAMP based on other than expenditure information. While the jointly signed statement in this letter affirms that ODOT's actual expenditures are consistent with the investment strategies in the TAMP, providing an enumerated and precise comparison of planned expenditures to actual expenditures by the work types established by FHWA was postponed to a later date.

Expenditure information for pavement and bridge projects funded by the department is recorded in a number of different databases and formats. Reporting annual expenditures in terms of work types established for the asset management plan requires a crosswalk which reformats ODOT's defined work category expenditures into TAMP regulation work type expenditures. Both pavement and bridge section staff have indicated that information from available data bases can be used to create reliable rules for reformatting ODOT pavement and bridge expenditures into TAMP work type expenditures. Over the course of the upcoming months, ODOT asset management staff will be working with ODOT finance, budget, STIP, information system, pavement, and bridge staff, as well as others, to identify information sources and approaches that will support the collection and presentation of actual expenditure information by TAMP work types. Using this expenditure information, a comparison will be made with the planned work type expenditures presented in the asset management plan to demonstrate implementation of plan investment strategies beginning with TAMP Consistency Documentation submitted in 2020.

GLOSSARY

GLOSSARY OF TERMS

Acronyms and Definitions:

ADA	Americans with Disabilities Act
ACT	Area Commission on Transportation
ADA	Americans with Disabilities Act
ACT	Area Commission on Transportation
BrM	Bridge Management Software (aka Pontis)
CAFE (Standards)	Corporate Average Fuel Economy
CRCP	Continuously Reinforced Concrete Pavement
Distressed Bridge	A bridge condition rating used by the Oregon Department of Transportation to indicate that the bridge has been identified as either structurally deficient or as having other deficiencies. A classification of "distressed bridge" does not imply that the bridge is unsafe.
FAST Act	Fixing America's Surface Transportation Act *(Federal transportation funding legislation, 2015)*
Functionally Obsolete (FO)	A bridge assessment rating used by the Federal Highway Administration to indicate that a bridge does not meet current (primarily geometric) standards. The rating is based on bridge inspection appraisal ratings. Functionally obsolete bridges are those that do not have adequate lane widths, shoulder widths, vertical clearances, or design loads to serve traffic demand. This definition also includes bridges that may be occasionally flooded.
HB2017	House Bill 2017, Keep Oregon Moving Act; transportation funding package passed by Oregon State Legislature in 2017
HMAC	Hot Mixed Asphalt Concrete
HPMS	Highway Performance Monitoring System
ITS	Intelligent Transportation Systems
IRI	International Roughness Index *(pavement)*
IS	Interstate System
ITS	Intelligent Transportation Systems
JCP	Joint Concrete Pavement
JTA	Jobs and Transportation Act; transportation funding package passed by Oregon State Legislature in 2009
Key Performance Measures (KPMs)	A measure used to evaluate the progress of an organization in managing to a particular goal. ODOT's KPMs are a subset of performance measures identified as central to fulfilling the agency's mission
LM	Lane Miles

Lifecycle Planning (LCP)	An engineering and economic analysis tool that focuses on the consideration of all the costs incurred during the service life of an asset. LCP provides a process for estimating the costs of managing assets over their entire life with the goal of minimizing costs while preserving or improving their condition and performance
Lifeline Route	State highway routes critical to evacuation and emergency response in a Cascadia Subduction Event. These routes have been identified as Priority Fix-it Corridors
MAP-21	Moving Ahead for Progress in the 21st Century Act *(Federal transportation funding legislation, 2012)*
Major Bridge Maintenance (MBM)	One of three funding approaches the Bridge Program uses to manage the bridge system. The MBM program typically addresses smaller scale bridge preservation needs and emergency bridge repairs that are outside the scope of work that can be accomplished by an ODOT District.
MPA	Metropolitan Planning Area
MPO	Metropolitan Planning Organization
MTIP	Metropolitan Transportation Improvement Program
Modernization	A general term used by ODOT that covers construction of a new transportation asset as well as reconstruction of an existing asset or assets.
National Bridge Inventory (NBI)	The aggregation of structure inventory and appraisal data collected to fulfill the requirements of the federal National Bridge Inspection Standards (NBIS).
National Highway System (NHS)	The National Highway System comprises approximately 225,000 miles of roadway nationwide, including the Interstate Highway System as well as other roads designated as important to the nation's economy, defense, and intermodal mobility. The NHS was developed by the United States Department of Transportation in cooperation with the states, local officials and metropolitan planning organizations.
OFP	Oregon Freight Plan
OHP	Oregon Highway Plan
OTC	Oregon Transportation Commission
OTP	Oregon Transportation Plan
Other Deficiencies (OD)	A bridge condition rating used by ODOT to indicate that a bridge has identified needs in one or more of nine factors and is a candidate for repair or replacement. This condition rating is specifically designed to address specific bridge needs such as freight mobility, deterioration, serviceability, and safety. A classification of "other deficiencies" does not imply that the bridge is unsafe
Preservation	Activities that focus on preserving the condition and extending the service life of pavements though treatment activities at the most cost-effective time in the lifecycle of the asset. Preservation, as used by ODOT, encompasses three general treatment activities, thin overlays, major resurfacing that does not require and roadway substructure improvement (normal preservation) and rehabilitation work that combines resurfacing with repairs to roadway substructures
PM1	MAP-21 Federal Performance Measures *pertaining to transportation safety*
PM2	MAP-21 Federal Performance Measures *pertaining to bridge and pavement condition*
PM3	MAP-21 Federal Performance Measures *pertaining to system performance*
PMS	Pavement Monitoring System
PHFS	Primary Highway Freight System

SCS	State Classification System
SHS	State Highway System
Statewide Transportation Improvement Program (STIP)	Oregon's four-year transportation capital improvement program. The STIP document identifies the funding for, and scheduling of, transportation projects and programs.
Structurally Deficient (SD) Bridge	A bridge condition rating used by the Federal Highway Administration to indicate deteriorated physical conditions of the bridge's structural elements (primarily deck, superstructure, and substructure) and reduced load capacity. Some of these bridges are posted and may require trucks of a certain weight to detour. A classification of "structurally deficient" does not imply that bridges are unsafe. When an inspection reveals a safety problem, the bridge is posted for reduced loads, scheduled for repairs, or in unusual situations, closed until repairs can be completed. Structural deficiency is one of the many factors that are used in the ODOT State Bridge Program for project ranking or selection.
VMT	Vehicle Miles Traveled

INDEX OF PLANS, PUBLICATIONS, REPORTS

Document Name	Publisher	Year	Description	Relevance to TAMP Section	Web link
Oregon Transportation Plan	ODOT	2006		All	http://www.oregon.gov/ODOT/Planning/Pages/Plans.aspx
Oregon Highway Plan	ODOT	1999, 2015		All	http://www.oregon.gov/ODOT/Planning/Pages/Plans.aspx
Oregon Freight Plan	ODOT	2011, 2017		All	http://www.oregon.gov/ODOT/Planning/Pages/Plans.aspx
Strategic Business Plan 2018-2022		2018	Guides where the agency will devote resources, attention and creativity to more effectively fulfill our mission and vision.	All	http://transnet.odot.state.or.us/od/SBP/Documents/SBP%202018-2022%20Initial%20Plan%20Final.pdf
Oregon House Bill 2017 (HB2017)					
OTC Investment Strategy	Oregon Transportation Commission	2017	Highlights needs across the transportation system and presents a menu of options for strategic investment. Describes multiple funding scenarios and prioritization of funding with increased investment.	Investment Strategies	http://www.oregon.gov/ODOT/Get-Involved/OTC/OTC_InvestmentStrategy.pdf
One Oregon: a Vision for Oregon's Transportation System	Transportation Vision Panel, Governor's Office	2016		Investment Strategies	https://visionpanel.files.wordpress.com/2016/05/one-oregon-final-report-print-version2.pdf
State of the System Report	ODOT	2016	Provides information on the transportation system and progress in implementing the Oregon Transportation Plan.	All	http://staging.apps.oregon.gov/ODOT/About/Pages/State-of-the-System.aspx
Integrated Asset Management Strategic Plan	ODOT	2011		Asset Management Practices	http://www.oregon.gov/ODOT/Programs/Documents/AMI/04-amsp-10-111711_final.pdf
2016 Asset Management Gap Analysis	ODOT	2016		Asset Management Practices	*Appendix D*
ODOT Bridge Conditions Report (annual)	ODOT	2018		Performance Measures; Investment Strategies	http://www.oregon.gov/ODOT/Bridge/Documents/2016-Oregon-Bridge-Conditions-Report.pdf
ODOT Pavement Conditions	ODOT	2018		Performance	http://www.oregon.gov/ODOT/Construction/Pages/Pavement-

Report (biennial)				Measures; Investment Strategies	Condition-Reports.aspx
'Rough Roads Ahead 2' Report	ODOT	2017	Economic implications of deteriorating highway conditions.	Investment Strategies; Risk Management	http://www.oregon.gov/ODOT/Planning/Documents/Rough-Roads-Ahead-2.pdf
Key Performance Measures Progress Report	ODOT	2017		Performance Measures	http://www.oregon.gov/ODOT/PerformMang/Pages/index.aspx
Strategic Data Business Plan	ODOT			Asset Management Practices; Risk Management	http://transnet.odot.state.or.us/tdd/home/Strategic%20Data%20Business%20Plan/strategicdata.aspx
Statewide Transportation Improvement Program (STIP)	ODOT	*Ongoing*		Investment Strategies	http://www.oregon.gov/odot/stip/pages/index.aspx
Strategic Services: Risk Management Lifecycle	ODOT	2015		Risk Management	http://transnet.odot.state.or.us/hwy/TSpdlt/SiteAssets/Pages/Project-Risk-Management/RiskManagementFramework_FINAL_2015-1101.pdf
Oregon Resilience Plan	Office of Emergency Management			Risk Management	http://www.oregon.gov/oem/Documents/00_ORP_Table_of_Contents.pdf
Seismic Plus Report	ODOT			Risk Management	http://www.oregon.gov/ODOT/Bridge/Documents/Bridge_seismic/2014_Seismic_Plus_Report.pdf
Impacts of Potential Seismic Landslides on Lifeline Corridors	ODOT			Risk Management	https://digital.osl.state.or.us/islandora/object/osl%3A23354/datastream/OBJ/view
Transportation and Climate Change Planning	ODOT			Risk Management	http://www.oregon.gov/odot/programs/pages/climate-change.aspx
Climate Change Adaptation Strategy Report	ODOT			Risk Management	http://www.oregon.gov/ODOT/Programs/TDD%20Documents/Climate-Change-Adaptation-Strategy.pdf
Climate Change Vulnerability Assessment and Adaptation Options Study	ODOT			Risk Management	http://www.oregon.gov/ODOT/Programs/TDD%20Documents/Climate-Change-Vulnerability-Assessment-Adaptation-Options-Study.pdf
ODOT Transportation Management Assessment	McKinsey & Company, Department of Administrative Services	2017		All	Report: http://www.oregon.gov/ODOT/Get-Involved/Documents/ODOT_McKinsey_Final_Report.pdf DAS Recommendations: http://www.oregon.gov/ODOT/Get-Involved/Documents/ODOT_Management_Review_DAS_Recommendations.pdf
Highway Cost Allocation Study	ECONorthwest,	2017			http://www.oregon.gov/das/OEA/Pages/hcas.aspx

2017-2018 Biennium	Oregon DAS				
ODOT Pavement Design Guide	ODOT	2019		Pavement, Lifecycle Cost Analysis	https://www.oregon.gov/ODOT/Construction/Documents/pavement_design_guide.pdf
Strategic Business Plan *One ODOT: Positioned for the Future*	ODOT	2018			https://www.oregon.gov/ODOT/About/Documents/SBP.pdf
AASHTO Pavement Guide	AASHTO				https://store.transportation.org/(X(1)S(svq5lmddceee5enyvnpdmiiu))/Item/CollectionDetail?ID=117&AspxAutoDetectCookieSupport=1
HPMS Field Manual	FHWA	2018			https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/
NCPP Quick Checkup Tool	FHWA				https://www.fhwa.dot.gov/pavement/preservation/if07006.pdf
ODOT Pavement Data Collection Manual	ODOT	2019			https://www.oregon.gov/ODOT/Construction/Documents/pavement_data_collection_manual.pdf
Pavement Data Quality Management Plan	ODOT	2018			https://www.oregon.gov/ODOT/Construction/Documents/pavement_data_QM_plan.pdf

Appendix A

MPO & LOCAL AGENCY COORDINATION

A1. MPO Bridge and Pavement Asset Conditions Summary *(2016 snapshot)*

Appendix A1.pdf

A2. Local Agency Target Setting Process MOU

Appendix A2.pdf

Appendix B

TAMP SCOPE RECOMMENDATION MEMO

Appendix B.pdf

Appendix C

ODOT RISK MANAGEMENT ASSESSMENT

Appendix C.pdf

Appendix D

2016 ODOT GAP ANALYSIS REPORT

Appendix D.pdf

Appendix E

Summary of Bridge and Pavement Program Minimum Standards Compliance

Appendix E.pdf

Appendix F

Consistency Determination Worksheet with ODOT Comments

Appendix F.pdf

Appendix G

Baseline Performance Period Report, 2018

Appendix G.pdf

Appendix H

Gap Funding Strategies

Appendix H.pdf