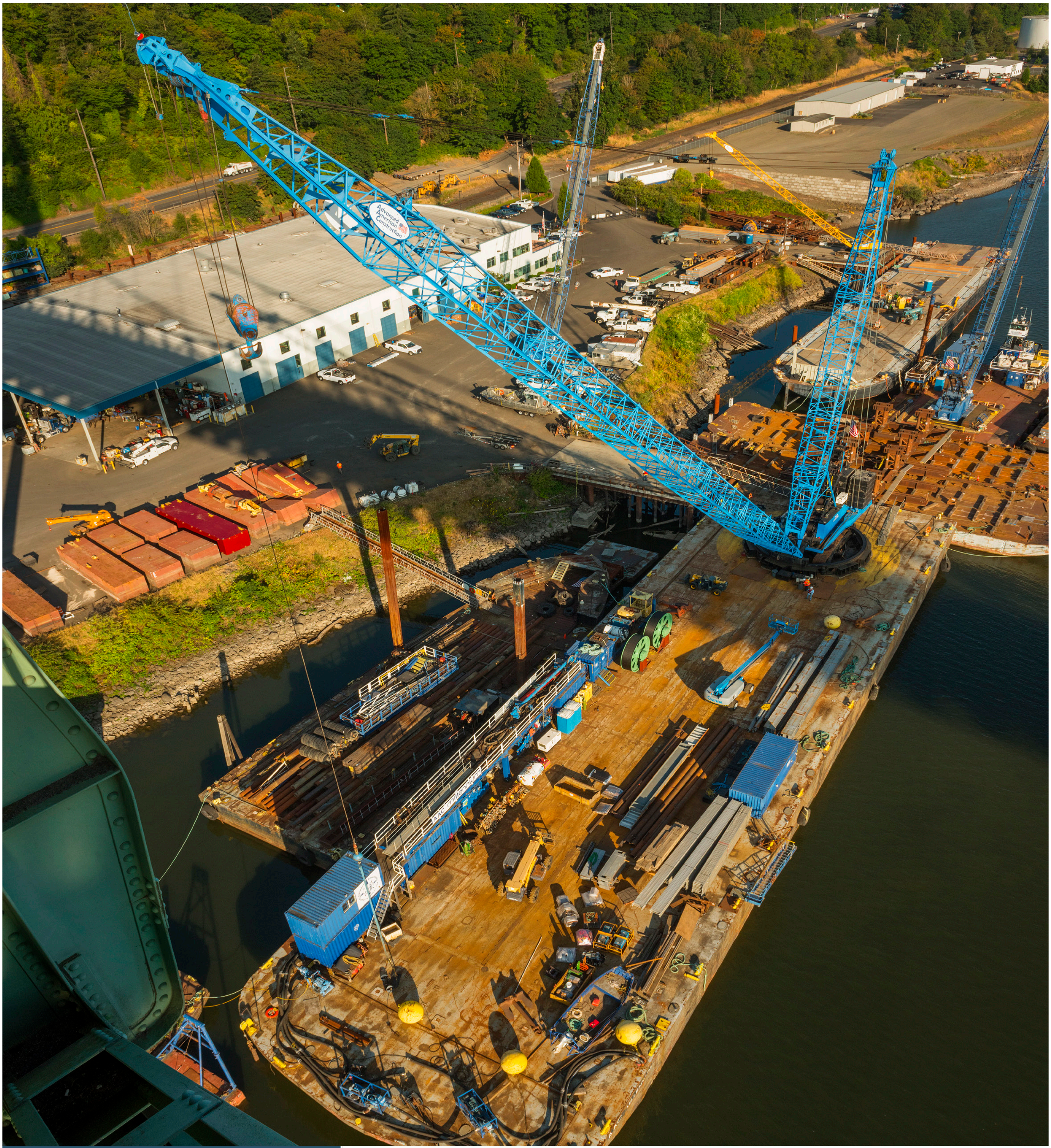

Oregon Department of Transportation

2021

Bridge Condition Report & Tunnel Data

Oregon Department of Transportation

2021 BRIDGE CONDITION REPORT & TUNNEL DATA

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Delivery & Operations Division | Bridge Section | https://www.oregon.gov/ODOT/Bridge/Pages/BCR.aspx

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EXECUTIVE SUMMARY

Needs Beyond Fix-It Priority Routes

Oregon's bridges are a critical component of our state's infrastructure. They not only connect communities, but are central to getting the services and supplies we need to live. We depend on them to get us to our destinations every day.

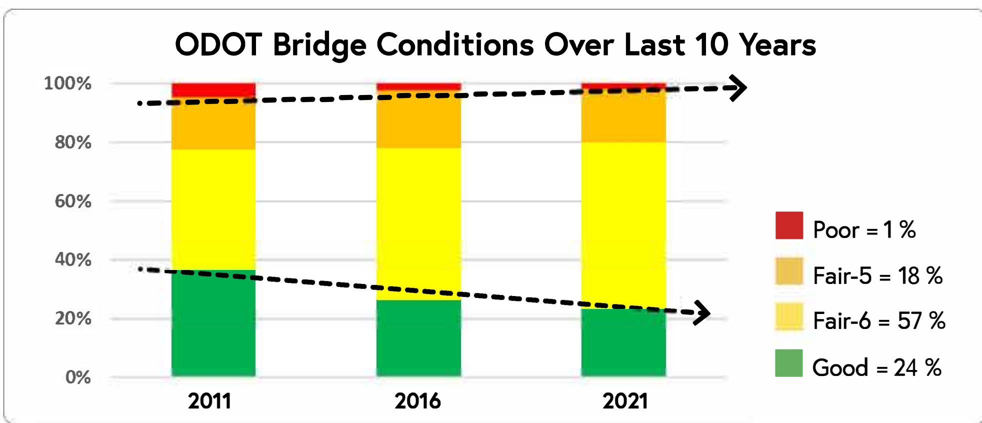
The Oregon Department of Transportation regularly assesses our state's bridge conditions and for the tenth consecutive year, we've seen an overall decline in bridge conditions. Over half of the bridges in service today were designed before 1970 and those older bridges weren't designed to carry the traffic volumes and weights of larger vehicles common today.

Although ODOT has seen increased funding for bridges from Oregon's House Bill 2017 and additional funding through the recently passed federal Infrastructure Investment and Jobs Act, it is still not enough to address all of the increasing needs of our aging bridge infrastructure.

Bridge Conditions Overview

Due to the age of our bridges, most are nearing their end of service life — the length of time it can be kept operational. This means that the size and frequency of repairs increases every year.

Repair projects on older structures are costly and have little return on investment. In the next 20 years we will need to replace many structures at a projected cost of $400 million annually, far short of our current funding levels.

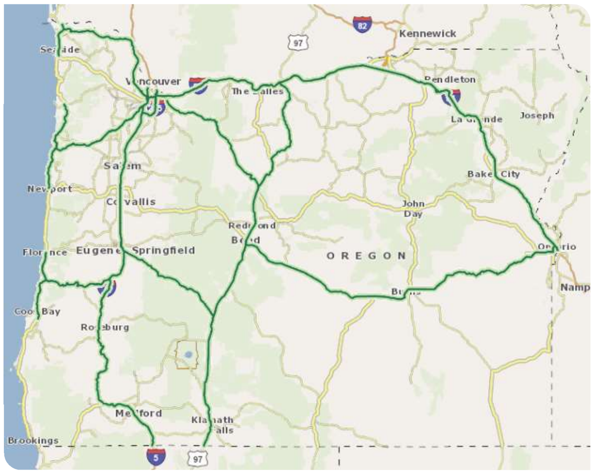


Because there isn't enough funding to replace all the bridges we need to, many poor condition bridges that ideally should be replaced are repaired and restored so they can remain in service. ODOT has done a good job extending the service life for many bridges well past their 50 year design life.

Current funding levels pay on average for only three bridge replacements a year which is well below the ideal rate of 27 bridge replacements per year to keep the system in good condition.

To maximize our budget, we've prioritized bridges on interstate, seismic and/or lifeline routes that are vital to freight movement. The Fix-It Priority Route strategy was first developed in 2011 and while this strategy is working well for now, it will not work as a long term solution.

There are many deteriorated bridges that are not located on Fix-It Priority Routes but are still important to individuals and businesses. Eventually bridges on lower-priority routes will not be serviceable leading to load restrictions or even closures.



Fix-It Priority Routes Map.

Seismic Bridge Program

The good news is that ODOT is making steady progress on our seismic resilience projects. As of September 2021, we addressed all vulnerable bridges on the northern-half of US 97 and the southern half is ready to begin construction.

We are also making progress on seismic upgrades to our southern Oregon bridges. This effort is divided into four projects. The first project is complete, the second project is in construction and we are designing the other two.

The I-205 improvement project will address the seismic vulnerability of nine bridges by either retrofitting or replacing them based on a cost/benefit analysis. The Abernethy Bridge will be retrofitted and afterwards will be the first major river crossing in Oregon expected to remain operational after a major seismic event.

We are hopeful that there will be more opportunities to apply for additional funds from the Infrastructure Investment and Jobs Act discretionary grants to make major improvements to Oregon's bridges which contribute toward a thriving economy.

2021 Bridge Condition Report Content

This year's Bridge Condition Report includes looks at Oregon's aging bridge inventory, updated national and state performance measures and program information for:

- Major Bridge Maintenance
- Bridge Preservation (Bridge Coating Projects)
- Seismic Program Status
- Bridge Load Rating

Tunnel condition data is listed for Oregon's 11 tunnels and five other agency tunnels.

ABBREVIATIONS AND DEFINITIONS

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.

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.

Key Performance Measure (KPM) – A measure used to evaluate the progress of an organization in managing to a particular goal.

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.

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

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. Congress approved the NHS in 1994. National Tunnel Inspection Standards (NTIS) – Federal Highway Administration guidelines for the inventory, inspection and load rating of tunnels.

Non-National Highway System (NNHS) – Routes not designated as part of the NHS.

Other Deficiencies (OD) – A bridge condition rating used by the Oregon Department of Transportation 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.

Types of ODs include:
- **Rail = Bridge Rail**
- **LC = Load Capacity**
- **LSL = Low Service Life**
- **MB = Movable Bridge**
- **DG = Other Geometric Clearances (Deck Geometry)**
- **Paint = Paint**
- **Scour = Scour**
- **TS = Timber Structures (Substructure)**
- **VC = Vertical Clearance**

Poor Detail Bridge – Bridges identified in the state bridge inventory that have critical design issues related to rail, decks, and reinforcement locations. Bridges with poor details have a higher incidence of shear cracking that may grow rapidly, holes in thin bridge decks developing without warning, low reserve load capacity, and instability during seismic events.

Scour Critical Bridge – A scour critical bridge is one with an abutment or pier foundation rated as unstable due to (1) observed scour at the bridge site or (2) a scour potential as determined by an engineering scour evaluation study.

Service Life – The time duration during which the bridge element, component, subsystem, or system provides the desired level of performance or functionality, with any required level of repair and/or maintenance.

State 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.

Structure Condition Abbreviations –
- **GD = Good**
- **FR = Fair**
- **PR = Poor**

Structurally Deficient (SD) – 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.

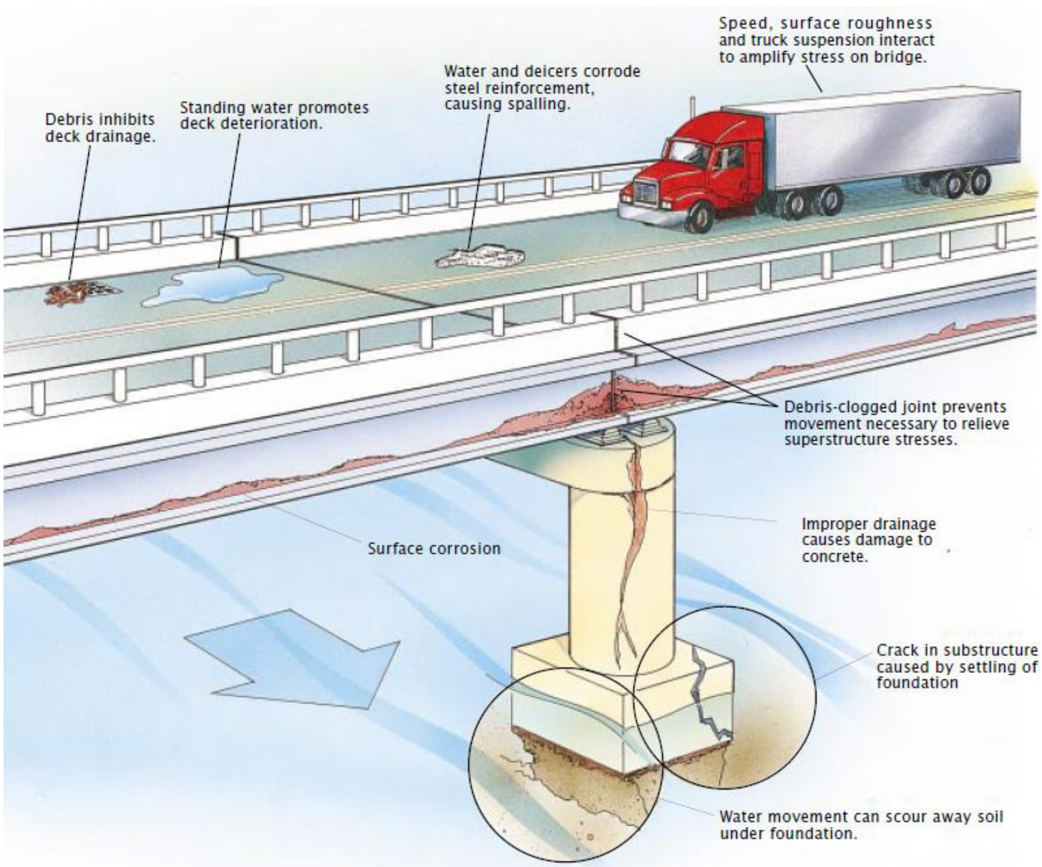
A classification of "structurally deficient" does not imply that bridges are unsafe. When an inspection reveals a safety problem, the bridge is posted for reduced loads, scheduled for repairs, or in unusual situations, closed until repairs can be completed. Structural deficiency is one of the many factors that are used in the ODOT State Bridge Program for project ranking or selection.

BRIDGES 101

General Deterioration Factors

Experience has shown that bridge deterioration is dependent on complex interactions of multiple factors as shown.

Extreme events (earthquakes, flooding, vehicle impacts) are another cause of bridge distress not considered as general deterioration, but result in the need for quick response and investment to restore mobility.

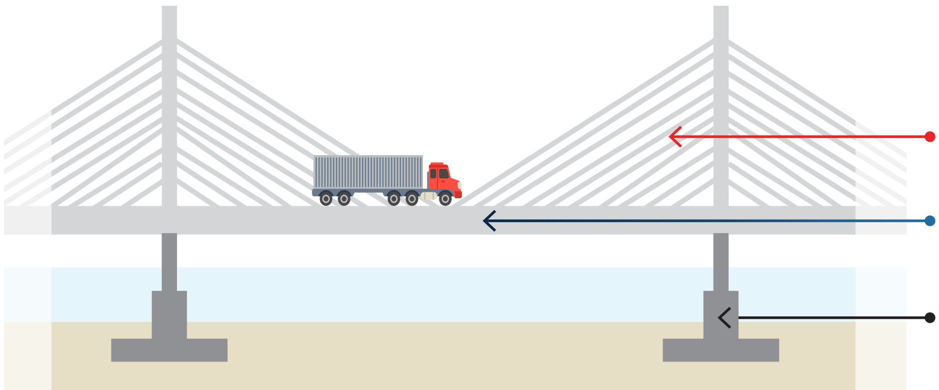


Adapted from "Why America's Bridges are Crumbling," by K.F. Dunker and B. G. Rabbat, 1993, March, Scientific American, 268, no. 3, p. 69. Permission for use courtesy of Jana Brenning, illustrator.

Bridge Condition Ratings

Bridge conditions are categorized by evaluating bridge components (deck, superstructure, and substructure) as shown in the graphic.

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 twenty feet and longer 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. Bridge condition ratings are described on the next page.



The NBI ratings provide simple tools for agencies to describe the overall conditions of their bridge populations and the overall effectiveness of their bridge programs. The critical rating is when a highway bridge is classified as **structurally deficient (SD).**

NBI Component	NBI Rating	Condition Rating Description
• Deck • Superstructure • Substructure • Culvert Rating (if applicable)	Lowest Condition NBI Rating of All Components (Scale =0-9)	8-9: Very Good Condition 7: Good Condition 5-6: Fair Condition 4: Poor Condition ≤ 3: Very Poor Condition

Bridge condition rating description.

Beginning in 2018, a bridge is classified as structurally deficient only if any component (deck, superstructure, substructure) has an NBI rating of 4 or less. Previously, load capacity and hydraulic opening below the bridge could result in an SD classification.

Maintenance Needs and Cost Impacts

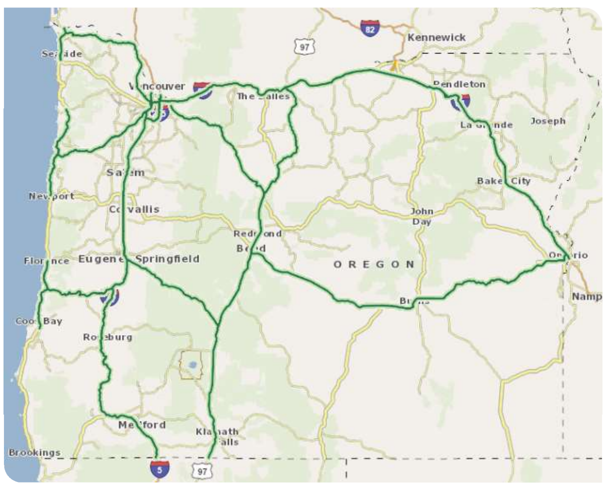
Keeping a bridge in fair to good condition requires routine inspections, proactive maintenance and preservation treatments. Examples of proactive maintenance are:

- 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.
- Installing scour countermeasures to protect the substructure from undermining and failure due to scour below the bridge.

Timing is critical when performing the work since the longer the deterioration occurs, the more extensive/expensive the required treatment.

NEEDS BEYOND FIX-IT PRIORITY ROUTES

In 2011, both the Bridge and Pavements programs were asked to develop strategies to help stretch limited funding. In June 2011, System Preservation Program Funds (DES-01) was first published. This notice provided direction on how bridge and pavement funds shall be spent on highway projects. The Bridge program was directed to do basic bridge rehabilitation projects and rare replacements. New bridges needed to be appropriate for the site, and economical in terms of construction, inspection, and maintenance. Fix-It Priority Routes were first introduced in the planning phase of the 2015-2018 STIP. These are the highest priority routes to maintain for freight movement. They are a combination of interstate routes, routes that were high priority during the Oregon Transportation Investment Act (OTIA) program, and the most important Seismic Lifeline Routes. The Fix-It Priority Routes are the most important routes in Oregon, and are given priority to address needs on these routes.

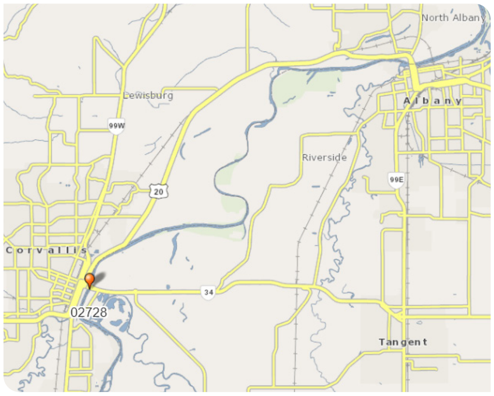


Fix-It Priority Routes Map.

Van Buren Bridge

Corvallis is the tenth largest city in Oregon, with a population of over 58,000. The closest Fix-It Priority Route is I-5, which goes through nearby Albany. Oregon 34 is an important route with an average daily traffic of 33,300, including 2,300 trucks. US-20 also connects Corvallis to I-5 with an average daily traffic of 16,900, including 710 trucks.

The Van Buren Bridge was built in 1913. It has one lane and carries eastbound traffic directly from Corvallis. In May 2021, the bridge became restricted to a 12 ton load limit for all vehicles. The funding to replace this bridge, a cost of $71,633,000, is included in House Bill 2017. The yearly funding available to the Bridge program for projects in the 2021 to 2024 timeframe is $88,166,667. Since the Van Buren Bridge is not on a Fix-It Priority Route, it would have had a lower priority for replacement than other bridges. Without the funding that was provided in HB 2017, the Van Buren Bridge would have remained in service with a 12 ton load limit or less until eventually the bridge would need to be closed to all traffic.



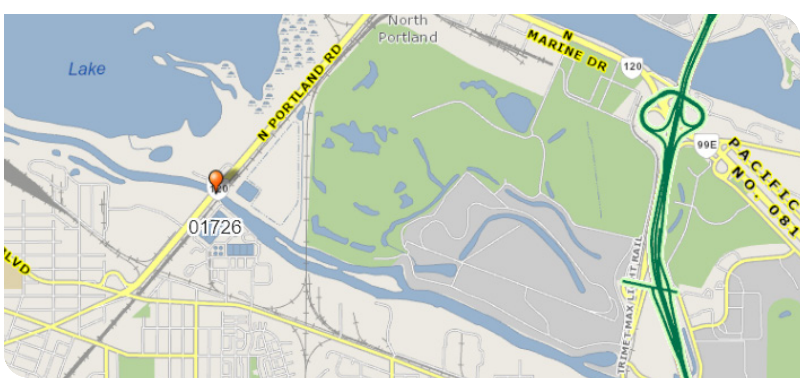
Location of Van Buren Bridge.

Van Buren Bridge.

Columbia Slough Bridge

The Columbia Slough Bridge is located on the Swift Highway, which provides access to heavy industry located on Marine Drive in Portland. This heavy industry includes a firm engaged in transporting shipping containers, a firm that specializes in carrying very heavy loads such as electrical transformers, and other freight companies. The Swift Highway is such an important route that it is part of the National Highway System. The National Highway System includes only 4% of the nation's roads, but carries more than 40% of all highway traffic, 75% of heavy truck traffic, and 90% of tourist traffic. The advantage of the National Highway System is that it encourages states to focus on a limited number of high-priority routes and concentrate on improving them with federal aid funds. The National Highway System also helps the United States meet the challenges of global economic competition by enhancing our different modes of transportation, increasing America's productivity and bolstering the economy.

In 2008, the Swift Highway, except for the Columbia Slough Bridge, was transferred to the City of Portland. The agreement states that the bridge will be transferred when it is replaced with a bridge that meets current national bridge design standards. While this bridge is on the National Highway System, it was never on a Fix-It Priority Route. Also it is no longer on a state highway. As a result, the replacement of this bridge is a very low priority for the Bridge program.



Location of Columbia Slough Bridge.

The Columbia Slough Bridge has a roadway width of just 24 feet. This is very narrow for moving large freight.

A side view of the Columbia Slough Bridge, showing the extensive use of timber for support.

The Columbia Slough Bridge was built in 1933 and while the main span over the slough has steel girders supported on a concrete foundation, there are 11 other spans that are timber.

Bridge substructure with a mix of older timber and newer steel piles.

In the picture above, four of the five original timber piles have been replaced with steel, due to deterioration. What you cannot see is that the horizontal timber beam that supports the girders is severely deteriorated. The 6 foot portion between the steel pile on the left and the remaining timber pile has only 2 inches of sound material on the top and bottom. The 10 inches in the middle are rotted and are not capable of carrying load.

The bridge shown on the following page is over the North Fork Alsea River, just south of the town of Alsea. This bridge is located in a rural part of Oregon, and while it is not on either a Fix-It Priority Route or the National Highway System, it is important to users. The horizontal steel beam replaced a deteriorated timber beam. In the upper right of the photograph, you can see extensive bolted repairs on one of the timber girders. Looking just underneath the horizontal steel beam, you can see two additional locations of girder strengthening. This bridge will soon be load posted, due to insufficient strength of timber load carrying elements.

Bridge substructure with a mix of older timber and newer steel piles.

The Fix-It Priority Route strategy is a sound, responsible way to navigate a period of constrained funding and has benefitted Oregon directly. However, it has serious limitations if constrained funding becomes status quo. As a long-term strategy, it's not sustainable as there are many significant needs that are not located on Fix-It Priority Routes. Bridges like the Van Buren Bridge in Corvallis, the Columbia Slough/Swift Highway Bridge in Portland, and the North Fork Alsea River Bridge near Alsea are examples of deteriorated bridges that are currently in service that are not on Fix-It Priority Routes. These bridges are important for both individuals and businesses. These three bridges are a small portion of the deteriorated and sometimes load posted bridges that are not on Fix-It Priority Routes that Oregonians use every day. Having bridges like these remaining in service takes maintenance and funds that could otherwise be used to preserve bridges that are in better condition. Bridges like these need to be replaced when their useful service life is exhausted to support a safe and reliable transportation system that connects people and helps our communities and economy thrive.

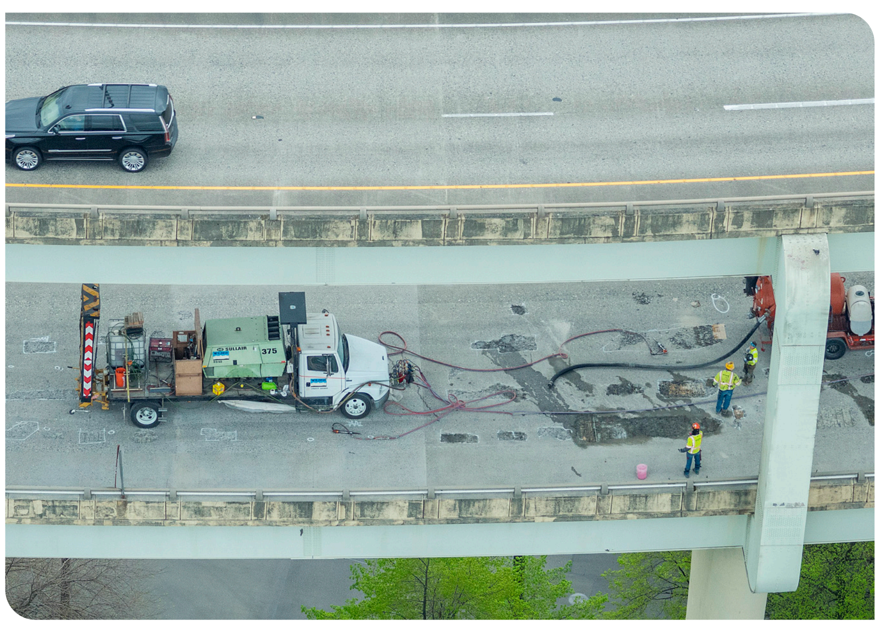
2021 BRIDGE CONDITIONS

> **"In 2021, ODOT replaced six bridges."**

ODOT's 2021 Bridge Condition Report summarizes bridge condition ratings on state highways and performance measures based on National Bridge Inventory (NBI) and ODOT data. As a consistent reference point for evaluation, ODOT uses the bridge conditions snapshot provided annually to the Federal Highway Administration. Data from the April 2021 submittal is the basis of this report.

Bridge conditions are reported in a number of different measures, none of which stands alone in the communication of bridge conditions for decision making purposes. The most common and those presented here, are the NBI ratings for the three major structural components of the bridge (deck, superstructure, and substructure, or the culvert rating), deficient bridge classification, and structural condition rating.

The structural condition rating ranging from 'Very Good' to 'Very Poor' is based on the lowest of the deck, superstructure, substructure, or culvert ratings.



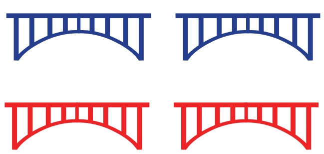
Repairing holes through the lower deck of the Fremont Bridge. This bridge was built in 1973.

Inventory Changes

ODOT currently manages 2,766 bridges. This year, 11 new bridges were added to the inventory, of which six were replacements. Of the replaced bridges, three of them were replacements of deteriorated bridges and the other three were replaced to improve function. Other new bridges were added as the replacement of structures formerly not in the inventory with structures eligible to be included in the inventory and the addition of a wildlife crossing to an existing alignment.

With only six new bridges replaced, ODOT continues to lose ground in the effort to manage the system. Current funding levels pay on average for only three bridge replacements a year. At that rate, an Oregon bridge will need to stay in service for over 900 years which is well beyond an expected service life of 75 to 100 years.

6 Bridge Replacements



3 Bridges: To improve function

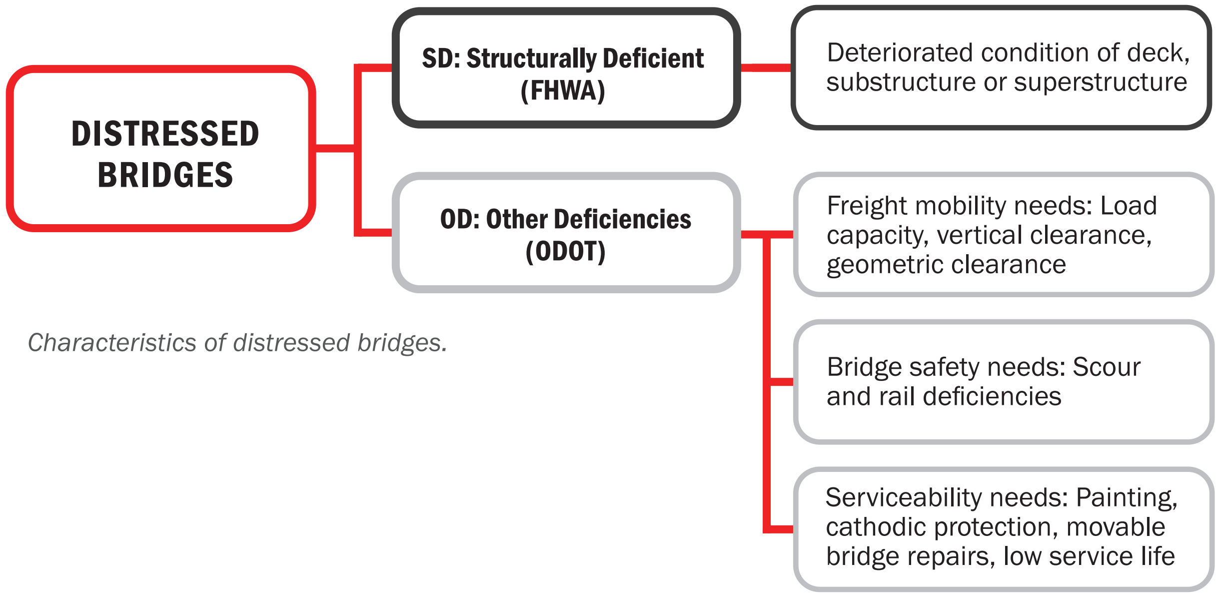
3 Bridges: Based on condition

Bridge Key Performance Measure
(Percent of Bridges Not Distressed)

ODOT measures bridge conditions based on the Bridge Key Performance Measure (KPM) – Percent of Bridges Not Distressed. The KPM includes two categories of bridges:

1. The percent of bridges not structurally deficient (SD) as defined by FHWA.
2. The percent of bridges without other deficiencies (OD) as defined by ODOT. Structurally deficient and *other deficiency* components capture different characteristics of bridge conditions as shown on the following page.

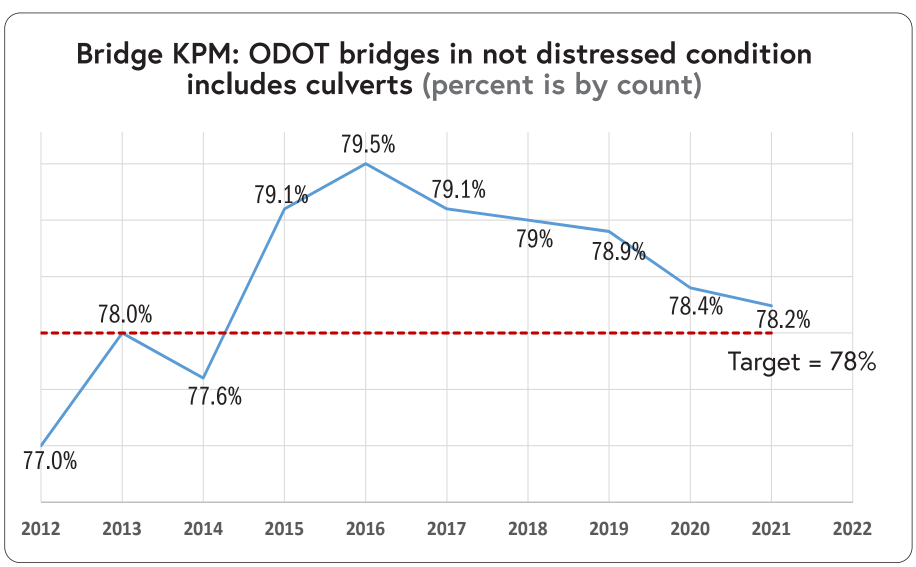
A condition of distressed indicates that the bridge is rated as structurally deficient or has at least one *other deficiency*. ODOT considers both structural deficiency and *other deficiency* aspects in determining bridge needs and selecting projects for the statewide Transportation Improvement Program.



Characteristics of distressed bridges.

For 2021, the Bridge KPM equals 78.2% indicating a 0.2% drop from 2020 exceeding the target of 78%. While the KPM indicates that bridge conditions exceed the target, 2021 marks the fifth year of a measurable decline.

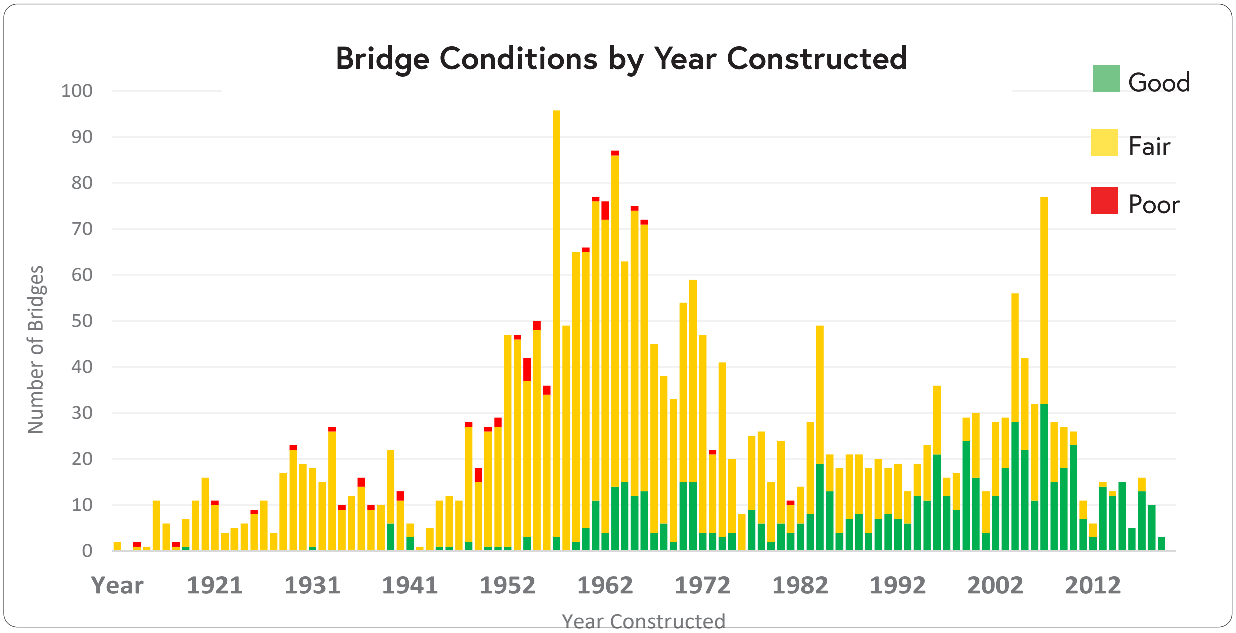
The number of bridges with other deficiencies fluctuates with time due to bridges being repaired where a deficiency is removed or deteriorating where a deficiency is added. Notable deficiency increases, however, were observed in two categories. First in the low service life deficiency which captures the overall condition and function of the bridge. Increased deficiencies have also been noted in deck geometry. The deck geometry category indicates that the traffic volumes on several bridges are above optimal bridge capacity.



ODOT bridges Not Distressed condition. Larger percentages are better.

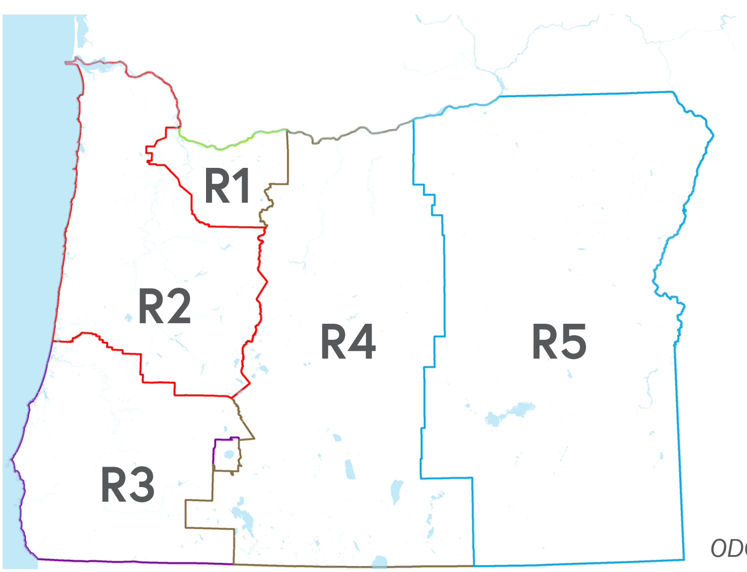
> "Current evaluations indicate a decline in bridge conditions for the FIFTH straight year."

An alternate approach to understand the system needs is to compare bridge conditions by the construction year. The graphic below provides a picture of the looming wave of bridges constructed in the 1960s (now over 60 years old) that are in fair condition and approaching the end of their service lives. While fair bridges are safe, as they continue to age the maintenance and rehabilitation needs increase.



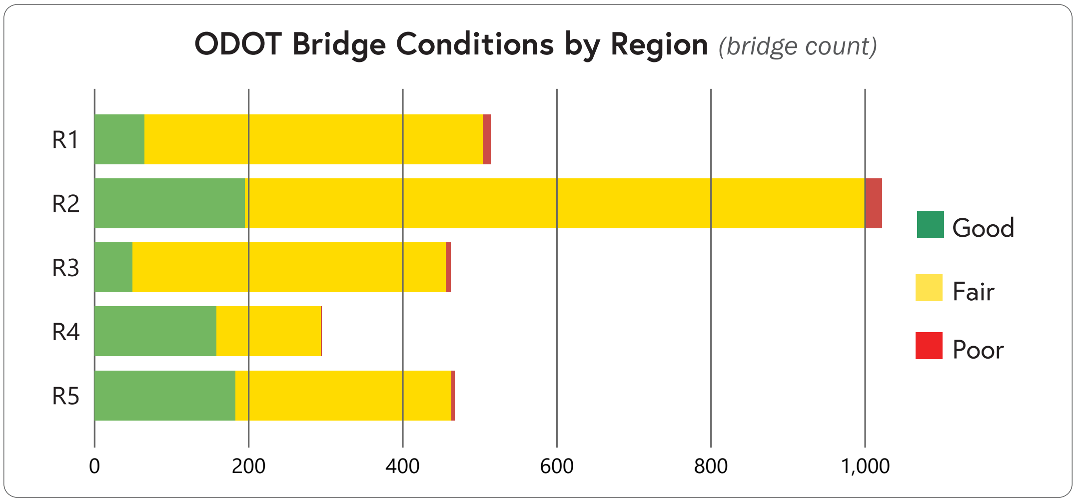
Bridge Conditions By Region

The distribution of bridges by bridge count and deck area are shown in the two graphics following the map. Region 1, which includes the Interstate Bridge over the Columbia, the Marquam and Fremont bridges over the Willamette in downtown Portland, all have more deck area than Regions 3, 4 and 5 combined.

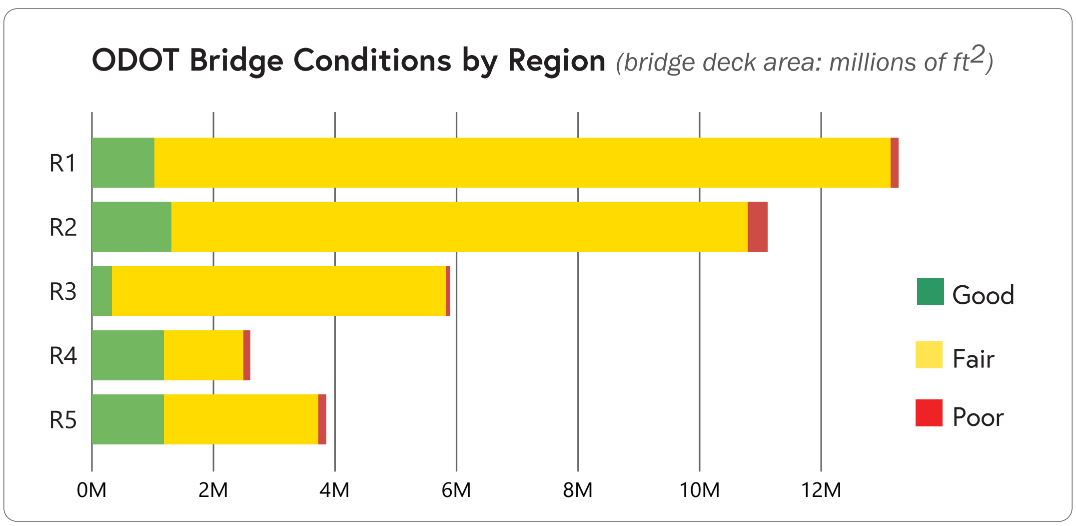


ODOT Region Map.

While the bridge system includes only 40 bridges in poor condition (structurally deficient), bridge conditions are slowly declining as noted by the Bridge KPM.



ODOT bridge conditions by count.



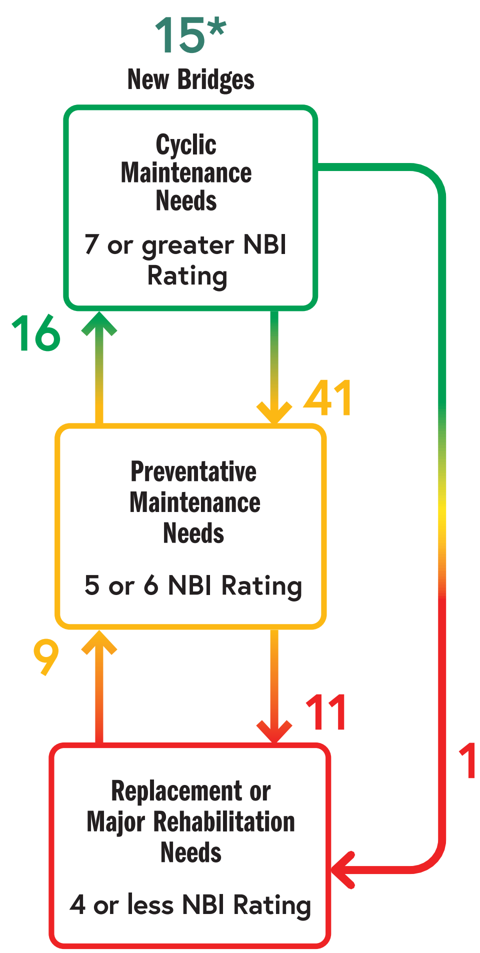
ODOT bridge conditions by 1,000 square feet of deck. Note that Region 1, which includes the Portland Metro area, includes the greatest quantity by bridge deck area.

2019-2021 Changes in Condition Ratings

The following chart shows both the dynamic nature of bridge conditions and the growing backlog of work for those bridges that have changed conditions. The period from 2019 to 2021 reflects bridge conditions over one full inspection cycle (24 months). In a balanced state, the number of bridges moving from green to yellow and red (deteriorating conditions) would be equal to the number moving from red to yellow and green (improving conditions).

The chart shows that we are managing the poor (red) bridges reasonably well, but the number of bridges moving from good (green) to fair (yellow), indicates that bridge preventative maintenance actions are not occurring at a rate necessary to maintain current conditions. Overall in the last two years, 53 bridges had lower (declining) overall condition ratings versus only 25 bridges with higher (improved) condition ratings.

2019-2021 Changes in Minimum NBI Ratings

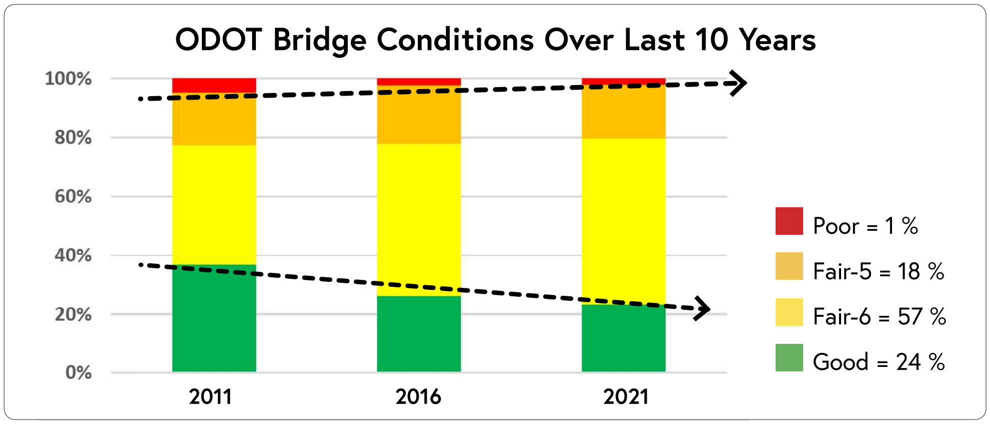


*Including 10 bridge replacements

> "More than twice as many bridges had deteriorating conditions than bridges with improving conditions."

Condition Changes Over The Last 10 Years

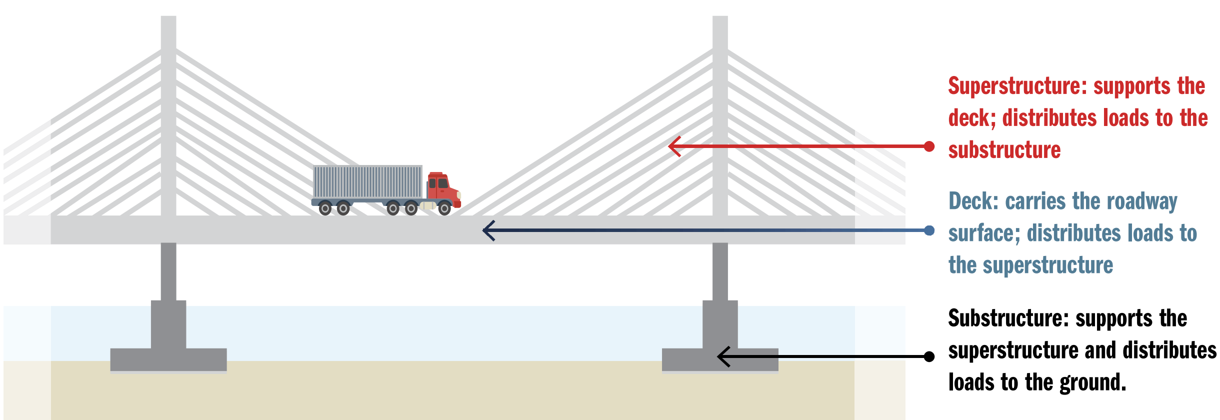
An overall assessment of bridge condition changes can be determined by comparing previous to current NBI ratings. The chart below provides the percentage of bridges in good, fair and poor condition in the last ten years. Bridges are classified as fair if the NBI value is 5 or 6, however, a value of NBI=5 indicates more distress.



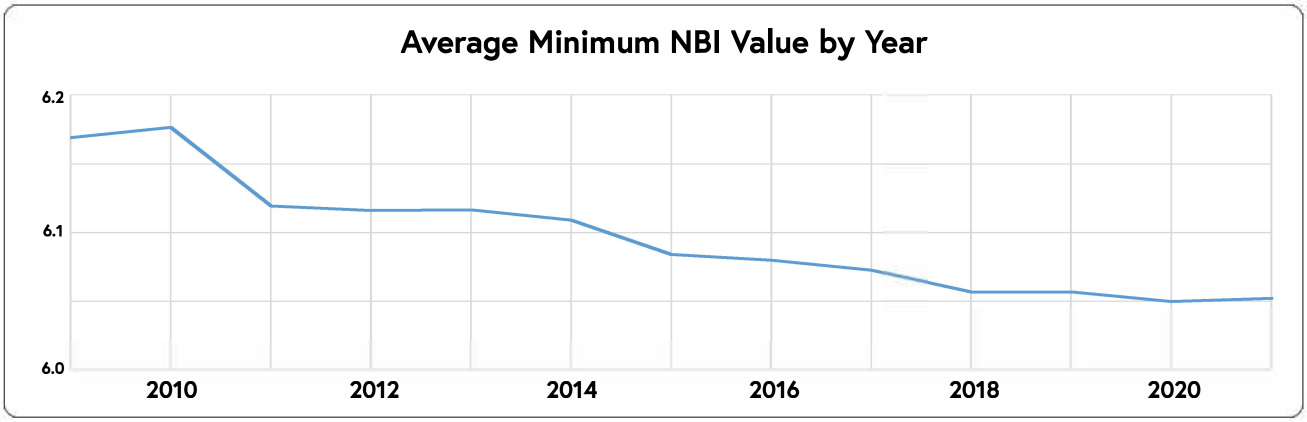
Of concern is the increasing number of bridges moving out of good condition into fair condition. The population of fair bridges continues to age and will require more and more rehabilitation and maintenance over time. Many fair condition bridges have already exceeded their service life but remain in place due to regular maintenance.

Substructure Conditions Deteriorating

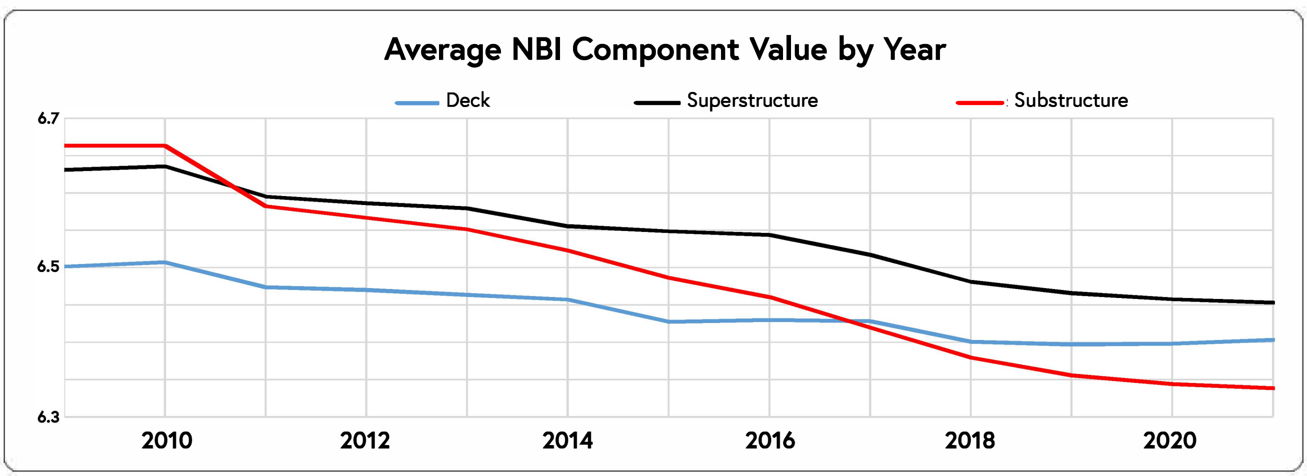
The NBI value is a simplified measure of bridge conditions, reflecting only the lowest of the superstructure, deck and substructure conditions. To get a clearer picture of bridge condition changes over time, FHWA submittal data was pulled for 2009 to 2021 to compare the overall, deck, superstructure and substructure conditions of ODOT bridges.



As shown in the graph, the overall NBI conditions (lowest of the superstructure, deck and substructure conditions) have declined since 2010, which would have been close to the end of the Oregon Transportation Investment Act (OTIA) work. Understanding which components of a bridge are deteriorating, is shown in the second graph.



In this graph, the component NBI values are plotted to indicate changes over time. In 2009, substructure conditions started out in the best condition, relative to the other components, but by 2017, they were in the worst condition. The average substructure NBI value indicates more bridge substructures have moved out of good condition into fair condition.



While a substructure deteriorating from good to fair condition is not a major concern at this time, as substructure conditions continue to decline, it will become problematic. Replacing a deck or strengthening the superstructure can be done multiple times, however, if a substructure deteriorates from fair to poor, the most cost effective treatment is generally replacement. As bridge substructures approach poor conditions, expect more bridge postings and potentially closures.

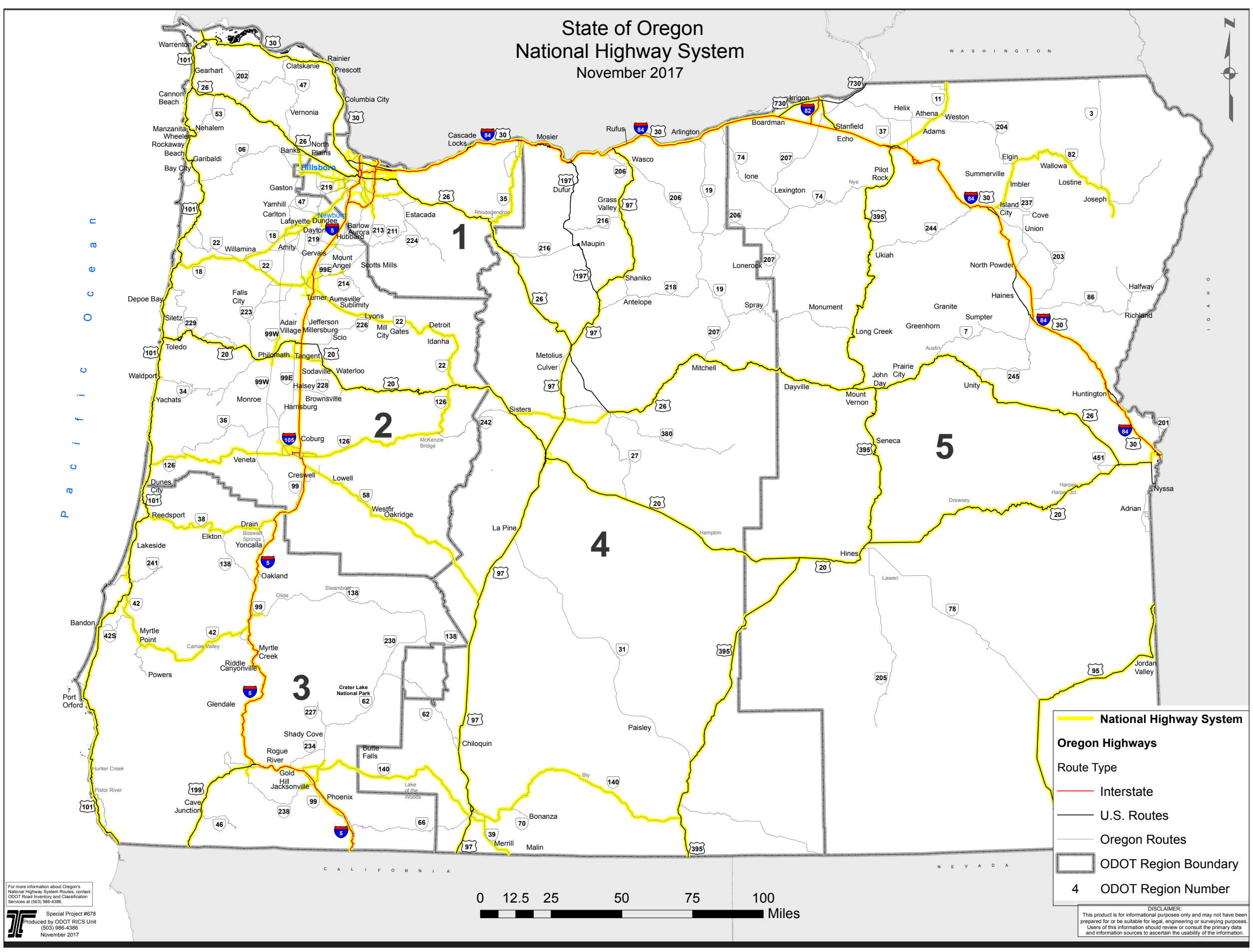
NATIONAL BRIDGE PERFORMANCE MEASURE

Condition Based Performance

The Moving Ahead for Progress in the 21st Century Act (MAP-21) requires states to establish bridge condition targets and report conditions based on specified performance measures including:

1. **Percent of NHS bridges by deck area classified as in good condition**

2. **Percent of NHS bridges by deck area classified as in poor condition**



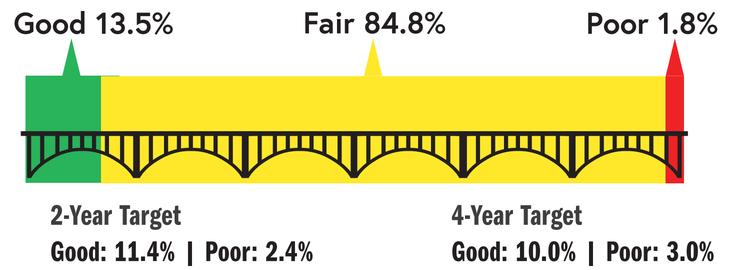
State of Oregon National Highway System.

National Bridge Performance Measure Details

The graph below indicates that Oregon is exceeding the targets set for the National Performance Measure. In fact, the percentage of good bridges increased from 2019 to 2020 and remained relatively flat from 2020 to 2021. The measured improvement can be attributed in part to newly constructed bridges added to the inventory as a result of modernization projects.

2021 Oregon National Bridge Performance Measure Values

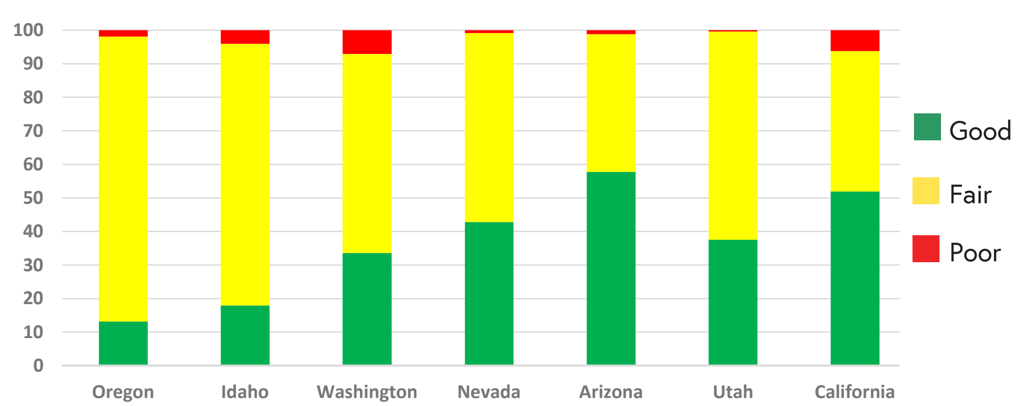
(percentage of deck area)



Oregon's NHS bridge conditions and two and four year targets are shown above. Oregon expects NHS bridge conditions to decline but be under the 10% threshold for poor bridges in the near future. However, with so many bridges in fair condition on the cusp of becoming poor, maintaining bridge conditions in the future will be challenging.

Compared to neighboring states, Oregon has the least quantity of NHS bridges in good condition. The graph shows Northwest states' bridge conditions using 2020 data submitted to FHWA. While Oregon ranks among the best for the least percentage of poor bridge conditions, it includes the smallest percentage of bridges in good condition as a result of few bridge replacements.

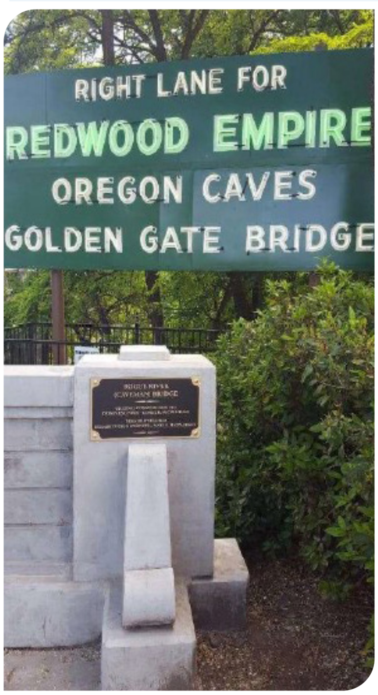
2020 Western States NHS Conditions *(by deck area)*



The Nation Performance Measure does not include penalties around the percent of good condition bridges; it does recognize the importance of having a range of bridge conditions in the statewide inventory providing a balanced approach to managing the bridge system.

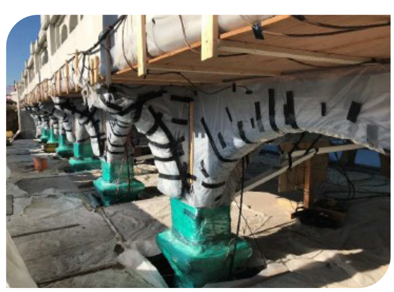
BRIDGE PROGRAM UPDATES

1	Major Bridge Maintenance	► Funding ► Accomplishments ► Repair of Older Bridges ► Timber Substructure
2	Bridge Preservation	► Data Driven Decision Making ► Painted Steel Bridges ► Bridge Deck Program
3	Seismic Program Status	► Phase 1 Seismic Plus Bridges ► Region 3 Triage Program ► Coordination with Counties
4	Bridge Load Rating	► History ► Basics ► SHVs and EVs



Rogue River (Caveman) Bridge Grants Pass ornamental rail rehabilitation.

Columbia River. (Interstate Bridge trunnion replacement)



Dry Canyon Bridge (Historic Columbia River Highway) re-alkalization project.

Umpqua River (Reedsport) Bridge painting project.

1 Major Bridge Maintenance

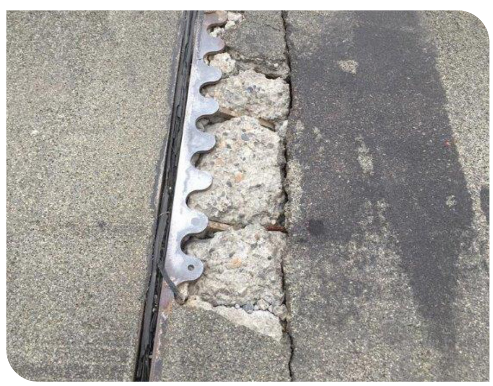
In 1990, the state of Oregon established the Major Bridge Maintenance (MBM) Program, to specifically address major and emergency bridge repairs. These repairs are typically large enough to be outside the scope of work that can be funded at the district level, but are too small or can't wait to be included in the STIP. MBM highlights include:

- Approximately 200 projects are selected annually.
- Starting in 2018, funding increased to $10,000,000/year.
- Starting in 2021, funding increased to $12,000,000/year.

One of the primary objectives of the MBM program is to address urgent maintenance recommendations. Urgent maintenance recommendations are defects identified during the routine bridge inspection that need to be corrected as soon as possible or pose a traffic safety concern. In 2020, the MBM program funded 38 projects to address urgent maintenance recommendations at a total cost of $4,935,500. Examples of these projects include repairing damaged joints that pose traffic hazards, replacing deteriorated timber members, and scour repairs.

Typical Distresses Addressed by MBM

Failed Deck.



Damaged Bridge Joint.

Distressed Timber.

Foundation Scour.

Preventative maintenance activities are widely considered a cost effective way to extend the service life of bridges. The deck is the highest value item on a bridge and it is also at the highest risk due to its exposure to weather, de-icing chemicals, and wear from traffic. When concrete decks are cracked, the risk to the deck is elevated because there are now pathways for water and de-icing chemicals to get deep into the concrete and reach the reinforcing steel. Once the reinforcing steel begins to corrode, costly deck rehab or replacement projects are required. However, if the deck can be sealed quickly, the deck service life can be significantly extended. In 2020, the MBM program funded projects to seal 23 bridge decks at a total cost of $876,400. This work helped protect approximately 362,800 square feet of bridge deck from degradation.

Maintaining the asphaltic concrete wearing surface (ACWS) on bridge decks and approaches has become a growing challenge for the state. Deferred maintenance on secondary highways has resulted in more bridge only paving projects. These smaller volume paving projects tend to attract high bids. In 2020, the MBM program funded paving work on 16 bridges at a total cost of $1,936,500. This represents a significant expenditure for the MBM program and will be a continued challenge for the agency into the future.

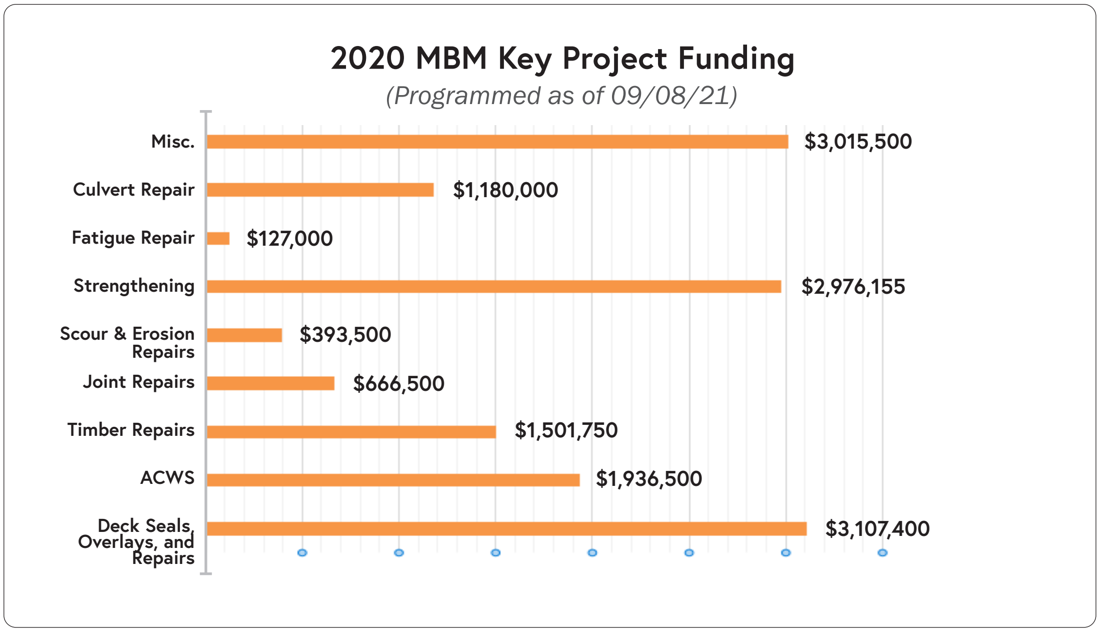
In addition to addressing urgent defects and performing preventative deck maintenance, the MBM program addressed scour repairs, deck joint repairs, timber repairs, approach repairs, bearing replacements, and maintenance on the moveable bridges. The variety and volume of work performed by the MBM program is what makes it a key component in maintaining Oregon's infrastructure.

2020 MBM Project Accomplishments

In 2020, ODOT repaired seven bridges in poor condition through the MBM program. In addition, we repaired 61 bridges with urgent or high priority needs. These are bridges with defects identified during routine bridge inspections that need to be corrected as soon as possible since they may pose a traffic safety issue.

There is a detailed list of MBM expenditures in the graphic below, which includes 10 bridges that were not strong enough to support modern truck weights and were therefore strengthened.

We are updating the load carrying capacities of all existing bridges in the state. By doing so, we will add more strengthening projects to avoid load postings and closures. You can find more details on ODOT's load rating efforts in this report.



MBM focus on Older Bridges

Each year the Major Bridge Maintenance program funds approximately 200 bridge repair projects typically in response to a localized defect on the bridge:

- Damaged joints
- Frozen bearings
- Rotted timber pile
- Spalling concrete, etc.

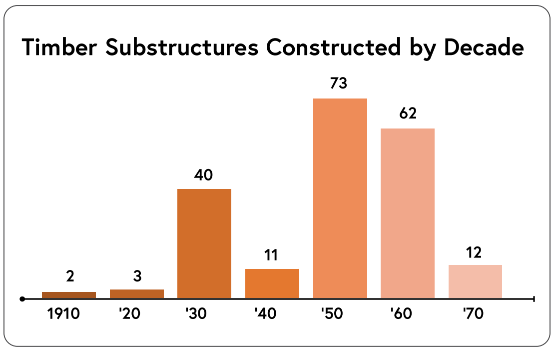
Localized MBM repairs can raise the bridge condition rating from poor to fair; however, the rise is only temporary as the bridge will continue to deteriorate. These repair projects aren't intended to rehabilitate the entire structure, but rather just address the defects that we must correct. Many of the bridges that require the repairs should be replaced, however, the upfront replacement costs simply aren't available as funding is allocated to higher priority bridges and spread around to keep more bridges in service.

As resources continue to shift toward maintaining deteriorating bridges that should be replaced, fewer resources are available for cost effective preservation and maintenance treatments. Eventually bridges on lower priority routes will not be serviceable leading to load restrictions or even closures posing a significant risk to Oregon's mobility in the coming decades.

Timber Substructures Conditions – High Demand on MBM!

Oregon has 203 bridges with timber substructures that are state owned and part of the National Bridge Inventory (NBI). Of these bridges, 193 have exceeded the original design life of 50 years. To keep these bridges in service requires continued maintenance to repair/replace members that have rotted to the point of no longer being able to safely support service loads.

The Major Bridge Maintenance program is dedicated to funding repairs to state owned bridges in the NBI. Repairs to timber substructures continue to be a substantial percentage of the overall program. There are 78 timber substructures which have at least moderate levels of degradation. As this population of bridges ages, we expect that the frequency and urgency of timber substructures repairs will continue to escalate. From 2018 to 2020, MBM program completed 134 timber pile repairs and 29 timber cap repairs on 75 structures. Associated cost for the repairs totaled $3.7M.



Although the dollar value of these repairs isn't tremendous, they do monopolize the available maintenance and design resources preventing other repairs from being completed. As the populations of timber substructures continue to age, we expect the percentage of maintenance resources dedicated to repairs to substantially increase.

Crushed timber cap.

Cross section of deteriorated timber cap.

East Champoeg Creek – Cap Replacement

The East Champoeg Creek Bridge on Hwy 140 (OR 219) had a critical finding in 2021 due to severe decay and and a crushed timer cap caused by age and a bug infestation. The bridge was restricted to one lane and we installed temporary shoring until we could complete repairs. The local ODOT bridge crew responds to high or urgent repairs on an almost yearly basis.

This bridge was constructed in 1959 on four timber bents and measures 63 feet in length. One timber cap was previously replaced in 2016.

2 Bridge Preservation: Data Driven Decision Making

Bridge preservation covers any actions taken to extend the lifespan of a bridge. These actions range from the smaller, maintenance level projects, such as sealing a bridge deck or replacing a joint, up to the larger projects such as painting steel structures or replacing bridge decks. For the larger scale projects, which are typically performed under the Bridge Preservation program, it is extremely important to target the correct bridges and ensure that the work is timely. If a project is delayed too many years, corrosion and age can dramatically increase the costs and reduce how much can be preserved.

Monitoring a crack in the trunnion of the Interstate Bridge using UT.

What Data Is Out There?

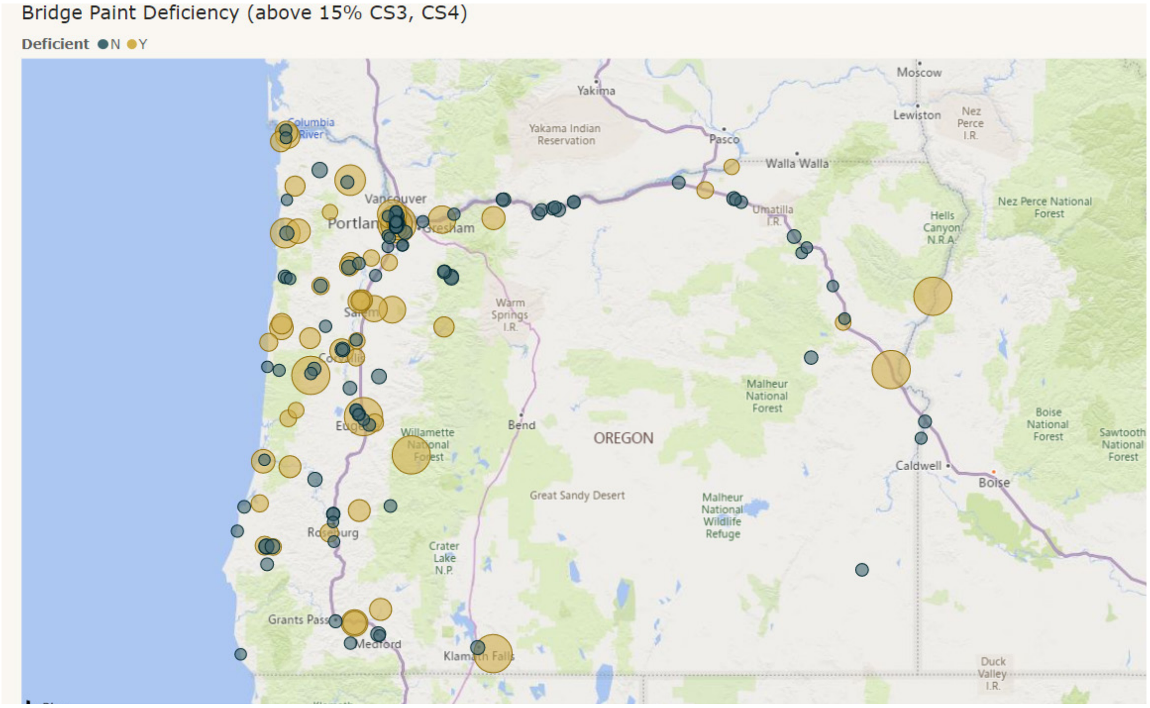
All bridges age over time and will eventually require preservation work, but identifying which bridges to work on and what work to do is a challenge. Making those decisions requires data, both about the bridges and about their environment. Much of the initial data comes from the NBI and bridge inspection data. This forms a baseline that can guide bridge selection, but to make wise choices, we collect additional in-depth data. This data includes, but is not limited to: chloride (salt) testing, concrete strength testing, corrosion survey and half-cell potential measurements and ultrasonic testing (UT) of fracture critical details.

Painted Steel Bridges

When Do We Paint Our Bridges?

The 370 painted steel bridges in ODOT's management are all regularly inspected to monitor the breakdown of the paint and the onset of surface corrosion. Just like on a house, even the best paint job will not last forever and will begin to breakdown first in the most exposed locations. For a bridge, those locations are in coastal environments or where large amounts of salt or debris are deposited on the coating. We document measurements of the amount of failed coating in the bridge element inspection, Element 390 Painted Steel.

The threshold for when a bridge needs painting is when 15% of the total area of painted steel is at condition state 3 (poor) or 4 (failed). Once 15% of the painted steel has moved to condition state 3 or 4, the entire bridge's surface area is added to the list of in-need bridges. How long a bridge might stay on this list is dependent on the rate at which the coating is failing and the overall cost of the project.



Map indicating painted bridges with circle size indicating level of deficiency.

Current State of the Painted Bridge Inventory

Focus on the Astoria Megler Bridge

The Astoria-Megler Bridge crosses the Columbia River to Washington from Astoria. The total length of the structure is 4.1 miles, composed of five primary structure types, including the 2,469 foot long cantilever truss main span. At almost two million square feet, the painted steel surface area of this bridge is by far the largest on the Oregon coast. Bridges on the coast, or within the spray of the ocean, are particularly vulnerable to salt induced corrosion and, as a result, require more frequent repainting.

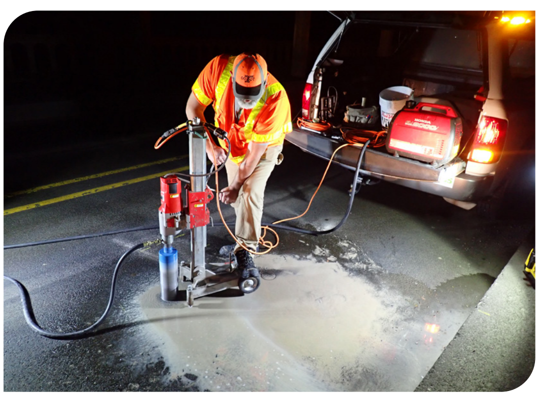
In Astoria, due to the exposed location and the resident colony of cormorants whose waste products further corrode the steel, the paint is only expected to last approximately 20 years before we reschedule painting. These are expensive paint projects due to the complicated access and extreme winds. Getting the timing right for the next paint cycle is critical, as the nearest detour is 75 miles away if the bridge requires traffic restriction. As such, regular inspections monitor the paint condition and extent of corrosion. We recommend further research on the impact of the birds.

ODOT inspects the paint on the Astoria Megler bridge to prepare for an upcoming project.

Bridge Deck Program

Timing Is Everything

When it comes to bridge preservation, the timing of when we take a preservation action is just as important as what action we take. We use routine inspections to assist with finding the appropriate time and action. We use physical sampling, historic records, visual assessment and the as-built drawings to decide on the best options.



Taking a sample for testing.

A hole, caused by chemicals, extends all the way through the bridge deck.

What is a Bridge Deck and How Does It Go Bad?

In Oregon, bridge decks are generally built from a combination of concrete, steel, timber, and asphalt. Concrete and asphalt are the most common wearing surfaces. The purpose of a bridge deck is to provide a smooth riding surface while distributing forces to the superstructure components.

De-icing chemicals and other sources of chloride (an ion of chlorine), such as seawater, cause steel corrosion. This corrosion accumulates between the reinforcement and the concrete leading to delamination and even holes in the bridge deck.

Bridge deck after strengthening repairs.

Maintenance crews patch concrete deck at night.

Full deck removal.

Partial depth hydro-demolition of a bridge deck.

What does ODOT Do to Keep Our Bridge Decks in Service?

We perform a number of preservation actions to our bridge decks. The most common are patching, sealing, and re-surfacing. While our Maintenance crews patch our decks to improve the riding surface, patching is only a temporary fix because we haven't fixed the cause, only treated the symptom. Patching also exposes our crews to more hazards than we'd like. Some of those are night work, working next to traffic (in awkward positions), and more.

Can We Fix the Cause Rather than Treating the Symptoms?

The bridge deck program is intended to do just that. We use as much information as is available, or we find more through field visits and sampling. Ideally we catch deck repairs before they are contaminated with chlorides and apply a durable and long lasting material that both protects the concrete and prevents chlorides from reaching the rebar. Sometimes we don't catch it soon enough, but we can still mitigate the effects of the chlorides by removing the damaged concrete. Once the damaged concrete has been removed, we can add structural concrete back to restore the life of the bridge deck. Generally, even a partial depth removal is cheaper, quicker, and less intrusive than a full deck replacement. However, sometimes a full deck replacement is unavoidable. This could be because safety requirements exceed that of the original deck, or possibly the structure needs to be widened. These, among many other factors, contribute to the project delivery team's final decision about what preservation action is best suited for a project.

Deck Program Assistance on Four Southern Oregon Bridges

After years of wear from the interstate's almost 17,000 daily vehicles, 27% of which are heavy trucks, the two bridge decks at the Exit 6 Interchange and the two bridges over Crowson Road — located in Southern Ashland — were in need of rehabilitation. Originally, the assumed repairs included structural overlays, a 2-inch layer of concrete added to the top of the bridge decks to increase the stiffness of the decks and decrease live load deflection of the bridges.

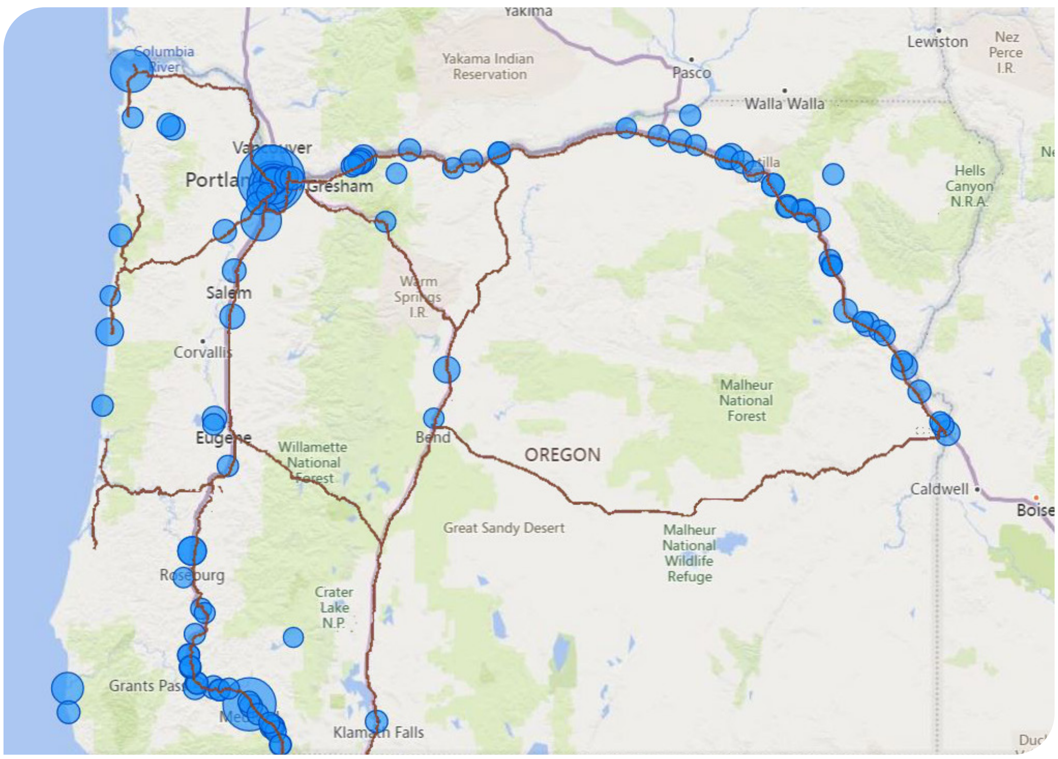
During project development of the Crowson Road bridges, the ODOT Bridge Preservation unit performed field investigations and determined that the bridge decks had chloride contamination above the 0.04% mark at the top transverse mat of deck reinforcing. Based upon the Bridge Preservation unit's finding, the repair scope changed from a 2-inch overlay to removing the contaminated portion of deck concrete, replacing all corroded reinforcing, and placing a thickened concrete overlay.

The team also conducted chloride intrusion tests on the Exit 6 bridges and concluded that the chlorides were above the 0.04% threshold and went to a depth where the team recommended a full deck removal and replacement of both bridge decks. To slow chloride intrusion, the deck replacement included a 3/4" premixed polymer concrete (PPC) overlay that can be easily removed and replaced with future preventative maintenance projects. They also used epoxy coated reinforcement to help slow corrosion if chlorides were to reach the bars.

Thanks to the collaboration between the Deck program, Bridge Design unit, and the Project Design team, they made an informed decision based on field testing and research and designed a repair to prolong the life of the bridges, especially in the harsh Siskiyou climate.

How Long Has Bridge Preservation Been Making Data Driven Decisions?

ODOT's Bridge Preservation unit has been performing chloride testing for almost 30 years throughout the state. In addition to chloride testing, Bridge Preservation can provide data for corrosive soils, seawater effect, paint deterioration, moveable bridge operations and repair, and much more. Over the years, we've seen various technologies and test methods, but the best indicator of potential corrosion of our concrete bridge decks is testing the chloride content. Between January 1, 2021, and September 1, 2021, the Preservation unit has assessed 43 projects with a bridge deck, often clarifying the scope which may reduce preservation costs.



Chloride tests and Fix-It Priority Routes.

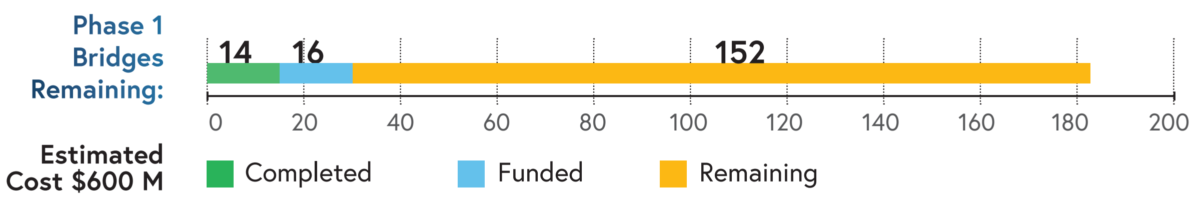
3 Seismic Program Status

The 2014 Seismic Plus Report identified five phases of bridge seismic work to "provide the maximum degree of mobility with reasonable investments spread over several decades." The goal of phasing is to strategically and systematically retrofit all seismically vulnerable bridges and address unstable slopes on key lifeline routes to allow for rescue and recovery following a major earthquake.

House Bill 2017 provides approximately $10 million per year in additional funding to address seismic improvements related to highways and bridges. ODOT planned to use the funds to work on Phase 1 bridges from Eugene, moving north on Interstate 5 and finishing up on Interstate 84 moving from east to west in 20 to 30 years. However, after determining that the current seismic retrofit and replacement costs are much higher than the original 2014 estimate, ODOT is reassessing that approach.

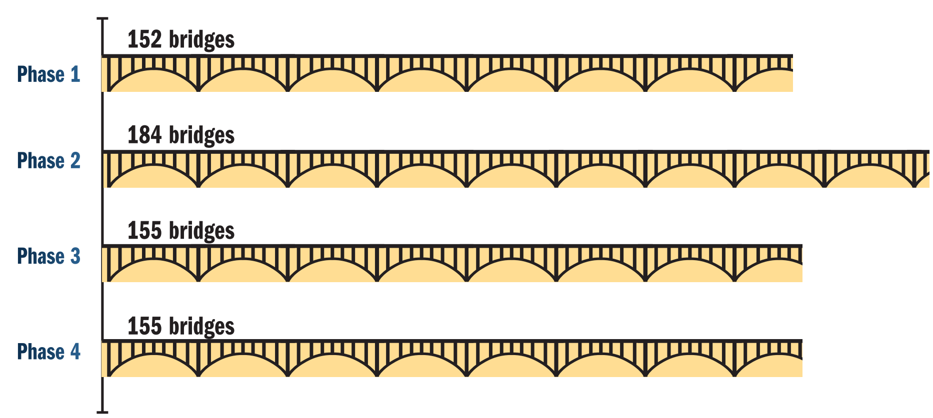
Phase 1 **Provides a connection to the Redmond Airport; east-west freight movement and a north-south corridor on US97 -- the cornerstone of the program.**

ODOT Phase 1 Seismic Routes



**Several bridges have been removed from the program after the field scoping or the preliminary design confirmed no need for seismic improvements.*

Seismic Bridge Costs Remaining by Phase

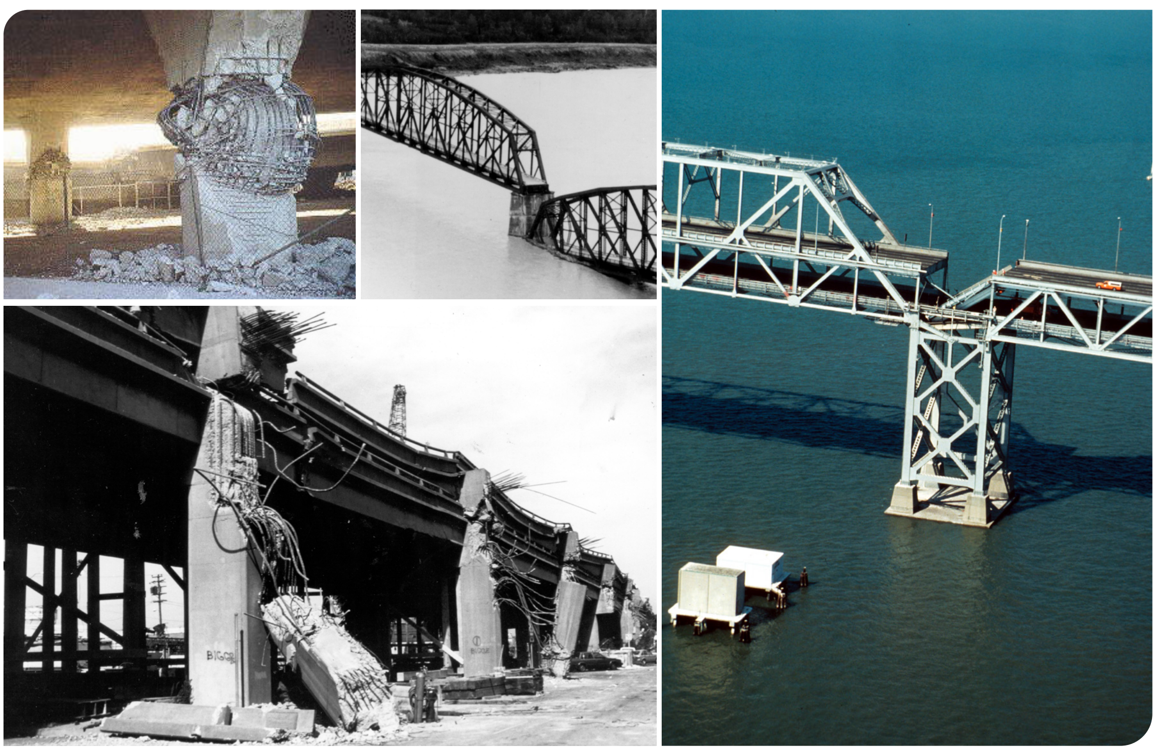


Phase 5 includes 12 bridge replacements like the Medford Viaduct, the Ross Island Bridge, several historic coastal bridges and other large bridges.

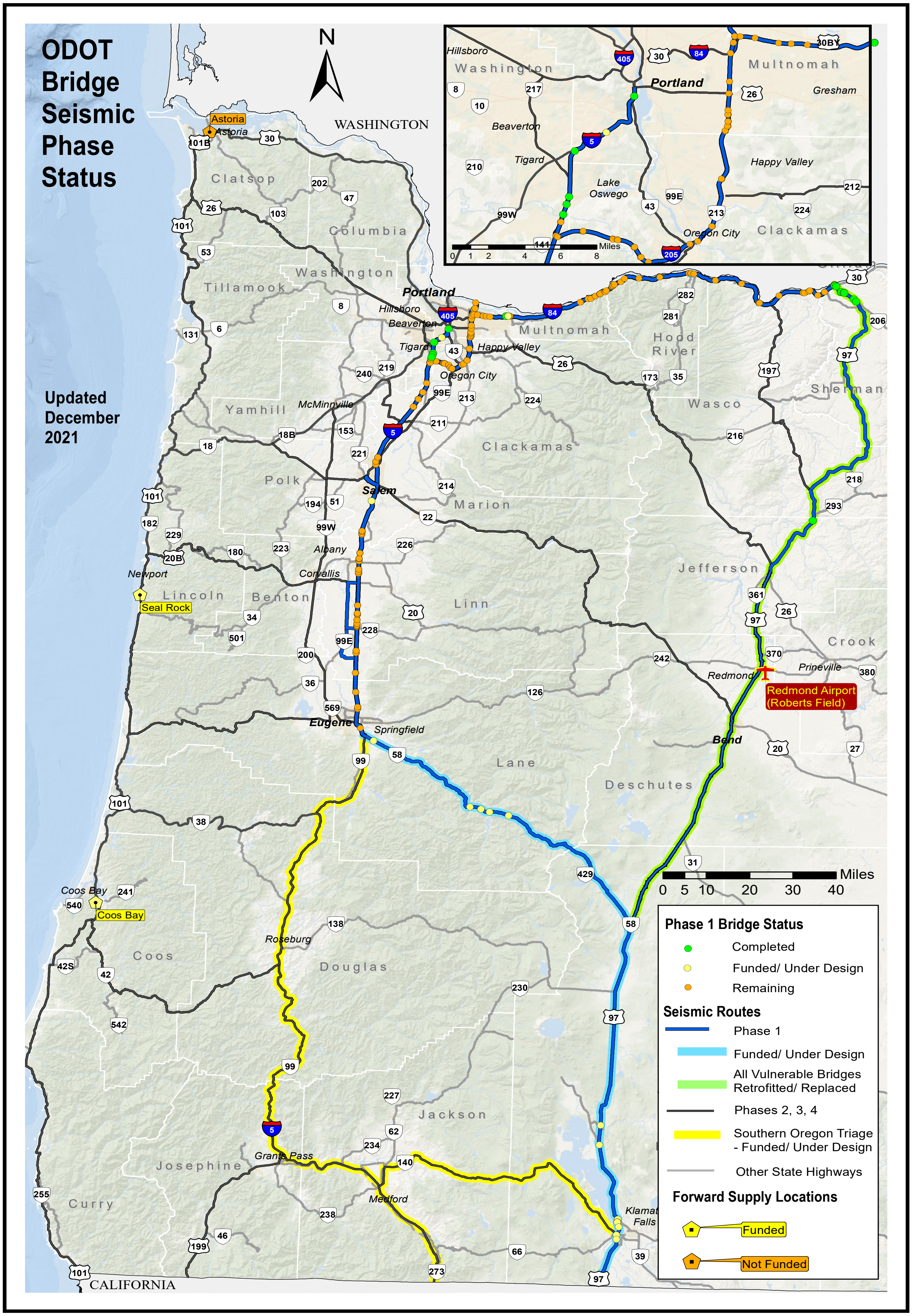
As of September 2021, ODOT has retrofit six bridges and replaced two bridges within the northern-half of the US 97 (I 84 to OR 58). We have completed design and construction is just about to start to strengthen the southern-half of the US 97 (OR 58 to California border). This project will retrofit six bridges and replace one bridge. Final design for four bridge retrofits and one bridge replacement on OR 58 is nearly complete.

The I-205 improvement project (from Stafford Road to OR 213) will also address the seismic vulnerability of nine bridges along this corridor, including the Abernethy Bridge, by either retrofitting or replacing them based on the cost/benefit analyses. After the retrofit, Abernethy Bridge will be the first major highway bridge river crossing in Oregon expected to remain operational after a major seismic event such as Cascadia Subduction Zone Earthquake. Construction of this project is expected to start in 2022.

In addition to the emphasis ODOT is placing on addressing the seismic vulnerabilities along the Phase 1 routes, additional bridges throughout the state are also becoming seismically resilient. This happens as older and vulnerable bridges are either replaced or been modernized for capacity or condition based reasons.



Bridge damage caused by historic earthquakes. Photos courtesy of USGS.



ODOT bridge sesmic phase status.

Seismic Strategy Update

Based on the current cost estimates and the available funds, it will take decades to complete Phase 1 of the Seismic Plus Program, at which time many of the bridges that were initially retrofitted will be reaching the end of their service life. Also, bridges still in relatively good condition may need to be replaced primarily due to existing seismic vulnerabilities.

ODOT recently developed and published the "ODOT's Seismic Implementation: Policies and Design Guidelines," a document that provides guidance to planners, project teams, scoping teams, designers, program managers and ODOT Maintenance and Operations as they implement the Seismic Program. The policy document is intended to facilitate discussions around options to maximize the value of the HB 2017 seismic funding.

The ODOT Seismic Implementation document designates the ODOT chief engineer as the program owner. A Seismic Program Advisory Group has been assembled to assist the chief engineer with strategic decisions and program direction during program implementation. Members of the advisory group represent key technical disciplines, districts, regions, and local agencies.

With both US 97 and OR 58 project bundles fully funded, the advisory group will focus on prioritizing the seismic investment for the remaining of Phase 1 corridors. The first priority is retrofitting major river crossings, however, we will consider viable detour routes when cost effective. The major Interstate 5 river crossings between Eugene and Portland include the Santiam River Bridge and the Boone Bridge, which will be evaluated as directed by the 2019 Legislature.

HB 2017 seismic funding will be used to address bridges identified for work as part of an updated strategy. We will make every effort to optimize funding to address overlapping bridge needs like replacing deteriorating structures on lifeline routes.

Other Funded Seismic Projects

The Southern Oregon Seismic Bridge Retrofit is an additional seismic project funded by HB 2017. This project is divided into four separate projects. The first project coincided with a pilot project to evaluate the cost-benefit of using the buckling restraint bracing (BRB) system for seismic bridge retrofits. The BRB system proved to be a cost-effective retrofit method for bridges with multi-column bents, especially for grade separation structures. It allowed ODOT to address the seismic vulnerabilities of the first two bridges of this project (Hwy 1 northbound and southbound over Leland Rd) at a relatively low cost. ODOT will continue exploring opportunities to use this retrofit strategy in future seismic retrofit projects.

The second project consists of five bridges and is under construction with an anticipated completion date of May 2023. We are finalizing design on the third project, also consisting of five bridges, with construction expected to start in early 2022. One of the bridges on the third project is supporting a detour route for several vulnerable bridges on Interstate 5. The forth project includes replacing three bridges on another detour route for Interstate 5. This project is at the early design phase.

Leland Road Bridge retrofitted with buckling restraint bracing.

The Southern Oregon Seismic Bridge Retrofit supports a strategy that focuses on mitigating seismic impacts along Interstate 5 south of Eugene and OR 140, which are key lifeline routes to and from the Rogue Valley. Most of the seismic impacts on the routes are expected to be addressed through quick repairs or temporary detours. We will use the funding to address those bridges and potentially unstable slopes that are higher risk or where a feasible detour does not exist.

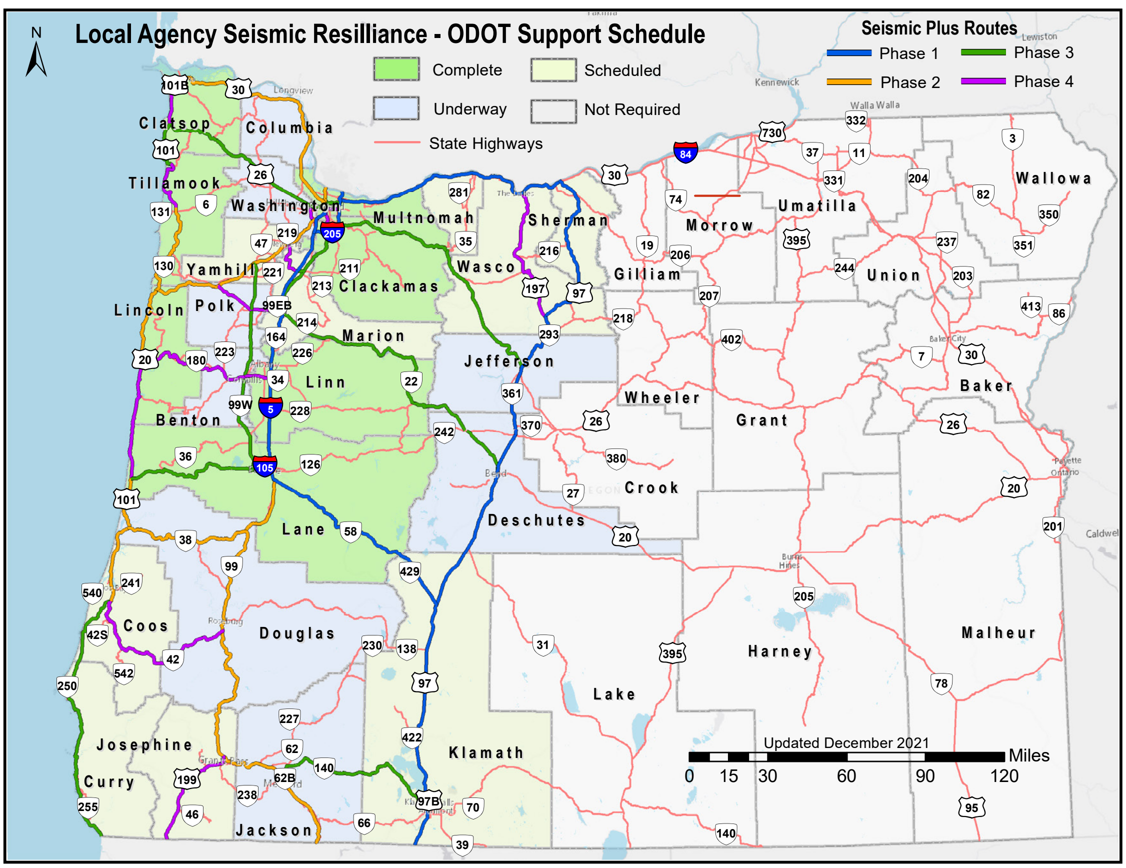
Right of way funding is available for coastal maintenance stations at Seal Rock and Coos Bay. We are considering an additional facility in Astoria but it is not currently funded. Each station will be supplied with seismic response kits. The purpose of the kits is to stockpile key materials and supplies that can assist local communities in the early days following a seismic event. The kits will include culvert pipes of various sizes, construction materials, solar powered generators and trailer mounted solar light panels, diesel and unleaded fuel storage tanks, survival supplies (water, field rations, first aid supplies), power tools, batteries, portable boats, flat railroad cars and satellite phones and Ham radios.

Local Agency Seismic Resilience Support

The Bridge seismic standards engineer and other leaders at ODOT are working collaboratively with Oregon counties to develop planning reports documenting county routes and priorities for seismic resiliency. ODOT provides bridge data and technical support and the counties provide information about their network. While the information is useful for county planning, we can also compare it to the state seismic bridge priorities to determine possible state highway detour routes that may be more cost effective to seismically retrofit or replace. Eventually the planning reports may provide an opportunity for seismic resiliency funding from either state or federal funds.

The status of the local agency work is provided below.

Complete	Underway	Scheduled
Clackamas	Benton	Coos
Clatsop	Columbia	Curry
Lane	Deschutes	Hood River
Lincoln	Douglas	Josephine
Linn	Jackson	Klamath
Multnomah	Jefferson	Marion
Tillamook	Polk	Sherman
	Washington	Wasco
		Yamhill



Local Agency Seismic Resilience - ODOT Support Schedule.

4 Bridge Load Rating

An early delivery truck with two axles.

An early freight truck with just three axles.

Trucks continue to evolve to improve the efficiency of freight movement and emergency response. To ensure bridges can safely support the trucks, ODOT evaluates each bridge to determine the safe load capacity based on a load rating.

ODOT is currently including the specialized hauling vehicles (SHVs), and emergency vehicles in all new load ratings. Due to the concentrated loading, we expect that there will be a need in the near future to strengthen or place load restrictions on many state and local agency bridges.

Load Rating History

In an effort to keep up with transportation demand, national design loads for bridges were increased in 1944, 1980, and 1993. Over half of the bridge population was designed before 1970 using design loads; yet the economy demands more efficient delivery services so trucks continue to get bigger and heavier.

Bridge Load Rating Basics

The load rating analysis determines the capability of a bridge to carry loads. The analysis calculates rating factors (RF) at many points to determine the bridge's weakest member. A rating factor is simply the ratio of the load the bridge can carry to the load produced by the vehicle.

The load capacity of a bridge takes into account the following factors:

- The weight of the bridge since the bridge must hold itself up.
- The bridge configuration like length of the bridge spans.
- The strength of the concrete, steel, or timber that was used to construct the bridge.
- The bridge condition – are steel members corroded or damaged? Is the concrete cracked? Are portions of the timber decayed?

Using the bridge related factors identified above, we evaluate different truck loading configurations. The analysis is based on the national bridge formula established in 1975 to limit the weight-to-length ratio of a vehicle. There are four categories of loads evaluated that cover different truck configurations.

Legal Loads

(includes SHVs)

Common semi-trucks, construction and waste management trucks with short wheel bases (SHVs)

≤80,000 lbs GVW

Continuous Trip Permits

Log trucks, milk tank trucks

≤105,500 lbs GVW

Single Trip Permit Loads

Non-divisible loads like vehicles hauling wind mill components; self-propelled cranes

Variable weights

Emergency Vehicle Loads

Fire trucks and other vehicles equipped to mitigate hazardous situations

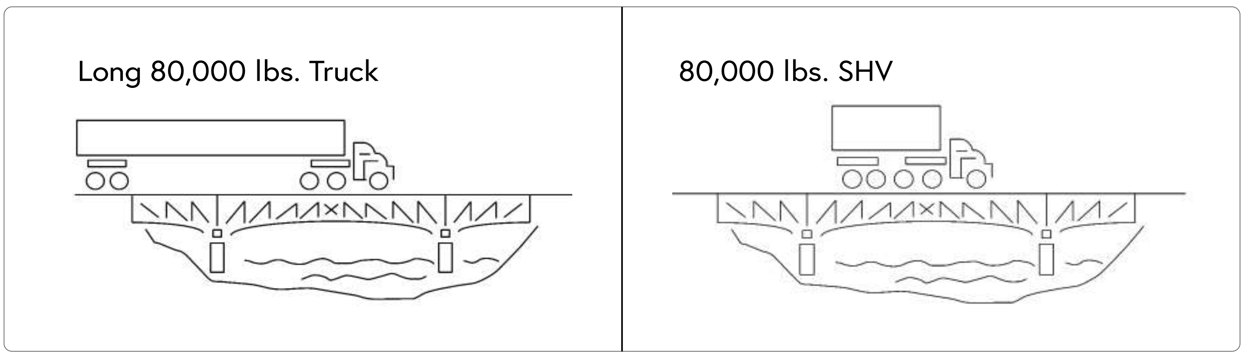
Up to 86,000 lbs GVW with short wheel bases that create highly concentrated loads

Concentrated Loading from SHVs and EVs

As trucks grew heavier in the 1950s and 1960s, ODOT had to do something to protect bridges. The solution was to link allowable weights to the number and spacing of axles and using the bridge formula to establish limitations. Limiting the weight-to-length ratio of a vehicle crossing a bridge is accomplished by either spreading the weight over additional axles or by increasing the distance between axles. One unintended consequence of the bridge formula is a new class of trucks that are called specialized hauling vehicles (SHVs). These trucks are a single-unit with many axles spaced closely together to comply with the requirements of the bridge formula.

Specialized Hauling Vehicles. (SHV)

As shown in a FHWA publication on the bridge formula (excerpt shown below), the loading on bridges can be considerably more for an 80,000 pound specialized hauling vehicle than for an 80,000 pound semi-truck.



Because of the national concern with SHVs there is now a requirement to update all load ratings to include these vehicles. Specialized hauling vehicles emerged at the same time as new, heavier emergency vehicles were beginning to use the roadways.

The current federal highway bill, Fixing America's Surface Transportation (FAST) Act, made it legal for emergency vehicles that have heavier than legal axle weights to travel on the interstate system to respond to wildland fires and other natural disasters. As a result, FHWA has mandated all states to load rate, and if necessary, load post bridges on interstate routes, or within reasonable access (one road mile) of an interstate, for FAST-Act emergency vehicles.

The FHWA mandate requires that lower risk bridges on an interstate or within one road mile, referred to as group 1 bridges, be rated for emergency vehicles when a normal re-rating is warranted. All other bridges that are on an interstate or within one road mile are identified as group 2 bridges and are required to be rated for emergency vehicles by December 31, 2021.

Firetruck. (Emergency Vehicle)

Keep in mind that these posting signs do not affect all emergency vehicles, only those that have heavier than legal axle weights. Emergency vehicles that meet legal axle weights only have to adhere to load postings for legal vehicles.

The truck shown on this page is an example of the Emergency Vehicles (EVs) legalized by the FAST Act. These EVs can have a tandem axle weighing nearly double that of the traditional legal tandem. The weight on the two rear axles of this firetruck is equal to the weight that a dump truck carries on five axles that are spread over 22 feet. Not only is this load much more concentrated than the SHVs, it is almost twice the concentrated load that was used to design the interstate era bridges built in the 1950s and 1960s.

It Gets More Complicated

The majority of Oregon bridges need updated load ratings using the current method of analysis and to account for the new types of heavier vehicles.

The engineering aspect of an analysis can be complicated. In some cases, the plans for older bridges are not available. Instead of being archived, they may have been placed in an unknown location, or inadvertently discarded as office locations and personnel changed. The challenge is that bridge details like the location of reinforcing steel is not known so a load rating is assigned based on the condition and length of the bridge spans.

Another complication is that a basic analysis may show the need for load posting or strengthening when the bridge shows no signs of distress. For these situations, ODOT uses a more advanced analysis to determine the strength of the bridge and then establish the appropriate load rating. If the load rating for a bridge in good condition results in a required load posting or strengthening, we may test the material or perform an on-site load test to determine the strength of the bridge.

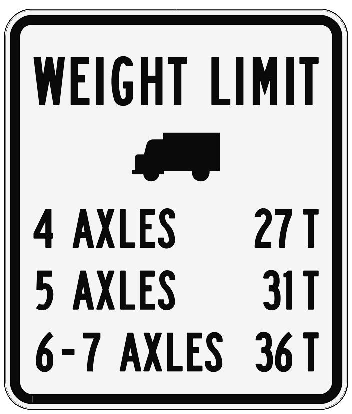
What Happens When a Bridge Can't Carry the Truck Load?

Oregon's economy depends on moving goods efficiently and communities depend on emergency vehicles having ready access to all bridges. Therefore, we make every effort to ensure bridges are safe and reliable. If a load rating indicates that one or more loads exceed the bridge capacity, ODOT uses the under capacity resolution process to address the load rating.

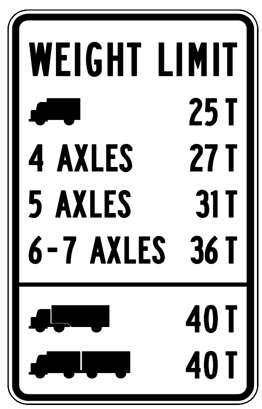
Actions include:

- Coordinating with local agencies, the freight industry and stakeholders including FHWA.
- Monitoring by the region bridge inspector (if not already begun.)
- Reviewing impacts of a load restriction, and determining alternate routes.
- Assembling a response team for state owned bridges and generating an action plan.
- Mobilizing a bridge crew to complete repairs if a bridge cannot be restricted or preparing a contract to either repair or replace the bridge, depending on timing and overall needs.

According to FHWA, if there is no readily available means to address the load rating, the bridge owner must post load restrictions as soon as possible but no later than 30 days after a load rating identifies the need for posting.



An example of a load posting sign for when only SHVs need to be restricted.



An example of a load posting sign for when all legal vehicles, including SHVs, need to be restricted.

ODOT is currently on schedule to meet federal mandates to have all bridges load rated, and if necessary, load posted for SHVs by December 31, 2022. There are many state and local agency bridges across Oregon that have already been load posted for SHVs. ODOT is currently on schedule to have all 160 group 2 bridges load rated by December 31, 2021. As a result of this FAST Act emergency vehicle load rating effort, ODOT has identified 84 bridges that are on or within one road mile of an interstate that will require load postings for emergency vehicles. These bridges will get emergency vehicle posting signs installed by the end of 2021, with a few installations in January 2022.

When load postings for a bridge get down to 15 tons or less, we will use a sign that has a single weight posting for all vehicles, showing the maximum tons allowed on the bridge.

2021 TUNNEL DATA

Tooth Rock Tunnel.

Keeping ODOT tunnels functioning with regular monitoring and timely maintenance is critical to ensure safe passage for all users. In addition, minimizing tunnel closures is critical to prevent hardship for the travelling public in the area served by the tunnel.

ODOT manages nine state owned vehicular tunnels and is responsible for all inspection, maintenance, and major rehabilitation of the structures. ODOT also provides inspection of two pedestrian tunnels that were formerly vehicular tunnels and since 2017, five vehicular tunnels owned by other road agencies.

Tooth Rock tunnel repair.

ODOT has performed inspections on tunnels for more than 20 years. Until 2017 there were no FHWA requirements to inspect or report tunnels. The inspections were done under the authority of the state of Oregon and the inspection program/procedures were devised by the state of Oregon, although they were based on the National Bridge Inspection Standards (NBIS). Under the ODOT program, tunnels were inspected on a two-year regular inspection cycle, with in-depth inspections on a 10-year cycle and ODOT district maintenance crews perform drainage inspections each year.

New National Tunnel Inspection Standards (NTIS) Implementation

In 2017, FHWA instituted a requirement that tunnels be inspected and made public the National Tunnel Inspection Standards (NTIS) for the inventory, inspection and load rating of tunnels. States were now required to report the results of these inspections yearly to FHWA, similarly to the way they are required to report bridge inspection information for the National Bridge Inventory (NBI).

While there are parallels between the data reported for the NBI and NTI, there is one striking difference. The NTI condition data is only element data (the condition of the individual parts of a tunnel, such as the liner, portal, electrical system, etc.) The NBI condition data includes element data as well as ratings of the major components of a bridge; deck, superstructure, substructure and culvert. The NTI has no equivalent to major components, only elements.

The major component ratings allowed FHWA to create a bridge condition rating for the entire structure. However, there is no major component rating for tunnels. Oregon wanted to be able to determine the overall tunnel condition (good, fair or poor). Putting the element condition information together to determine the overall tunnel condition provided a challenge as there is no established national standard.

To classify the tunnel condition with the updated NTI Oregon data, ODOT borrowed a bridge condition parameter termed Health Index (HI) with values ranging from 0 to 100. The HI, in general, incorporates the condition of each element with a weighted average based on the importance of the element to the tunnel and the unit of measurement. The 2021 tunnel condition information that is reported is based on the updated HI method calibrated with a general assessment of the tunnel conditions and engineering judgement.

Tooth Rock Tunnel Floor Repair

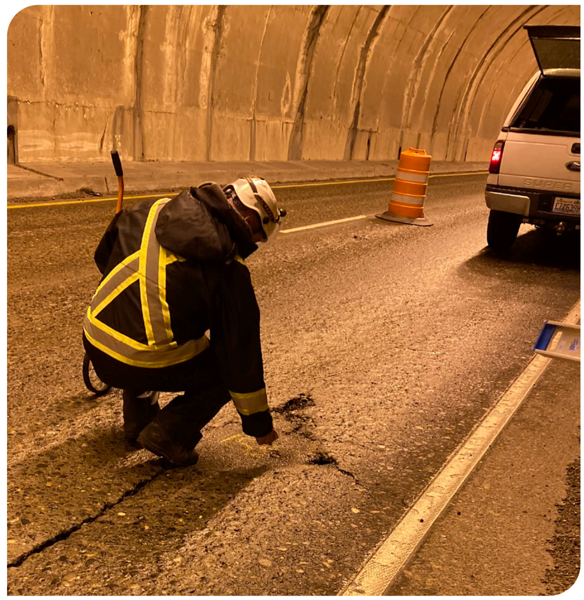
The Tooth Rock Tunnel is an 812 foot long, horseshoe shaped, concrete-lined tunnel built in 1936. It is located at mile point 41.25 on I-84. The east bound lanes of I-84 pass through the tunnel, making it the only tunnel on an interstate in Oregon. In 1966, the vertical clearance in the tunnel was increased by lowering the tunnel floor approximately 4 feet. More recently, a lighting rehabilitation project was completed in the spring of 2021.

The floor of the tunnel is a concrete slab placed directly on the soil/rock subgrade beneath the tunnel. The tunnel floor is heavily rutted, with the most significant ruts being over an inch deep. A section of the floor has settled half an inch at the intersection of the longitudinal joint and a crack approximately 40 feet in from the west portal. This is likely due to voids beneath the slab. Spalls and cracks cause a rough ride.

The Tooth Rock tunnel floor will be addressed as part of the I-84 Multnomah Falls-Cascade Locks project in the 2021-2024 STIP. ODOT will repair ruts by saw cutting both sides of the ruts, grinding between the saw cuts, and placing a layer of concrete. We will address spalls by removing unsound material, preparing the edges with saw cutting, and placing concrete to fill the patched area. Cracked sections will be removed entirely and replaced with reinforced concrete. This repair is expected to last 10 years.

In the future, the entire tunnel floor will need to be removed and replaced. During this time we could lower the floor to increase vertical clearance and improve freight movement. However, because we have the ability to preserve the existing tunnel floor with only minor impacts to users, we decided not to do a full replacement at this time.

Spalling in tunnel floor.



Cracking, patched spalls.

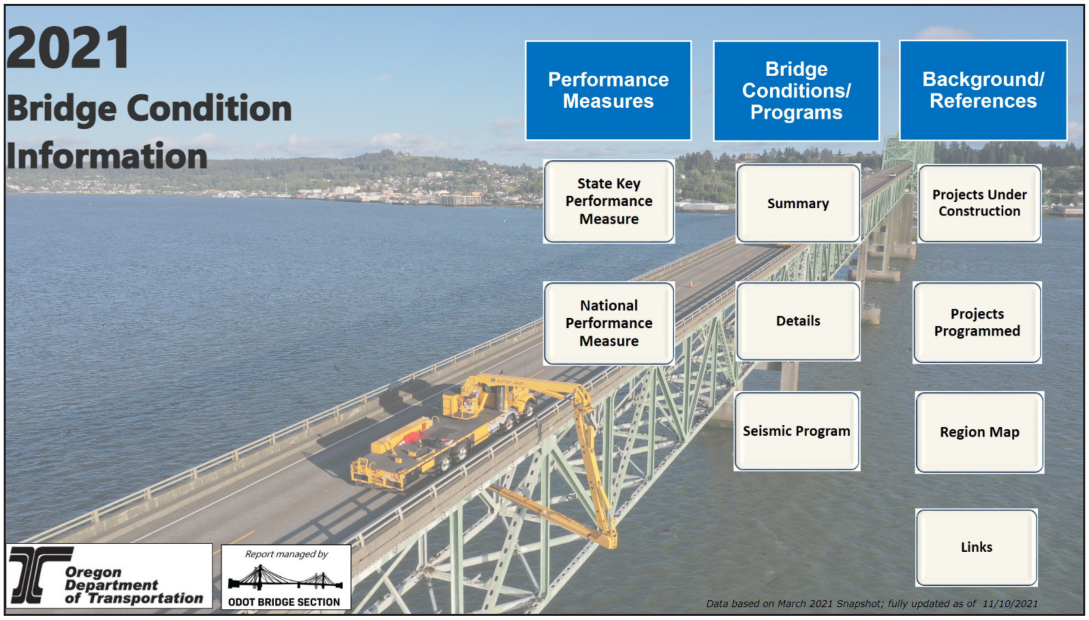
Deep rutting.

Tunnel Conditions

ODOT used the tunnel rating system based on the Oregon NTI element data to capture the data in the following table.

TUNNEL CONDITIONS AS OF FEBRUARY 2021 (based on 2021 FHWA submittal of NTI data)

Region	District	MP	Tunnel	Tunnel Name	Year	Length, ft	Materials	Condition	Owner/Notes
1	22	73.5	09103	Vista Ridge Tunnel, Hwy 47 EB	1969	1002	Reinforced Concrete	Good	ODOT
1	22	73.6	9103B	Vista Ridge Tunnel, Hwy 47 WB	1970	1048	Reinforced Concrete	Good	ODOT
1	23	41.2	04555	Tooth Rock Tunnel, Hwy 2 EB	1936	827	Reinforced Concrete	Fair	ODOT
1	23	20.2	20318	Oneonta Tunnel (Bike/Ped), Hwy 100 at MP 20.15	2008	115	Shotcrete	Closed	ODOT (Pedestrian traffic only)
2	01	35.7	02247	Arch Cape Tunnel, Hwy 9	1937	1228	Shotcrete/ Concrete	Good	ODOT
2	01	40.9	02552	Sunset Tunnel, Hwy 47 (Dennis L Edwards Tunnel)	1940	772	Shotcrete/ Concrete	Good	ODOT
2	05	56.1	02539	Salt Creek Tunnel, Hwy 18	1939	905	Reinforced Concrete	Fair	ODOT
2	05	178.5	03961	Cape Creek Tunnel, Hwy 9	1931	714	Shotcrete/ Concrete	Fair	ODOT
2	05	19.7	07139	Knowles Creek Tunnel, Hwy 62 at MP 19.68	1958	1430	Reinforced Concrete	Good	ODOT
3	07	39.8	03437	Elk Creek Tunnel, Hwy 45	1932	1090	Shotcrete	Good	ODOT
4	09	56.0	00653	Mosier Tunnels	1920	369	Shotcrete	Good	ODOT (Pedestrian traffic only)
Other Agency Tunnels			51C26	W Burnside Tunnel	1940	230	Reinforced	Fair	Portland
			51C32	Rocky Butte Tunnel	1939	400	Reinforced Concrete	Fair	Portland
			25B125	Cornell Tunnel #1, NW Cornell Rd	1940	497	Reinforced Concrete	Fair	Portland
			25B127	Cornell Tunnel #2, (W), NW Cornell Rd	1941	247	Reinforced Concrete	Fair	Portland
			22476	Owyhee Tunnel, Owyhee Lake Rd	1929	200	Rock	Fair	Malheur County



More information is available online through the 2021 Interactive Bridge Condition Report. The report includes detailed bridge condition information by region, county, district and route with tables and an interactive map. The front page of the report is shown above.

Oregon Department of Transportation

2021

Bridge Condition Report & Tunnel Data

Delivery & Operations Division | Bridge Section | https://www.oregon.gov/ODOT/Bridge/Pages/BCR.aspx