Oregon Department of Transportation

2020

Bridge Condition Report & Tunnel Data

Oregon Department of Transportation

2020 BRIDGE CONDITION REPORT & TUNNEL DATA

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EXECUTIVE SUMMARY

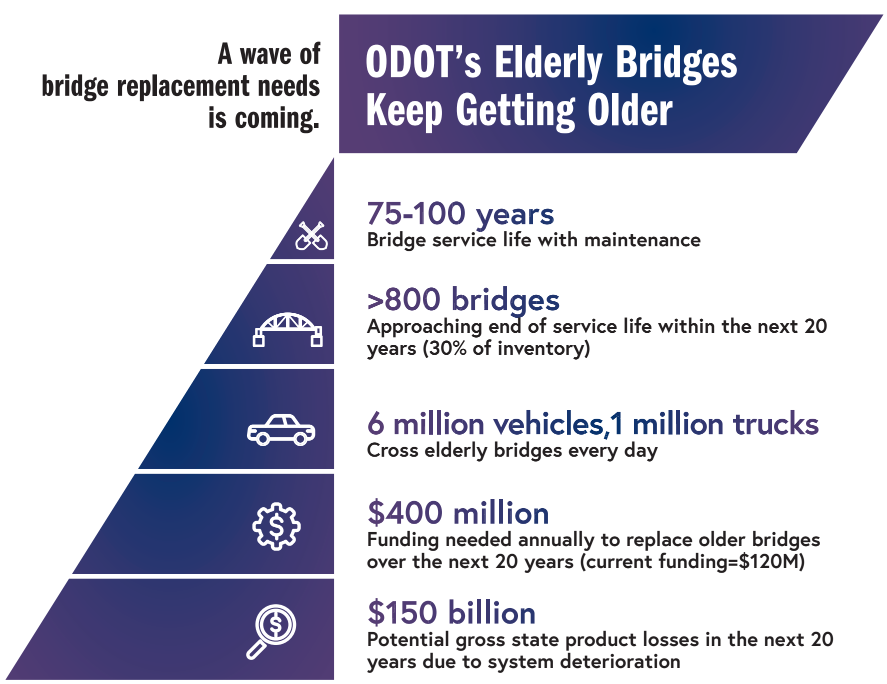
OREGON'S AGING BRIDGES INVENTORY

We all depend on a reliable road network, including bridges. Unfortunately, Oregon's inventory of aging and deteriorating bridges is trending towards eventually becoming unreliable. While ODOT does a good job of maintaining our older bridges to keep them safe, the service life of a bridge is limited.

What can we expect in the future? An aging bridge inventory will mean an increase in short term bridge closures to address unexpected repairs, load postings that limit emergency vehicles or semi-trucks, and worst case, permanent bridge closures. While there are no easy solutions, it is important to understand what is coming in order to make decisions now that can help to manage the decline of bridge conditions on the state highway system.

Nearly 800 bridges in the inventory are greater than 60 years old and can be considered elderly. When constructed these bridges were intended to last 50 years before requiring replacement. Favorable legislation, maintenance practices, detailing, and a focus on repairs in lieu of replacements have all contributed to extending the service life of these bridges to 75 to 100 years. Even with the increase in loads and exposure to salts, many of these older bridges will be able to remain in use with regular maintenance and small repair projects.

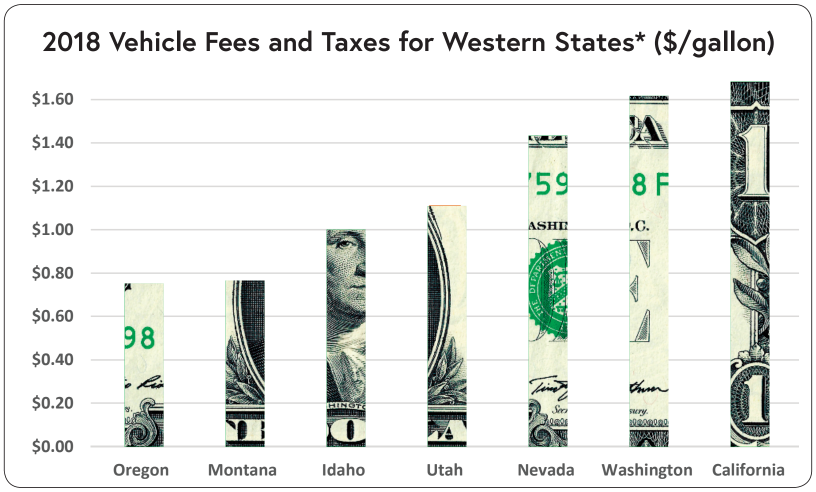
But the bulk of the elderly population presents a much larger problem. The number of bridges that are reaching the end of their service lives and requiring attention far exceeds the available funding needed for repairs and replacement.



WHAT IS THE VALUE OF A BRIDGE TO YOU?

No doubt, all bridges are important in Oregon. But what would you do if the bridge you cross every morning to get to work was suddenly closed? Most likely you would find a detour that would take you to your destination but it would come at a cost of time and added fuel.

What we pay in Oregon vehicle fees and taxes is less than all of our bordering and neighboring states as shown in the graphic below.



**Includes fees, state and federal gas taxes.* *https://www.oregon.gov/ODOT/Data/Documents/auto-tax-comparison-jan-18.pdf*

Right now we are managing a decline in conditions doing what we can with what we have. Some of the decisions we have to make are not the most cost effective but are necessary to keep a bridge in service. Eventually, we will run out of repair options and difficult decisions will need to be made. That bridge that you depend on to get to work may just be the one that has to be load posted or closed because it is no longer safe and funding for repairs has to go to higher priorities. What would you pay for increased reliability in the transportation system – more than you are now?

2020 BRIDGE CONDITION REPORT CONTENT

This year's Bridge Condition Report includes a more detailed discussion around Oregon's aging bridge inventory; updated national and state performance measures and program information for:

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

Tunnel Condition Data is listed for Oregon's 11 tunnels and five other agency tunnels. Last, excerpts from the 2019 Oregon Transportation Asset Management Plan are presented.

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 –
- **VG = Very Good**
- **GD = Good**
- **FR = Fair**
- **PR = Poor**
- **VP = Very 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.

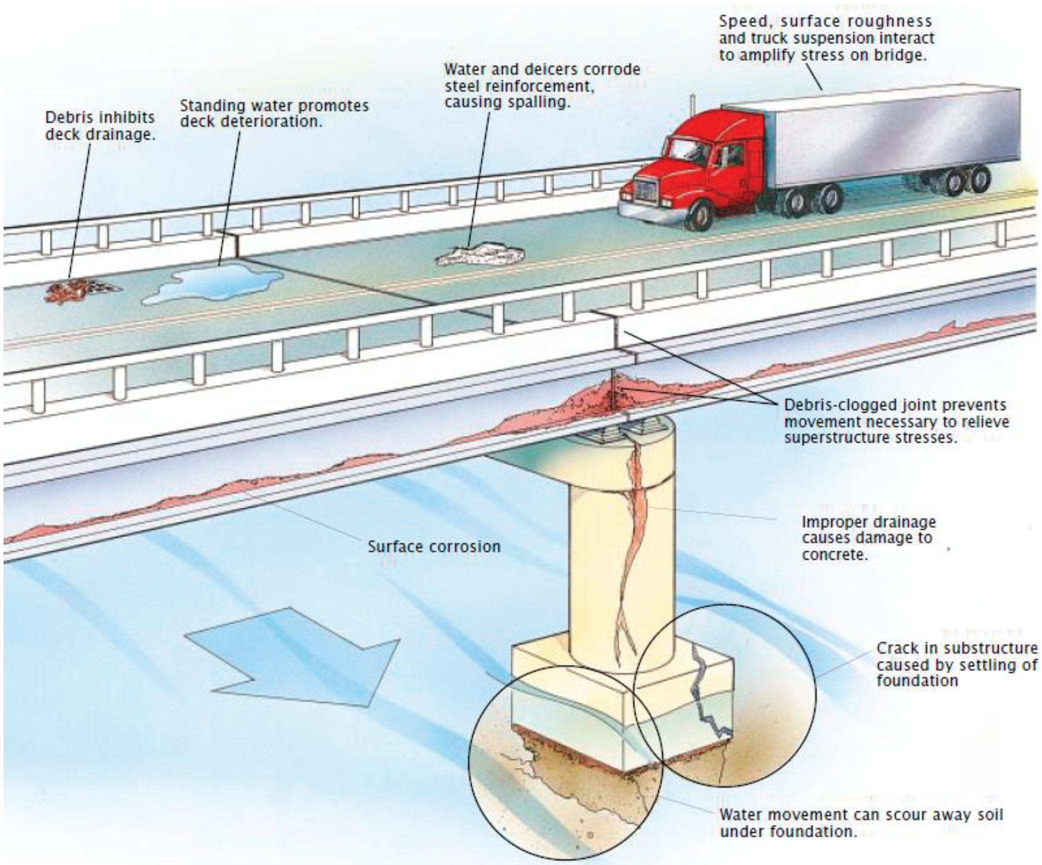
A classification of "structurally deficient" does not imply that bridges are unsafe. When an inspection reveals a safety problem, the bridge is posted for reduced loads, scheduled for repairs, or in unusual situations, closed until repairs can be completed. Structural deficiency is one of the many factors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

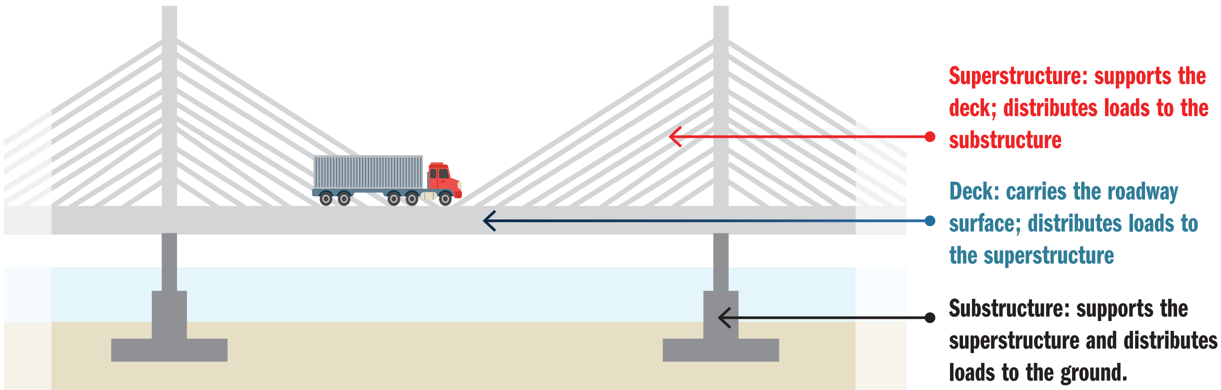


Adapted from "Why America's Bridges are Crumbling," by K.F. Dunker and B. G. Rabbat, 1993, March, Scientific American, 268, no. 3, p. 69. Permission for use courtesy of Jana Brenning, illustrator.

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 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. 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.

OREGON'S AGING BRIDGE INVENTORY

We all depend on a reliable road network, including bridges. Unfortunately, Oregon's inventory of aging and deteriorating bridges is trending towards eventually becoming unreliable. While ODOT does a good job of maintaining our older bridges to keep them safe, the service life of a bridge is limited.

What can we expect in the future? An aging bridge inventory will mean an increase in short term bridge closures to address unexpected repairs, load postings that limit emergency vehicles or semi-trucks, and worst case, permanent bridge closures. While there are no easy solutions, it is important to understand what is coming in order to make decisions now that can help to manage the decline of bridge conditions on the State Highway system.

What is Service Life?

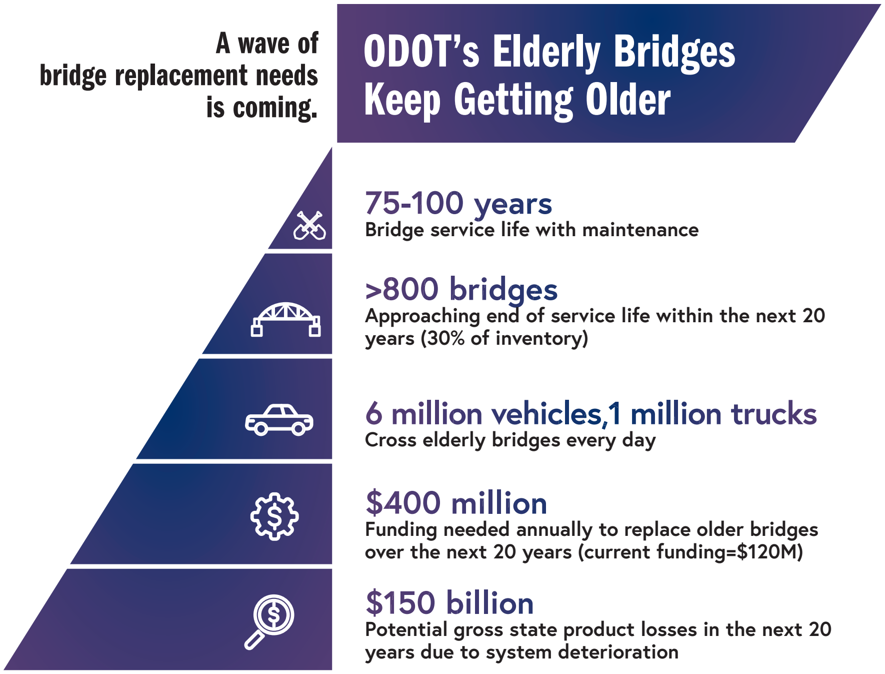
It can be difficult to visualize what it means when engineers refer to bridge service life, maintenance, repairs, or even deterioration. A great analogy is to look at bridges in the context of owning a car. Both bridges and cars require routine maintenance to maximize how long they can be used. As they get older the operation of each becomes less reliable and repairs become more costly.

At some point the owner will have to decide if repairs are still cost effective or if it is time to consider a replacement. The length of time the car/bridge can be kept in operation is the service life. The end of service life is when it is no longer economical or feasible to perform repairs and replacement is the only viable option. For cars, this is often when the engine or transmission requires replacement. For bridges this can be when the deck requires rehabilitation or replacement.

Aging Bridges

Bridges in Oregon tell a great story of how to extend the life of bridges. Nearly 800 bridges in the inventory are greater than 60 years old and can be considered elderly. When constructed these bridges were intended to last 50 years before requiring replacement. Favorable legislation, maintenance practices, detailing, and a focus on repairs in lieu of replacements have all contributed to extending the service life of these bridges to greater than 75 years. Even with the increase in loads and exposure to salts, many of these older bridges will be able to remain in use with regular maintenance and small repair projects. But the size of this population built during the 1950's and 1960's presents a much larger problem.

As the bridges age and approach the end of their service lives, the size and frequency of repairs increases. Many bridges have already had substantial repairs completed and are due for more in the near future. Repair projects on old structures can be costly and have little return on the investment. That means, from an economic analysis would determine that a bridge replacement is the smartest long term investment. However, with bridge inventory needs exceeding available financing, few replacements can be funded. There is little choice but to divert maintenance funds to repair the bridge and keep the route open. The number of bridges that are reaching this condition can be visualized as a wave and the number of these bridges far exceeds the available funding.



Resuscitated Bridges

Because there isn't enough funding to replace bridges, many poor condition bridges are repaired as mentioned above and *resuscitated* (restored from poor to fair) so they can remain in service. ODOT is very conscientious about maintaining a safe and reliable bridge network. Bridges that have significant defects will be flagged for urgent repairs which often result in improving the bridge condition just enough to move it out of poor condition and back to fair.

While these bridges are safe, they will continue to have underlying issues that result in a cycle of needed repairs or resuscitations.

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

Resuscitated bridges are often timber bridges with failing timber piles. Maintenance responds by shoring up the bridge and repairing the timber with a steel pile. Over time, more timber piles will continue to deteriorate requiring more repairs. It is not unusual for a timber bridge to be resuscitated every couple of years. These bridges should be replaced, however, due to funding constraints and higher priorities, they are often passed over.

ODOT averages about 12 resuscitated bridges per year. The majority of the needs are for the substructure, however, in some cases the need is with the deck or superstructure. Resuscitated bridge work has resulted in a large number of bridges categorized as fair, but with a higher risk for quickly deteriorating back into poor condition. As the bridge inventory conditions continue to decline, the number of needed resuscitations will further strain ODOT's maintenance forces. Without funding for sustainable replacements, this will eventually lead to bridge restrictions and closures on routes other than prioritized Fix-It, NHS or freight routes.

Historic Bridges

The car/bridge analogy referred to in the bridge service life section can be expanded to include classic cars and historic bridges. Both are maintained to last indefinitely because there is no replacement option that could match the original. Several bridges in Oregon's inventory are iconic with great historic value. ODOT works diligently to preserve them with timely work.

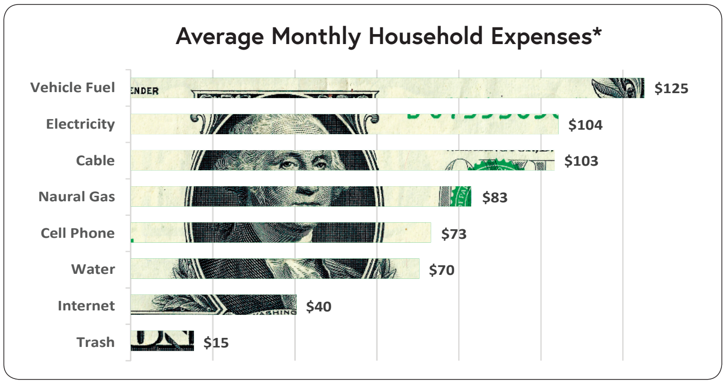
There is a one big difference, however, between classic cars and bridges. Classic cars can be protected from the weather and used infrequently. Shielding a bridge from environmental conditions and minimizing use is not possible so a significant share of ODOT's bridge program funding goes to maintaining these bridges using techniques like cathodic protection and regular painting for steel structures.

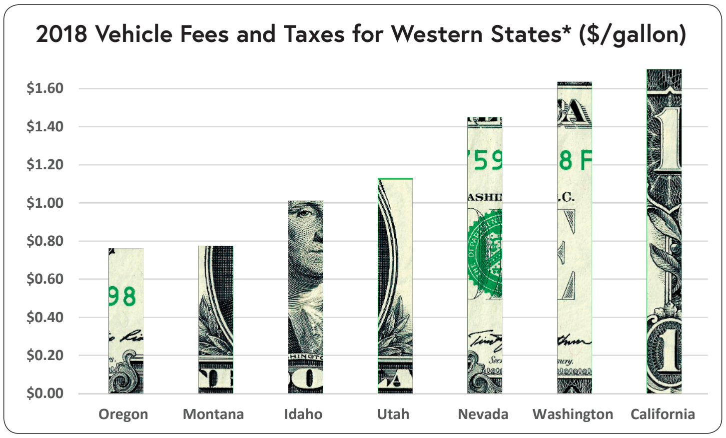
Historic bridges are a priority for bridge work and as these bridges also continue to age, requiring more intensive work, bridge program funding will be further stretched to meet the needs of the entire inventory.

What is the value of a bridge to you?

No doubt, all bridges are important in Oregon. But what would you do if the bridge you cross every morning to get to work was suddenly closed? Most likely you would find a detour that would take you to your destination but it would come at a cost of time and added fuel. So what's it worth to not be delayed in relation to other items we choose to spend our money on?

According to an internet mortgage website, average monthly household expenditures for 2018 are shown below. The cost of fuel at $3/gallon is included assuming a household uses 500 gallons of gas a year to go 11,000 miles (22 miles/gallon). At this rate, the cost of fuel is at the top of expenditures for a household, but not by much.
**https://www.creditdonkey.com/average-utility-bills.html*





**Includes fees, state and federal gas taxes. https://www.oregon.gov/ODOT/Data/Documents/auto-tax-comparison-jan-18.pdf*

A conservative estimate for the cost of delay of a person traveling on their own time in their own vehicle is about $12/hour. It is much more if the travel is during work hours. *https://ops.fhwa.dot.gov/wz/resources/publications/fhwahop12005/sec2.htm*

Would it be worth an additional $12/month to you to reduce the chances that you are delayed? That $12/month spread out equates to an increase of $0.29/gallon which seems like a lot but compared to all of the other household expenses listed, is really a bargain. Fuel fees and taxes pay for clearing traffic crashes, patching potholes, repaving roadways, snow removal, replacing deteriorated roads and bridges, and installing traffic safety features to protect drivers. That $0.29/gallon would increase the Oregon gas tax by 85% which would be a significant increase in transportation funding.

What we pay in Oregon vehicle fees and taxes is less than all of our bordering and neighboring states as shown in the graphic above. Even with adding an additional $0.29/gallon we still would be below most of the western states.

What would you pay for increased reliability in the transportation system? Maybe $0.29/gallon ($144/year) isn't the right number but it does provide an order of magnitude. Right now we are managing a decline in conditions doing what we can with what we have. Some of the decisions we have to make are not the most cost effective but are necessary to keep a bridge in service. Eventually, we will run out of repair options and difficult decisions will need to be made. That bridge that you depend on to get to work may just be the one that has to be load posted or closed because it is no longer safe and funding for repairs has to go to higher priorities.

2020 BRIDGE CONDITIONS

> **IN 2020, ODOT REPLACED FOUR BRIDGES.**

ODOT's 2020 Bridge Condition Report summarizes bridge condition ratings on state highways and performance measures based on National Bridge Inventory 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 2020 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.

Inventory Changes

ODOT currently manages 2,760 bridges. This year, four new bridges were added to the inventory. Two of the bridges were replacements of deteriorated bridges and two were replaced to provide seismic resilience. Other additions to the inventory were the result of jurisdictional changes and dividing the Yaquina, McCullough and Astoria-Megler bridges into segments for inspection purposes.

With only four new bridges added to the inventory, 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.

4 Bridge Replacements

2 Bridges: To improve function

2 Bridges: Based on condition

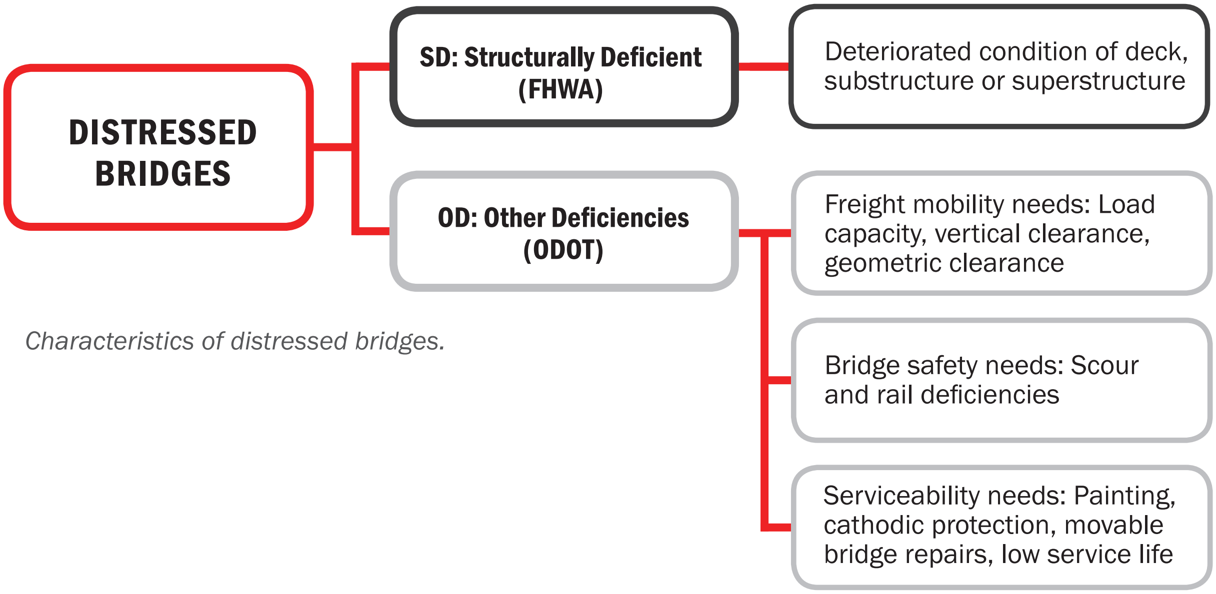
Bridge Key Performance Measure

(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.

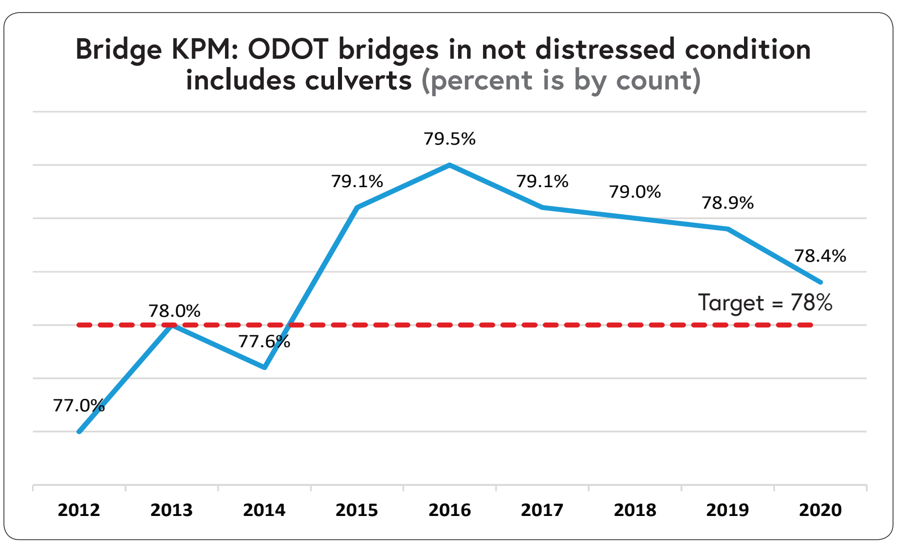
A condition of distressed indicates that the bridge is rated as structurally deficient or has at least one *other deficiency*. ODOT considers both structurally deficiency and *other deficiency* aspects in determining bridge needs and selecting projects for the Statewide Transportation Improvement Program.



Characteristics of distressed bridges.

For 2020, the Bridge KPM equals 78.4% indicating a 0.5% drop from 2019 exceeding the target of 78%. While the KPM indicates that bridge conditions exceed the target, 2020 marks the fourth year of a measurable decline.

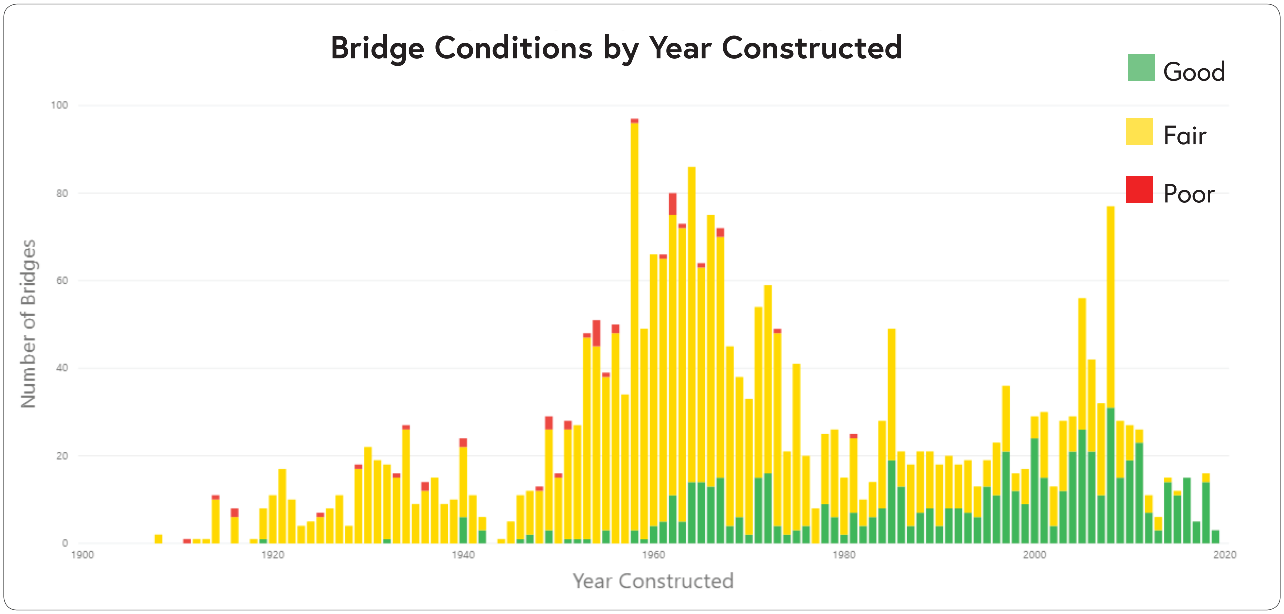
The number of bridges with other deficiencies fluctuates with time due to bridges being repaired where a deficiency is removed or deteriorating where a deficiency is added. Notable deficiency increases, however, were observed in two categories. First in the low service life deficiency which captures 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 is above optimal bridge capacity.



ODOT bridges Not Distressed condition. Larger percentages are better.

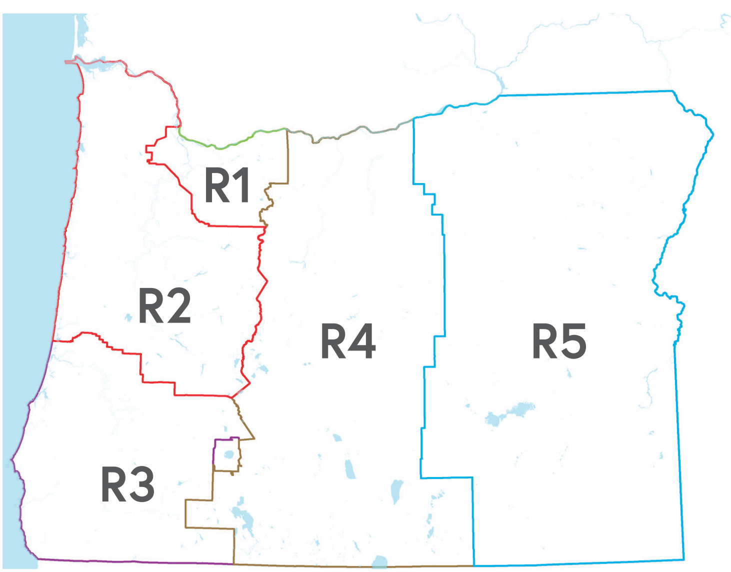
> **"CURRENT EVALUATIONS INDICATE A DECLINE IN BRIDGE CONDITIONS FOR THE FOURTH STRAIGHT YEAR."**

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 1960's (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.

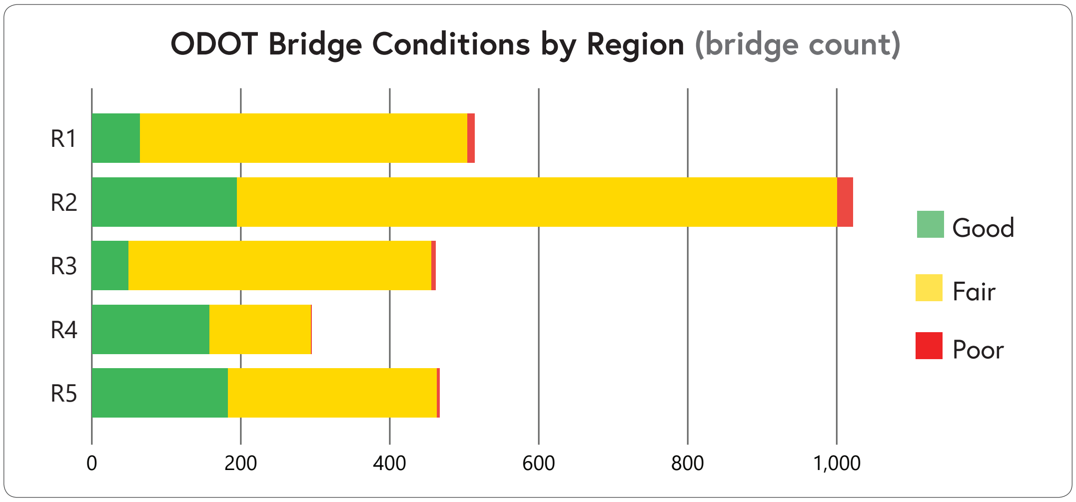


Bridge Conditions By Region

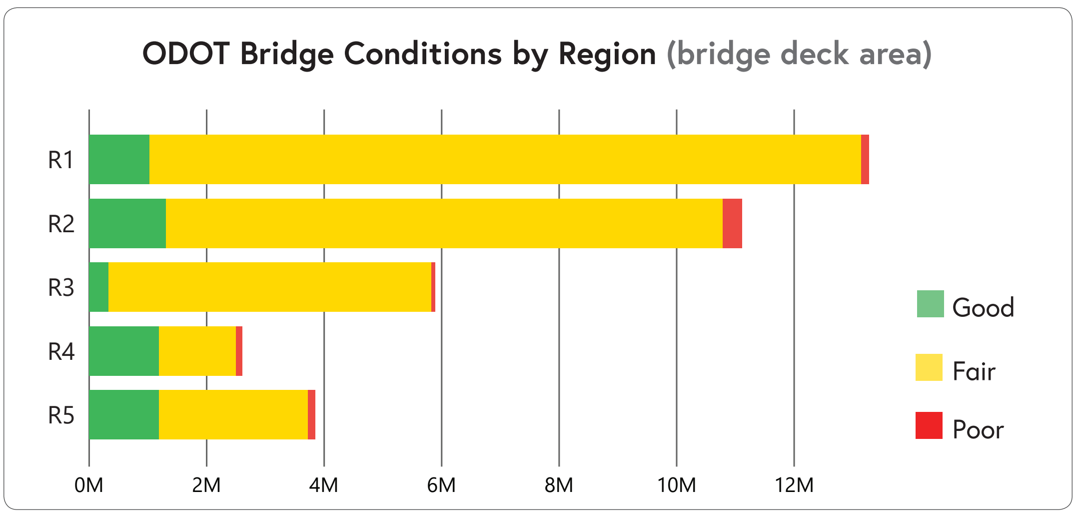
The distribution of bridges by bridge count and deck area are shown in the two graphics following for comparison. Region 1 which includes the Interstate Bridge over the Columbia, the Marquam and Fremont bridges over the Willamette in downtown Portland has more deck area than Regions 3, 4 and 5 combined.



While the bridge system includes only 42 bridges in poor condition (structurally deficient), bridge conditions are slowly declining as noted by the Bridge KPM.



ODOT bridge conditions by count.

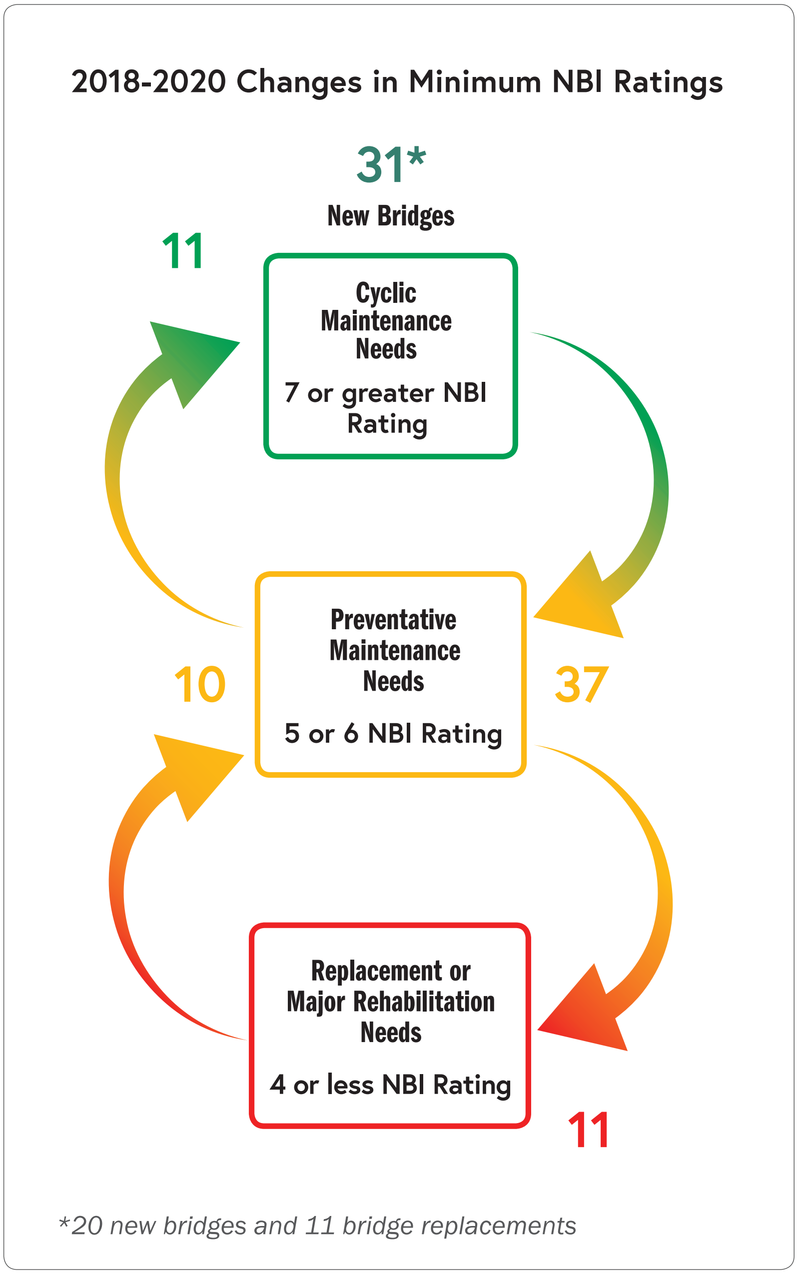


ODOT bridge conditions by 1,000 square feet of deck. Note that Region 1, which includes the Portland Metro area, includes the greatest quantity by bridge deck area.

2018-2020 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 2018 to 2020 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).

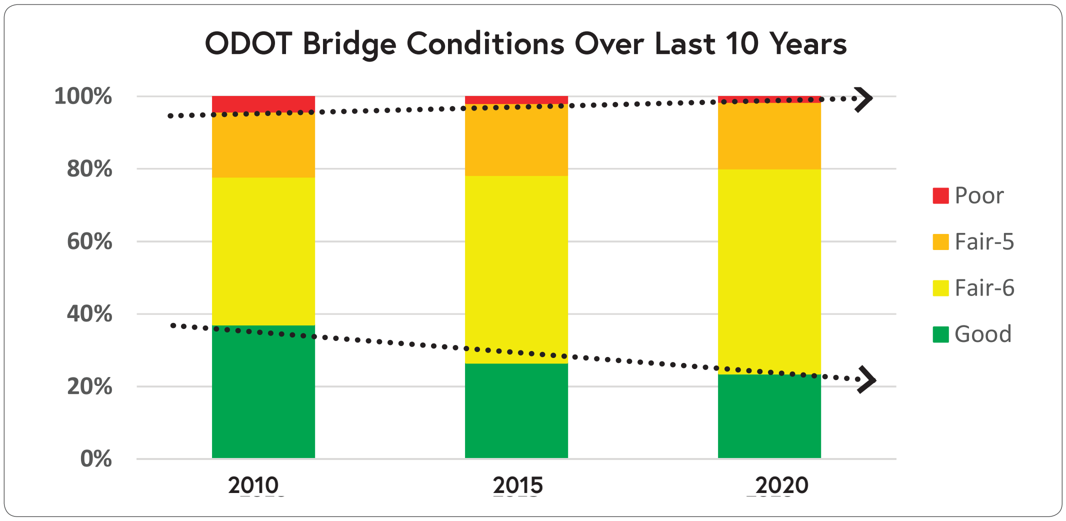
The chart shows that we are managing the Poor (Red) bridges reasonably well, but the number of bridges moving from Good (Green) to Fair (Yellow), indicates that bridge preventative maintenance actions are not occurring at a rate necessary to maintain current conditions. Overall in the last two years, 48 bridges had lower (declining) overall condition ratings versus only 21 bridges with higher (improved) condition ratings.



> **"MORE THAN TWICE AS MANY BRIDGES HAD DETERIORATING CONDITIONS THAN BRIDGES WITH IMPROVING CONDITIONS."**

Condition Changes Over The Last 10 Years

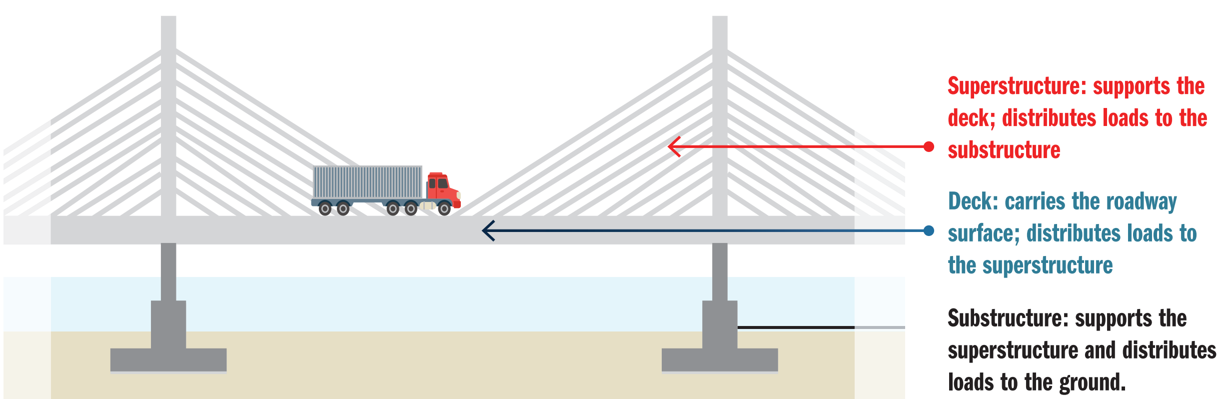
An overall assessment of bridge condition changes can be determined by comparing previous to current NBI ratings. The chart below provides the percentage of bridges in good, fair and poor condition in the last ten years. Bridges are classified as fair if the NBI value is 5 or 6, however, a value of NBI=5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



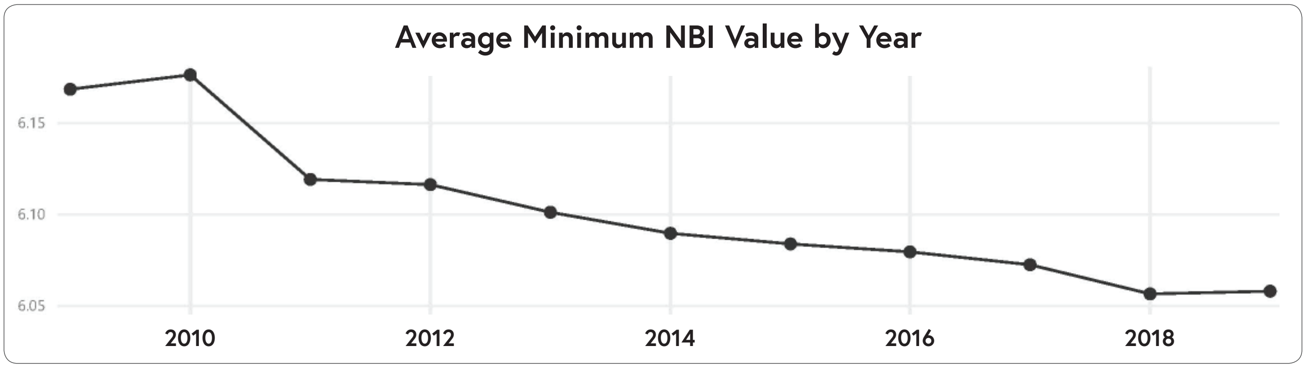
Of concern is the increasing number of bridges moving out of good condition into fair condition. The population of fair bridges continues to age and will require more and more rehabilitation and maintenance over time. Many fair condition bridges have already exceeded their service life but remain in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

Substructure Conditions Deteriorating

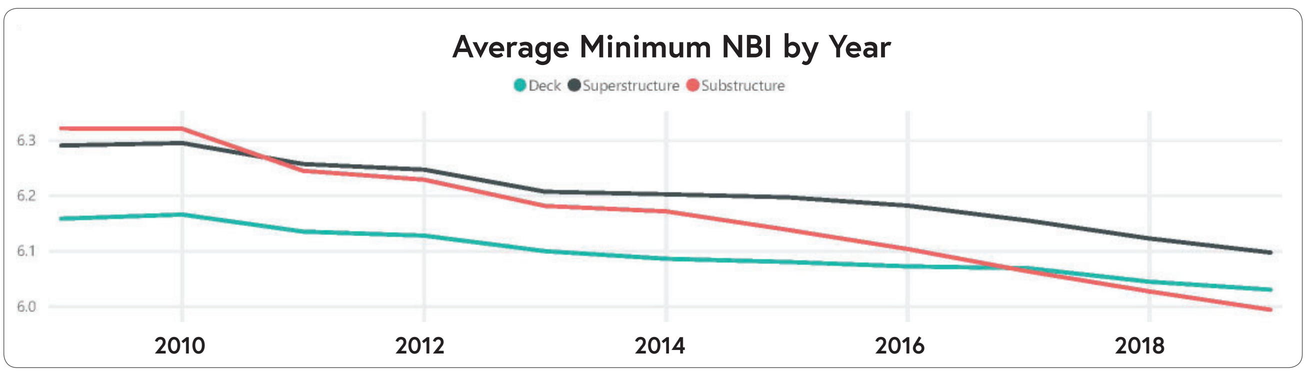
The NBI value is a simplified measure of bridge conditions, reflecting only the lowest of the superstructure, deck and substructure conditions. To get a clearer picture of bridge condition changes over time, FHWA submittal data was pulled for 2009 to 2019 to compare the overall, deck, superstructure 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 2019, 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.

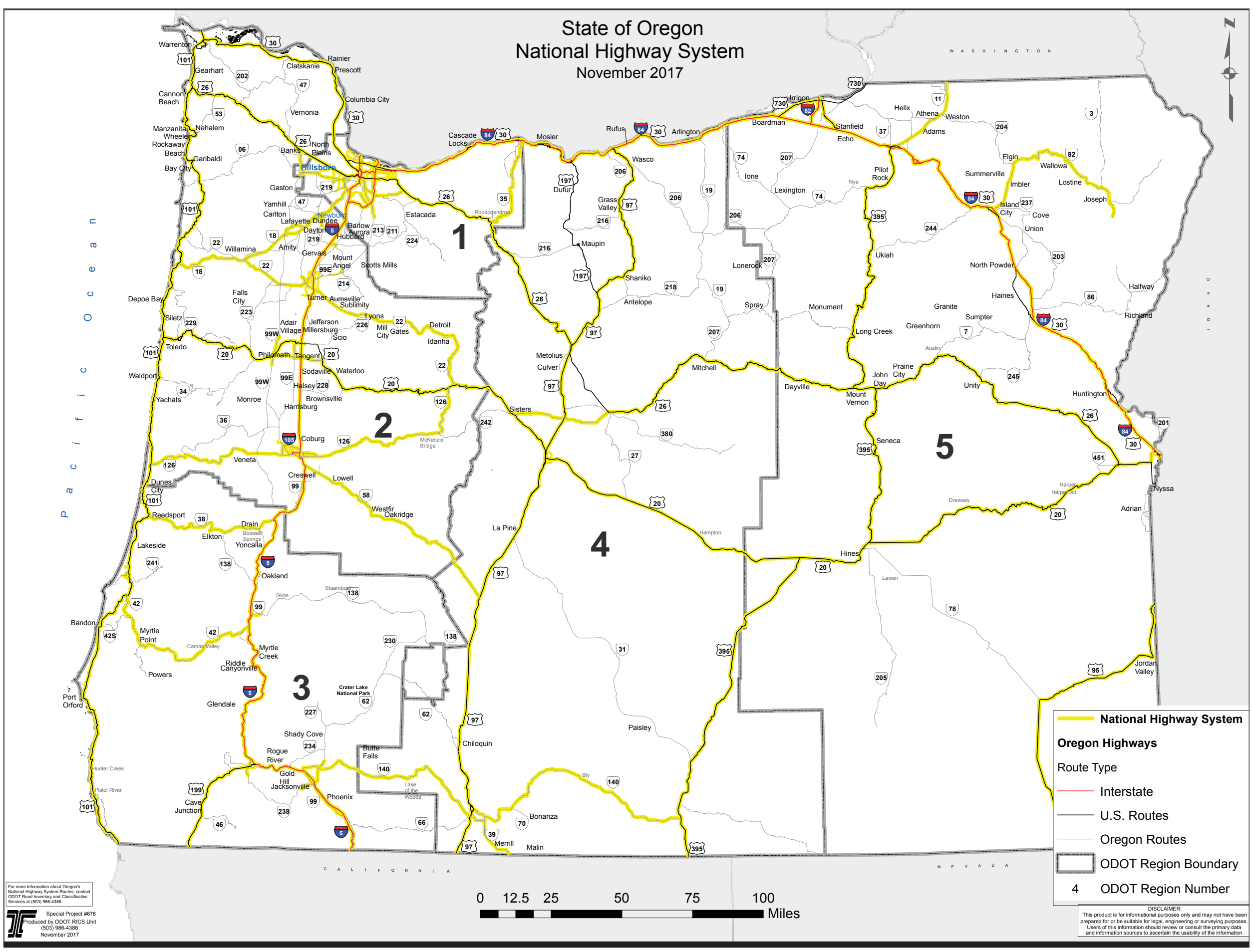
NATIONAL BRIDGE PERFORMANCE MEASURE

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

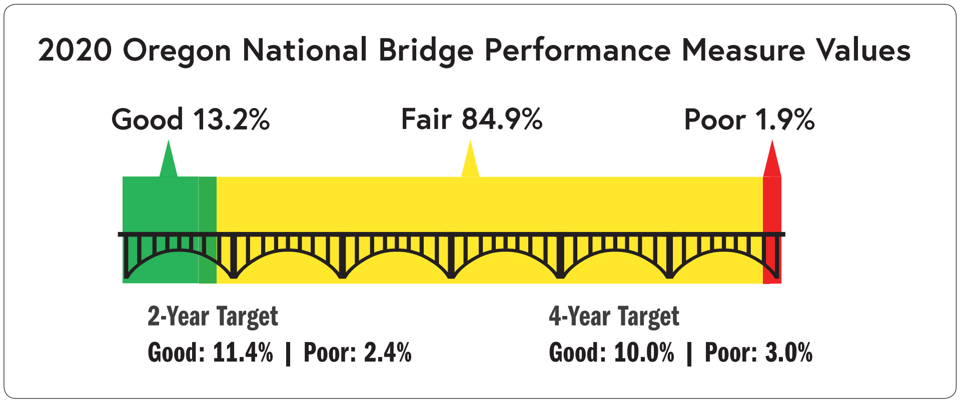
2. Percent of NHS bridges by deck area classified as in Poor condition



National Highway System

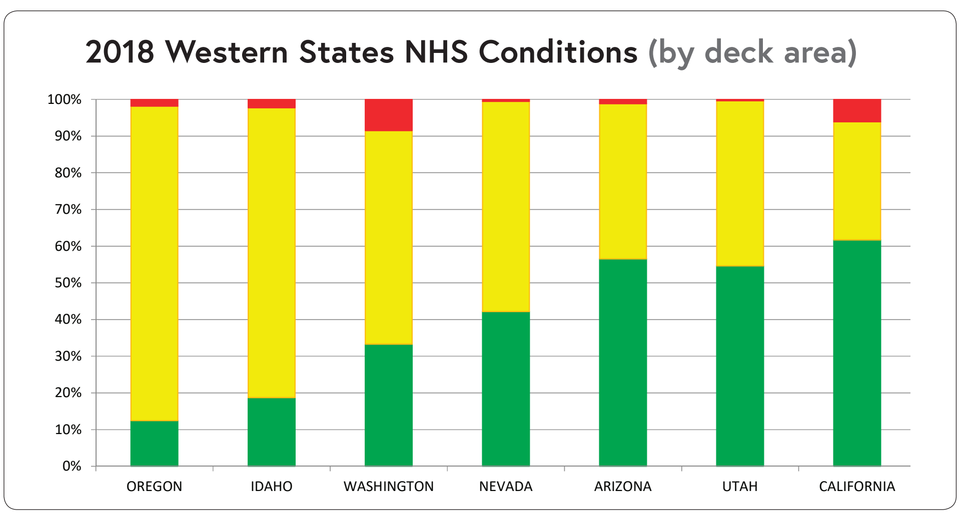
National Bridge Performance Measure Details

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 2018 to 2019 and remained relatively flat from 2019 to 2020. The measured improvement can be attributed in part to newly constructed bridges added to the inventory as a result of modernization projects.



Oregon's NHS bridge conditions and 2 and 4 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.

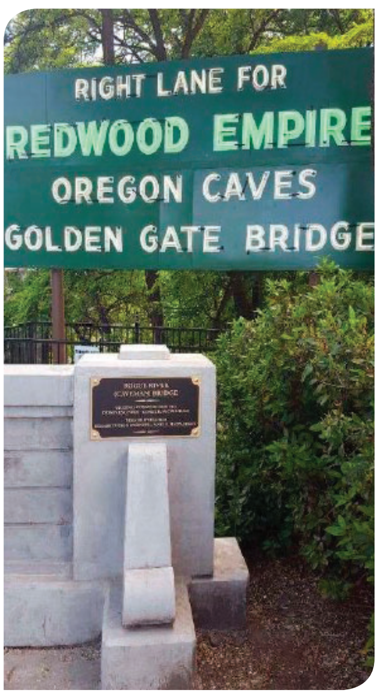
Compared to neighboring states, Oregon has the least quantity of NHS bridges in good condition. The graph shows Northwest states' bridge conditions using 2018 data submitted to FHWA. While Oregon ranks among the best for the least percentage of poor bridge conditions, it includes the smallest percentage of bridges in good condition as a result of few bridge replacements.



The NPM 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

		FOCUS
1	Major Bridge Maintenance	► Funding ► Accomplishments ► Repair of Older Bridges
2	Bridge Preservation	► Cathodic Protecting Background ► Devils Lake Outlet ("D" River) Bridge Story ► History of Success and Replacing Anodes
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 cathodic protection.

1 Major Bridge Maintenance

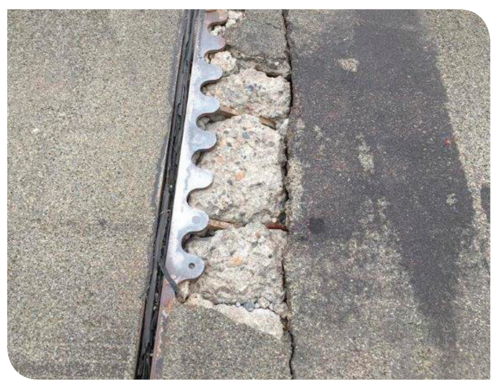
In 1990, the state of Oregon established the Major Bridge Maintenance (MBM) Program, to specifically address major and emergency bridge repairs. These repairs are typically large enough to be outside the scope of work that can be funded at the district level, but are too small or can't wait to be included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

- Approximately 200 projects are selected annually.
- Starting in 2018, funding increased to $10,000,000/year.
- Starting in 2022, funding will increase to $12,000,000/year.

Significant effort goes into deck treatments as the deck is typically the highest value item on a bridge. 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 to the level of the reinforcing steel. Once the reinforcing steel begins to corrode costly deck rehab or replacement will be required.

Typical Distresses Addressed by MBM

Failed Deck



Damaged Bridge Joint

Distressed Timber

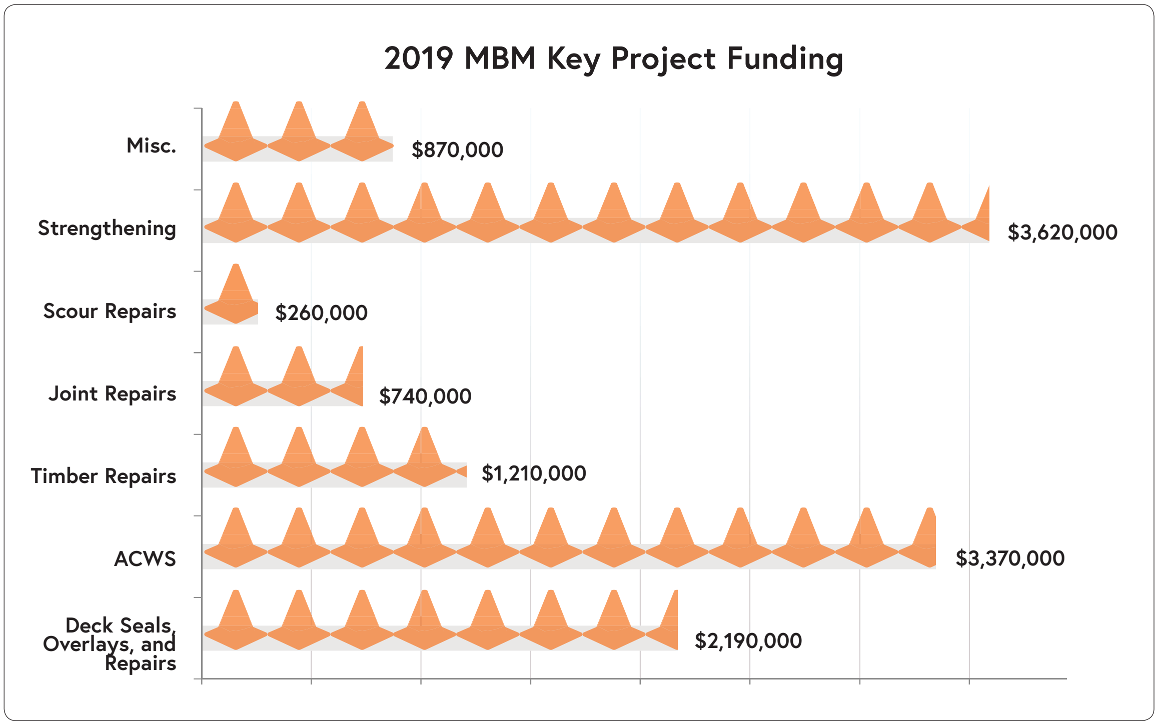
Foundation Scour

2019 MBM Project Accomplishments

In 2019, five structurally deficient bridges were repaired through the MBM program to maintain their serviceability. In addition, 49 bridges with urgent or high priority needs were repaired. 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.

A detailed list of MBM expenditures is provided in the graphic below which now includes strengthening projects. Thirteen bridges were calculated to have insufficient strength to support modern truck weights so were strengthened as part of the MBM program.

On-going efforts are underway to update the load carrying capacities of existing bridges. As more bridges are evaluated for capacity, more strengthening projects will be needed in order to avoid load postings or closures. More details on ODOT's load rating efforts are included in the 2019 Bridge Condition 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 must be corrected. See the discussion on resuscitated bridges provided earlier in this report. 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. This cycle has been termed the "worst-first" approach. 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.

South Yamhill River Timber Bridge (3-Mile) Repairs

During an inspection of the in June 2020, one of the pile caps was found to have begun to crush under traffic. The cap had been monitored in the hopes that the scheduled bridge replacement project would be completed before the cap needed to be replaced. Unfortunately, the pile cap replacement became an "urgent" need and was replaced by maintenance later in the summer.

This bridge has required a lot of recent repairs to limp it to replacement; 16 piles in 2018, 2 caps and 2 piles in 2017, 7 piles in 2016, 2 piles in 2013, 1 cap in 2007 and 7 caps in 2006. Most of the listed repairs were required to keep the bridge open. The bridge is a great example of the risk associated with managing these older timber bridges and the challenge of maintenance to keep up. The South Yamhill River Bridge is a good example of a resuscitated bridge. Pictures from the recent "maintenance" work is shown below.

Deteriorated timber cap

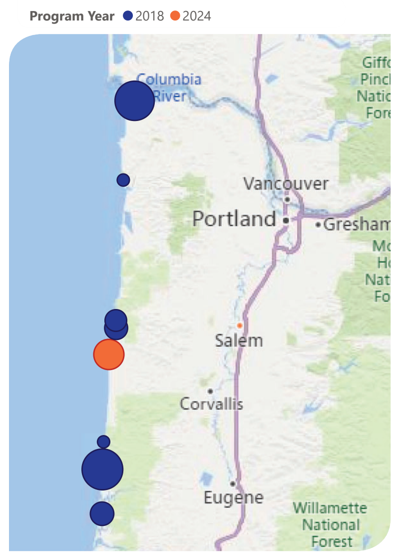
Scaffolding in place to repair bridge

2 Bridge Preservation: Cathodic Protection of Concrete Bridges

Coastal Bridge Preservation Comes in Waves

Timing is everything when it comes to bridge preservation especially for coastal bridges. And when a concrete coastal bridge starts to show signs of corrosion, it's time to step in and replace or install a cathodic protection system. Right now eight bridges with cathodic protection work are underway.

Bridge Projects with Cathodic Protection
(circle size represents relative cost)



A Bit of Background

To understand cathodic protection, it's important to first realize what happens without it. Bridges along the coast face extreme conditions in comparison to the valley or high desert of Oregon. When a concrete bridge is exposed to high levels of salt water, the salt can migrate through the concrete coming in contact with the reinforcing steel creating a chemical reaction that is corrosion. The rust formed as a result of corrosion takes up more space than the steel forcing the concrete to crack and eventually break away or spall. Not a good thing for priceless Oregon Coast bridges.

Enter cathodic protection -- a cost effective technique used to preserve our high value concrete coastal bridges. In some cases, bridges initially planned for replacement due to corrosion have been preserved with cathodic protection. Although a bridge replacement would provide more than 75 years of service, for less money cathodic protection can extend the life about 30 years, allowing Bridge Program funds to be expended on other needs.

Cathodic protection allows the reinforcing steel to resist the corrosion from salt by supplying electric current to the steel. This creates a chemical reaction that pushes salt away from the steel toward an anode (like zinc). The zinc may be sprayed on as a coating or pucks may be embedded in the bridge concrete and connected to the steel through wiring. The zinc corrodes and is sacrificed (termed a sacrificial anode), in order for the steel to remain intact.

The cathodic protection costs for the eight bridges is about $40,000,000 which is about 10% of the bridge replacement value. While that might seem like a lot of money, many of the bridges are iconic, beautiful bridges that are irreplaceable like the Siuslaw River Bridge shown on the left.

Devils Lake Outlet ("D" River) Bridge Story

A good example of bridge preservation with cathodic protection is the Devils Lake Outlet Bridge, located in Lincoln City on US101. The bridge was constructed in 1949 and now carries close to 25,000 vehicles a day. Due to condition issues, the bridge was originally identified for replacement back in 2007. Bridge replacement would have been expensive and problematic since there is no feasible detour location. That section of US101 normally backs up under summer traffic, imagine if part of the highway was closed for an extended time. Looking at options to address the bridge, it quickly became clear that the bridge could be preserved at a lesser cost with less traffic impacts using cathodic protection.

In addition to protecting the concrete with cathodic protection, the bridge is also being strengthened to meet today's freight demands. The girders on the span over "D" River are receiving additional reinforcing bars and concrete, and the deck is having titanium reinforcement added just below the roadway surface over the piers. Believe it or no, using titanium is the most cost effective solution because far fewer bars are needed to reach the same strength. A stronger overhang and stronger railings are being installed. An open 3-tube design was chosen because the area is scenic. A durable polyester wearing surface is being placed to protect the investments from traffic and rainwater seeping through any cracks that might exist in the deck.

"D" River Bridge before strengthening repairs

After some strengthening repairs completed

Please note the wood section in the left picture is helping keep the working deck steady, not holding up any concrete. The work is completed in sections to avoid the need for temporary shoring while traffic flows overhead.

Applying cathodic protection will ensure no widespread corrosion occurs over at least the next two decades.

Aging Anodes

A cornerstone of the Cathodic Protection program is the use of anodes, designed to provide bridge protection for 25 years. With the cathodic protection program approaching 30 years of implementation, there are several successful systems that have reached the end of their service life.

The Cape Creek Bridge pictured below was the first bridge to have a zinc anode system installed in 1991. The bridge is in excellent shape, but the corroded anode was peeling away from the bridge before a 2018 project that is scheduled to be completed in late 2020.

Cape Creek Bridge

Cape Creek Bridge lasted 29 years with little maintenance other than the electronic maintenance of the power systems necessary to provide cathodic protection. Currently, very little concrete repair is needed because cathodic protection has kept the bridge in such good condition.

The Yaquina Bay Bridge is also under contract to have its anode replaced on both the north and south approaches. The north approach had an experimental graphite anode installed in 1987 on spans 2 and 3 but none on spans 4 and 5. The power supply was damaged before the anode peeled away from the concrete, but even after not being operated for several years, the difference in condition shows how well cathodic protection protects the structure from corrosion damage. The project will repair and place anode on spans 4 and 5.

Yaquina Bay Bridge Span 2

Yaquina Bay Bridge Span 4 Corrosion Damage

Anode replacement projects are also planned on:

- Depoe Bay Bridge (19-21 STIP Shelf Project)
- Rocky Creek (Ben Jones) Bridge (21-24 STIP)
- Rogue River (Isaac Patterson) Bridge (Phase I, 21-24 STIP)
- Rogue River (Isaac Patterson) Bridge (Phase II considered for 24-27 STIP)
- Cummins Creek Bridge (Considered for 24-27 STIP)

Since little concrete repair is needed when cathodic protection is renewed on a regular schedule the construction costs can be as much as 25% lower than the initial application of cathodic protection, further reducing the annualized rate compared to replacement cost of the bridge. However, each time the anode is replaced a small amount of cement is removed. A slurry coating may be needed before a 3rd round of anode is installed which would likely make the overall project costs similar to when the bridges were first repaired.

Rocky Creek (Ben Jones) Bridge Courtesy The Library of Congress

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 the phasing is to retrofit all seismically vulnerable bridges and address unstable slopes on key lifeline routes in a strategic and systematic program to allow for rescue and recovery following a major earthquake.

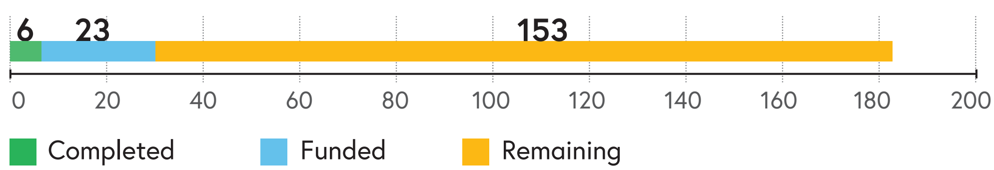
Additional funding to address seismic improvements related to highways and bridges is included with the HB 2017 transportation package at about $10M/year. With the new funds, ODOT planned to work on Phase 1 bridges moving from Eugene, north on I-5 and finishing up on I-84 moving from east to west in 20 to 30 years. After determining that the current seismic retrofit and replacement costs are much higher than the original planning level estimates made in 2014, 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.**

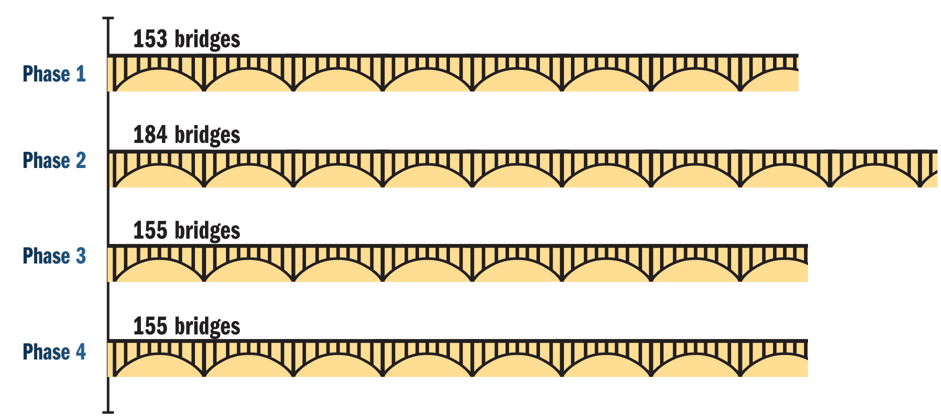
ODOT Phase 1 Seismic Routes

Phase 1 Bridges Remaining:

Estimated Cost $600 M

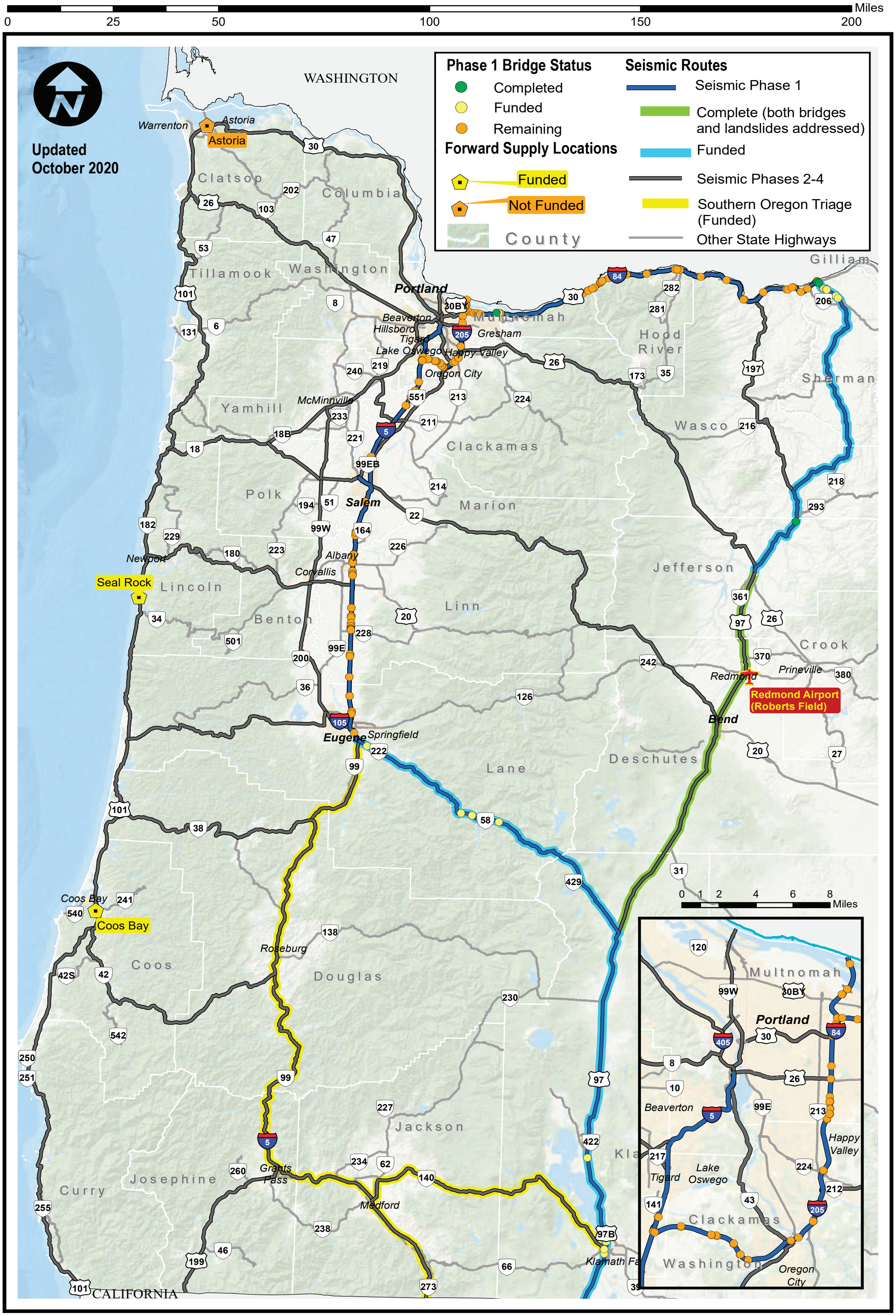


Seismic Bridges Remaining by Phase



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

ODOT Phase 1 Seismic Routes



Seismic Strategy Update

Based on the current estimated costs, it would take decades to complete Phase 1 of the Seismic Plus Program at which time many of the bridges that were initially retrofitted would be reaching the end of their service life. Also, to address seismic resiliency bridges still in relatively good condition would need to be replaced.

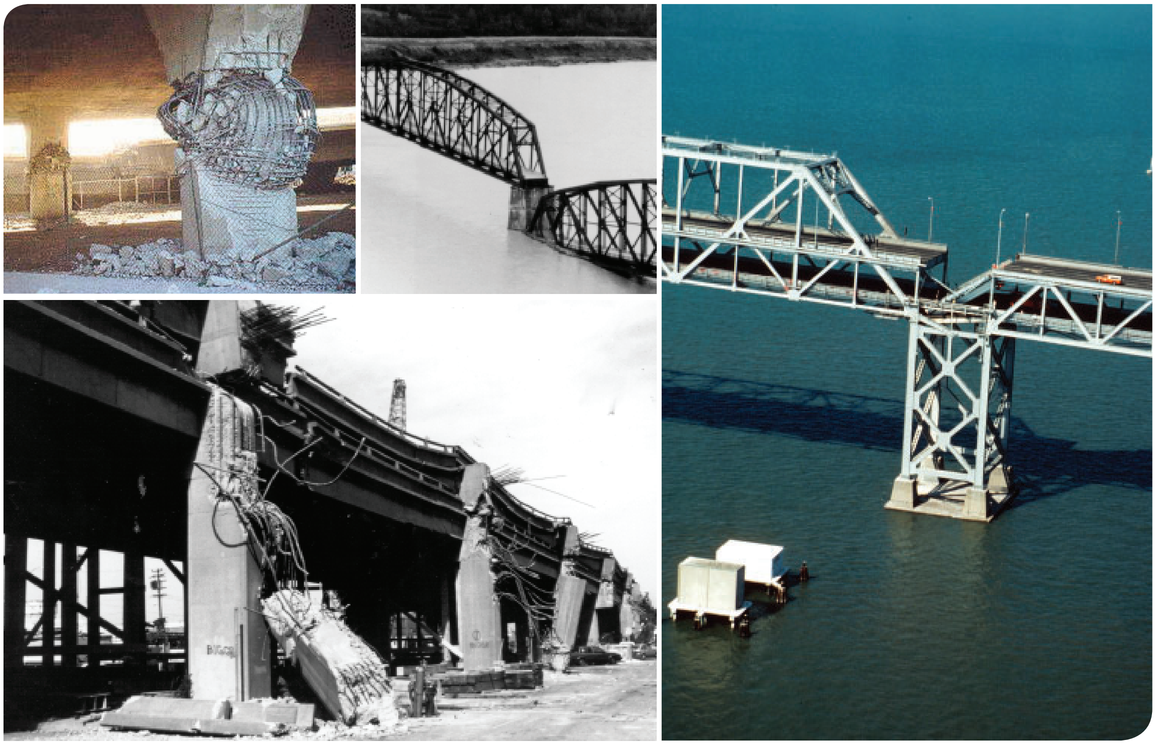
ODOT recently developed an implementation policy document that will go to the Oregon Transportation Commission for approval. The policy document is intended to facilitate discussions around options to maximize the value of the HB 2107 seismic funding. We expect the first priority will be on retrofitting major river crossings. The major I-5 river crossings between Eugene and Portland include the Boone Bridge which will be evaluated as directed by the 2019 Legislature, and the Santiam River Bridge.

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

Other Funded Seismic Projects

HB 2017 provided funding for an additional seismic project entitled the Southern Oregon Seismic Bridge Retrofit which includes three phases. The first phase is scheduled to go to bid later in 2020. The strategy 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. The funding will be used to address those bridges and potentially unstable slopes that are more problematic or where a feasible detour does not exist.

Right of way funding is available for Coastal Maintenance Stations at Seal Rock and Coos Bay; an additional facility at Astoria is being considered but 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 be used to assist local communities in the early days following a seismic event. The kits will include culvert pipes of various sizes; construction materials; solar power 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.



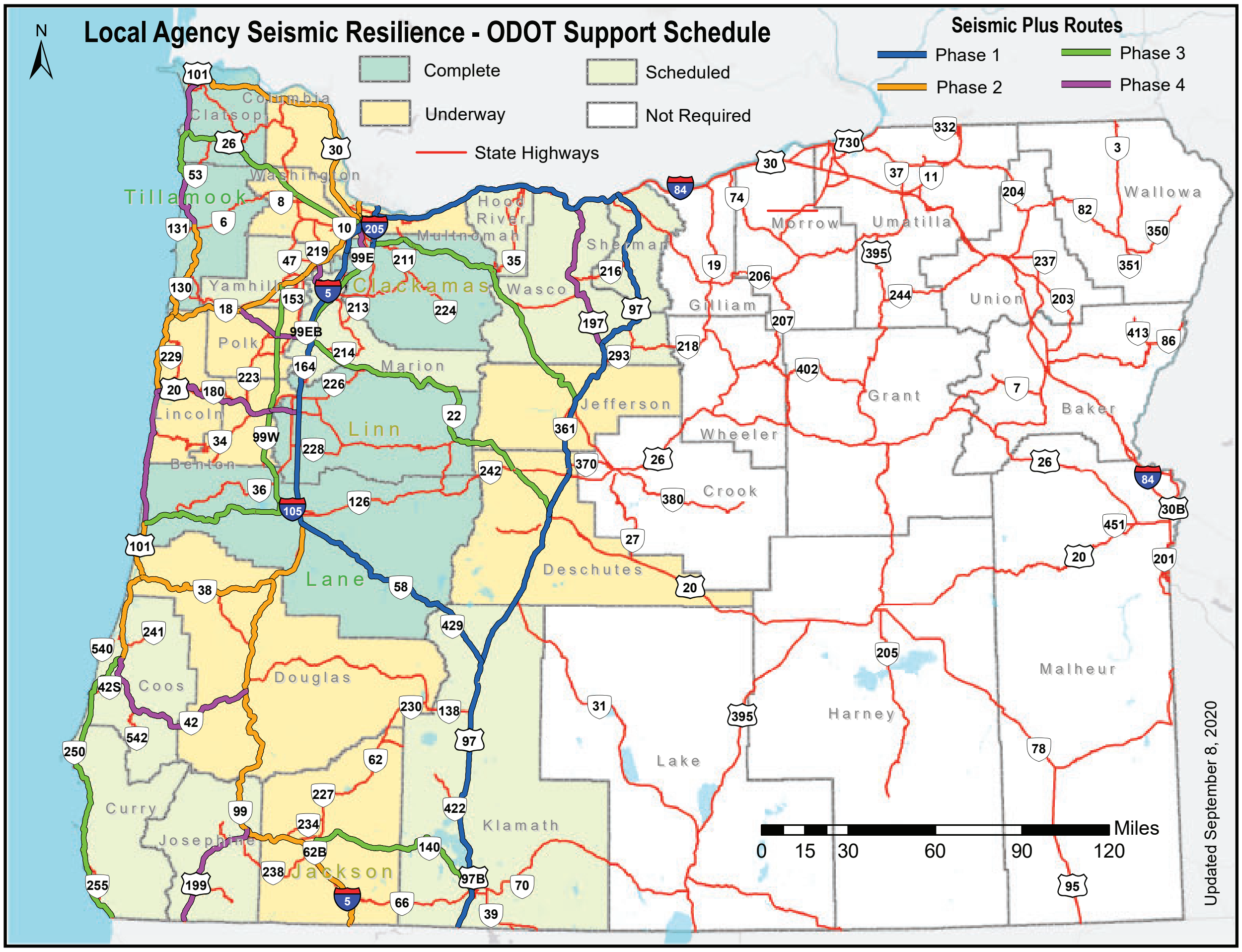
Bridge damage caused by historic earthquakes. Photos courtesy of USGS.

Local Agency Seismic Resilience Support

The Bridge Seismic Standards Engineer and other ODOT leadership, is 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, a comparison can be made 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 and the map on the next page.

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



Local Agency Seismic Resilience - ODOT Support Schedule

4 Bridge Load Rating

Trucks continue to evolve to improve the efficiency of freight movement and emergency response. The result is modern trucks travelling over older bridges designed for much smaller loads. 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, it is expected 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 from two versions ago; yet the economy demands more efficient delivery services so trucks continue to get bigger and heavier.

Bridge Load Rating Basics

The capability of a bridge to carry loads is determined through the Load Rating analysis. The analysis calculates Rating Factors 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 considered.

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, different truck loading configurations are evaluated. 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

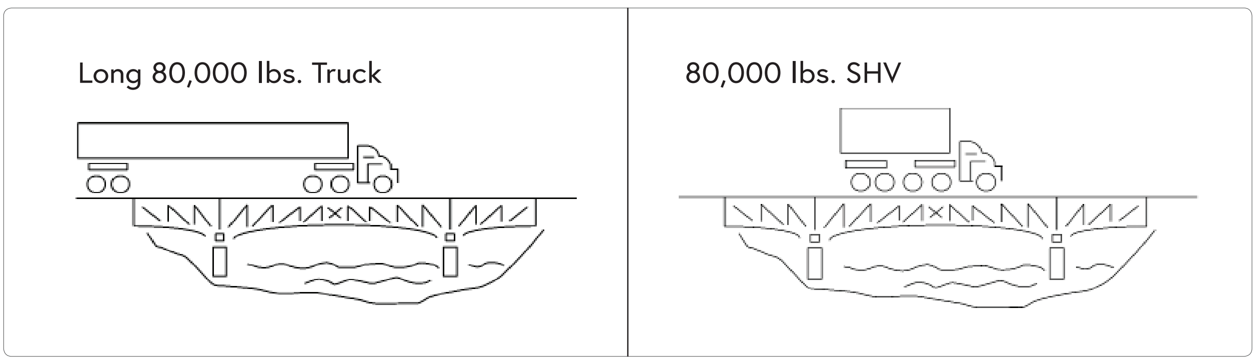
Up to 86,000 lbs GVW with short wheel bases that create highly concentrated loads

Concentrated Loading from SHVs and EVs

As trucks grew heavier in the 1950's and 1960's, something had to be done to protect bridges. The solution was to link allowable weights to the number and spacing of axles with limitations established by the Bridge Formula. 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.



The national concern with SHVs resulted in the requirement to update all load ratings to include these vehicles. While this effort was underway, the loading on bridges due to emergency vehicles was also identified as a concern.

The firetruck shown on the next page provides an example of an emergency vehicle of concern. 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 loading 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 1950's and 1960's.

It Gets More Complicated

The load ratings for the majority of Oregon bridges need to be updated due to the changes in vehicles, and also to use the current method for analysis.

Firetruck (Emergency Vehicle)

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 can be that a basic analysis may show the need for load posting or strengthening when the bridge shows no signs of distress. For these situations, a load rating using more advanced analysis is done to determine the strength of the bridge. If the load rating for a bridge in good condition still shows the need for load posting or strengthening, material testing or an on-site load test may be performed to determine the strength of the bridge.

What happens when a bridge can't carry the truck load?

Oregon's economy depends on goods being moved efficiently and communities depend on emergency vehicles having ready access so every effort is made 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:

- Coordination with local agencies, the freight industry, stakeholders including FHWA;
- Monitoring by the Region Bridge Inspector (if not already begun);
- Review of the impacts of a load restriction, and alternate routes;
- For state owned bridges, assembly by ODOT maintenance of a response team to generate an action plan;
- If the bridge cannot be restricted, a bridge crew is mobilized to complete repairs or a contract is prepared to either repair or replace the bridge, depending on timing and overall needs.

If there is no readily available means to address the load rating, according to FHWA, load postings are to be made as soon as possible but no later than 30 days after a load rating identifies the need for posting.

Van Buren Bridge (Corvallis) load posting sign

2020 TUNNEL DATA

Arch Cape Tunnel

Installation of new lighting

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 starting in 2017, five vehicular tunnels owned by other road agencies.

Inspections have been performed on ODOT tunnels for more than 20 years based on the National Bridge Inspection Standards (NBIS), modified by Oregon DOT Tunnel Inspection Procedures. Under the ODOT program, tunnels were on a two-year regular inspection cycle, with in depth inspections on a 10-year cycle and drainage inspections each year by the ODOT district maintenance crews.

New National Tunnel Inspection Standards (NTIS) Implementation

Federal Highway Administration (FHWA) guidelines require state DOTs to follow the new National Tunnel Inspection Standards (NTIS) for the inventory, inspection and load rating of tunnels. ODOT is annually required to provide a snapshot of Oregon tunnel conditions to the FHWA.

The data provided in the following table is based on the new NTIS standards. As a result of updating to the new standards, ODOT has developed a revised assessment of the structural condition for the tunnels.

Putting the element condition information together to determine the overall tunnel condition (good, fair or poor) provides a new challenge as there is no established national standard. The old method of rating generally considered one tunnel element, the liner. With the new NTIS implementation additional elements are individually assessed like ceiling slab, anchors, ceiling girder, wearing surfaces, etc.

To classify the tunnel condition with the updated 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 2019 tunnel condition information reported is based on the updated HI method calibrated with a general assessment of the tunnel conditions and engineering judgement.

Arch Cape Tunnel Lighting

A recent project replaced the entire Arch Cape Tunnel lighting system. The tunnel is located on U.S. 101 about five miles south of Cannon Beach in Clatsop County.

The tunnel was opened in 1937 and is approximately 1,230 feet long. The lighting was last replaced in 1998. The project replaced the old broken and corroded sodium lights with new LED lights that are more energy efficient and provide better light. All wiring was replaced along with new stainless steel supporting hardware that can better withstand the effects of ocean salt conditions.

Last, new pedestrian and bicycle activated flashing beacon signals with buttons and signs were installed on either side of the tunnel. When activated, the signals alert motorists that pedestrians and bicycles are entering or in the tunnel.

Arch Cape Tunnel lighting construction

TUNNEL CONDITIONS AS OF JUNE 2020 **(based on the most recent inspection)**

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	PDX
			51C32	Rocky Butte Tunnel	1939	400	Reinforced Concrete	Fair	PDX
			25B125	Cornell Tunnel #1, NW Cornell Rd	1940	497	Reinforced Concrete	Fair	PDX
			25B127	Cornell Tunnel #2, (W), NW Cornell Rd	1941	247	Reinforced Concrete	Fair	PDX
			22476	Owyhee Tunnel, Owyhee Lake Rd	1929	200	Rock	Fair	Malheur County

2019 OREGON TRANSPORTATION ASSET MANAGEMENT PLAN: Bridge Information

As part of a federal requirement, each state department of transportation is required to develop an asset management plan for the National Highway System (NHS) to improve or preserve the condition and performance of the system. In addition, ODOT chose to include analyses beyond the NHS routes. The plan was submitted to FHWA in June 2019 for review and certification. The full content of the plan can be found at ODOT_TAMP. The following section includes a portion of the information related to bridges and projected conditions.

Bridge Conditions Overview

Bridges on Oregon's state and national highway systems face a number of complex factors that affect condition. These include, but are not limited to:

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

In addition to the factors listed, the bridge system continues to age. The average age of all bridges in the inventory is 48 years. Also:

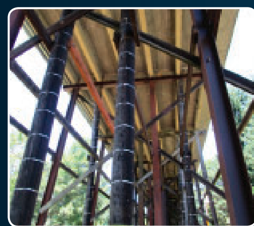
75-100 years **bridge service life with maintenance**

>800 bridges approaching >75 years old within the next 20 years (30% of inventory)

While bridges on the NHS system are generally newer than those on the total state system, NHS bridges are impacted by higher traffic volumes and heavier truck loads.

Within the population of aging bridges, many bridges on Oregon's highway system require constant attention due to the construction materials, the location, and/or the significance of the bridge. These bridges often are the most expensive to maintain and require regular maintenance.

More than 600 bridges in the inventory (about 22%) fall into one of the following categories shown in the figure below. Programming work for these bridges in addition to other high priorities adds to the complexity of managing a diverse bridge system.



483	216	94	19
Poor Detail Bridges	Timber Bridges	Historic Bridges	Border Bridges

Poor Detail Bridges: 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.

Timber Bridges: Bridges with one or more timber elements including piles, decks, girders, stringers, pier caps, etc. Typically, bridges with timber piles are the most problematic.

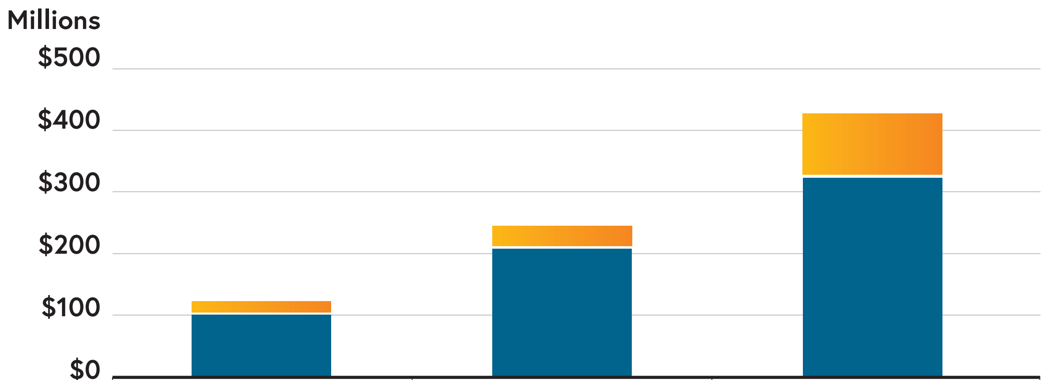
Historic Bridges: Bridges either on the National Register of Historic Places or Eligible for the National Register of Historic Places. An additional 45 bridges may be eligible following further investigation.

Border Bridges: Bridges connecting Oregon with Washington or Idaho.

Bridge Funding Gap Analysis

Using 2018 data, an analysis was done to determine the funding needed to maintain current bridge conditions and to reach a Desired State of Good Repair (DSOGR) based upon the Oregon Transportation Commission Investment Strategy available at OTC_Investment_Strategy. The results shown in the figure on the next page compare current funding with the funding needed to maintain or improve conditions.

Funding Scenario Annual Needs Estimate



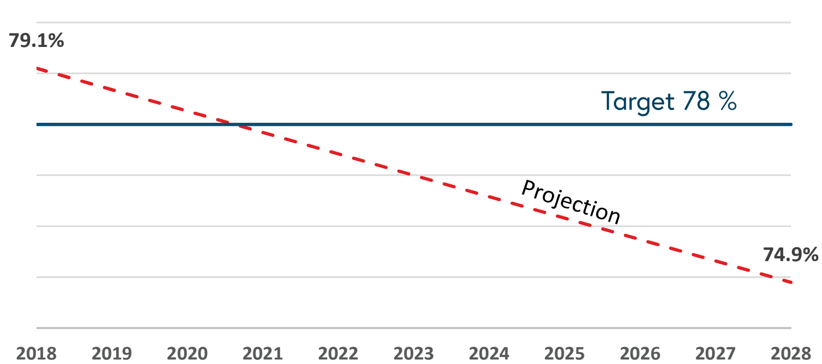
	Current Funding	Maintain Current Conditions	Desired State of Good Repair
Non-NHS	$11,000,000	$39,000,000	$96,000,000
NHS	$101,000,000	$219,000,000	$339,000,000

The analysis confirmed that the bridge program is significantly underfunded to even maintain current conditions. While NHS bridges need more than double the funding available to maintain current conditions, the non-NHS bridges need three and a half times the current funding available.

Bridge Key Performance Measure Projection

An analysis was performed to project the Bridge KPM (percent of bridges not distressed) over the next 10 years with current funding. As noted below, the HB 2017 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 the Bridge KPM is primarily due to the aging bridge system and a long history of lack of funding for bridge replacements.

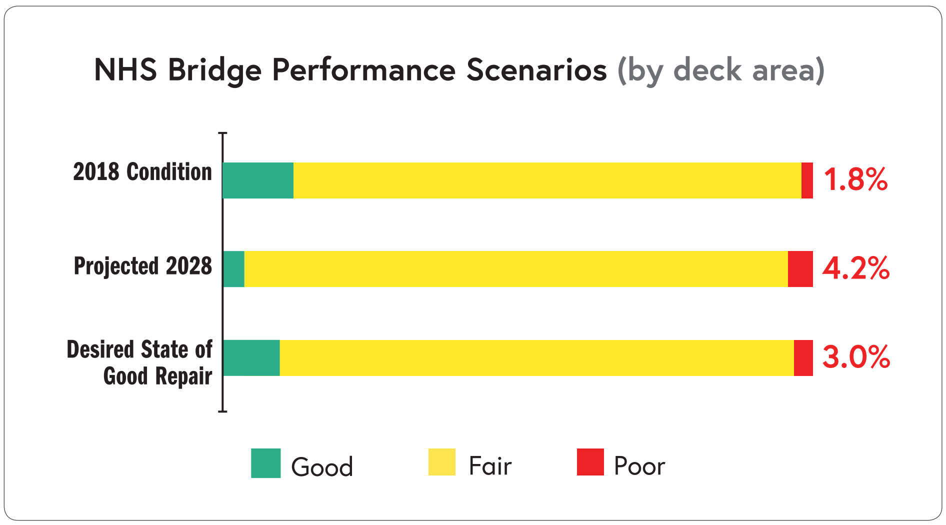
Projected Bridge KPM (percent by count)



Bridge Performance - National Performance Measure Metrics

As shown in the graph, NHS bridge condition projections indicate the percentage of *bridges in good condition will continue to decline* even with the new HB 2017 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 expected, which reflects a construction quality issue in concrete mixtures and placement.

Projections for the percent of bridges by *deck area becoming poor shows a steady increase* in the next 10 years. However, HB 2017 funding is projected to slow this increase. By 2028, the percentage is predicted to exceed the Desired State of Good Repair, which has been established at 3%.



> **"AS AGING BRIDGES DETERIORATE, CONDITIONS BECOME LESS PREDICTABLE INCREASING THE RISKS OF LOAD POSTINGS AND CLOSURES."**

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 Fix-It corridors. The 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 conditions grows, overall risks of bridge load restrictions and closures will increase.

One more for the road: Westfir Old Barnard Bridge Emergency Scour Repairs

ODOT bridge inspection dive crews conducting a routine inspection found a hole under the footing at the Westfir Old Barnard Bridge in August 2019. The bridge, located off of OR 58, was immediately closed for safety.

A repair plan was quickly developed that included:

- Stabilizing the bridge with steel beams,
- Diverting water from the side channel by a dam made up of bags filled with gravel,
- Removing logs and debris from last winter's storms and landslides,
- Building a form around the footing of the bridge, filling it with concrete, and covering it with rock.

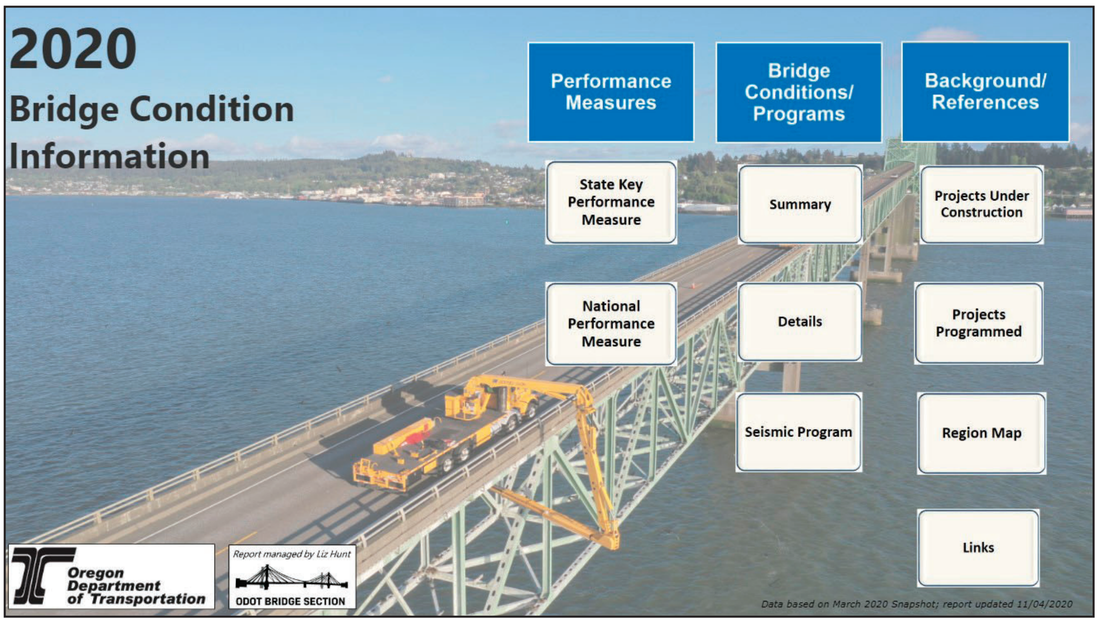
Once the concrete set, the water was released back through the channel and the bridge was re-opened. The project is an example of good teamwork and collaboration between ODOT and multiple agencies (Oregon Department of Fish and Wildlife, U.S. Forest Service, Oregon Marine Board, and Army Corp of Engineers).

Empty channel

Inspecting the repair site

Making an assessment

Building the form



More information is available online through the 2020 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

2020

Bridge Condition Report & Tunnel Data