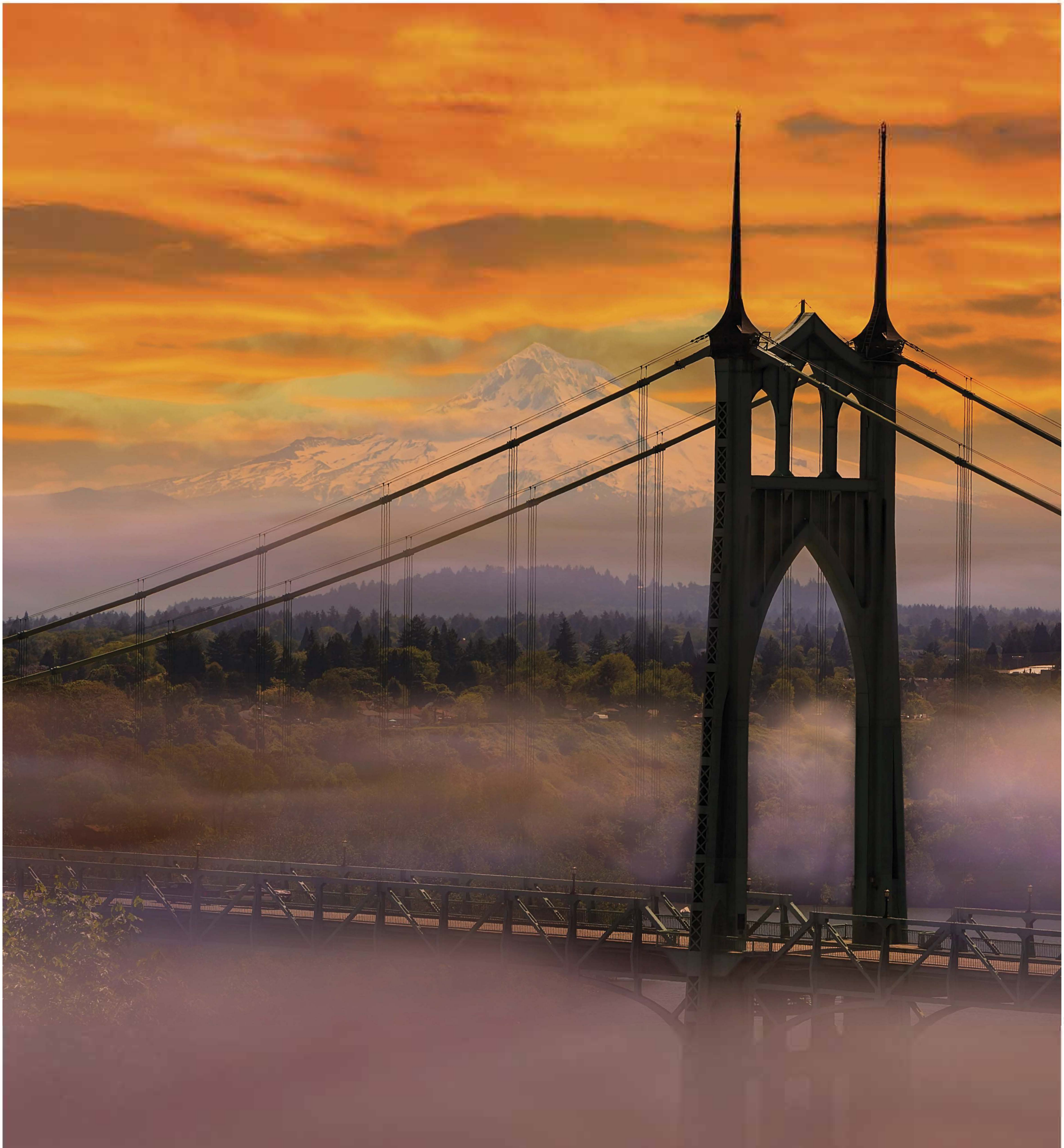

Oregon Department of Transportation

2022
Bridge Condition Report
& Tunnel Data

Oregon Department of Transportation

Astoria-Megler Bridge.

2022 BRIDGE CONDITION REPORT & TUNNEL DATA

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The Cost of Major Bridges

The State of Oregon has approximately 7,000 bridges statewide, with approximately 2,700 on the state highway system. The majority of these bridges are small to medium in size and rarely noticed by the traveling public. A much smaller number of these are major bridges that people do recognize. Major bridges, in this context, means those bridges that are in the top 1% (27 bridges) based on the area of the roadway. The majority of these bridges cross either the Columbia or the Willamette Rivers. Almost all of the remaining bridges are located on the coastline or cross other rivers. Only the Medford Viaduct does not cross water. While these are all important bridges, 16 of the 27 carry an interstate highway and seven are border bridges. There are four bridges that carry an interstate highway and are also border bridges.

Not only are these major bridges highly visible, they are also expensive to maintain and to replace. In the fall of 2022, we programmed projects for the 2025-2027 Statewide Transportation Improvement Program. Rehabilitation projects have already been programmed which included five of these 27 bridges. The costliest project is for painting the western approach ramps of the Fremont Bridge, programmed at slightly over $103 million. This bridge was built in 1973 and by the time this project is complete, the original paint protecting the steel from corrosion on these ramps will have been in service for over 50 years. It is important to note that the aging paint protecting the steel elements on the main span over the Willamette River and the eastern approach ramps, will remain in service until future paint projects can be programmed. The Fremont Bridge has significant current and future needs, in addition to painting. There have been full-depth failures of the roadway, featured in previous Bridge Condition Reports.

The hole developed on a Fremont Bridge ramp. Full depth deck failure of the roadway can be expensive for both maintenance and replacement. Photograph by Jeremy Kappers

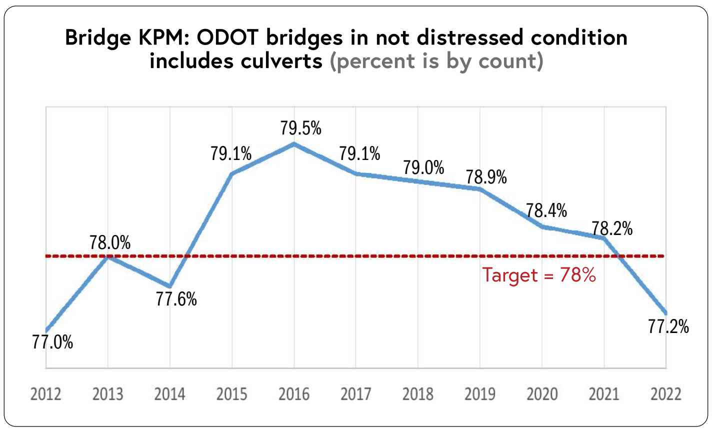
Balancing the needs of the top 1% of the state highway bridges with the needs of the remaining bridges is challenging. The entire Fremont Bridge, including the extensive approach ramps on each end, has the same driving surface area as approximately 200 two-lane bridges that are 170 feet long and 40 feet wide.

The Fremont Bridge is in fair condition, along with approximately 75% of the other bridges on the state highway system, based on deck area. The funds that are programmed for each preservation project could have been used to address the needs on many other smaller state highway bridges. With the aging Interstate Era bridges, and deteriorated timber bridges that are best addressed through replacement, we must use a balanced approach in programming available funding.

Bridge Key Performance Measure (KPM)

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.



ODOT bridges in not distressed condition. Larger percentages are better. In 2022, the Bridge KPM dropped a full percentage point to 77.2%.

The primary cause of the significant drop in the Bridge KPM is due to load rating. In 2022, ODOT load rated bridges at a higher rate than usual to meet new federal requirements that all load ratings include the specialized hauling vehicles. While these bridges had load ratings, the ratings were done using older methods. ODOT now uses the same load rating method for all bridges, which can result in lower rating factors for older bridges that were designed to the standards in place at the time.

2022 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 (Preserving Oregon's Big Bridges)
- 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 – **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.

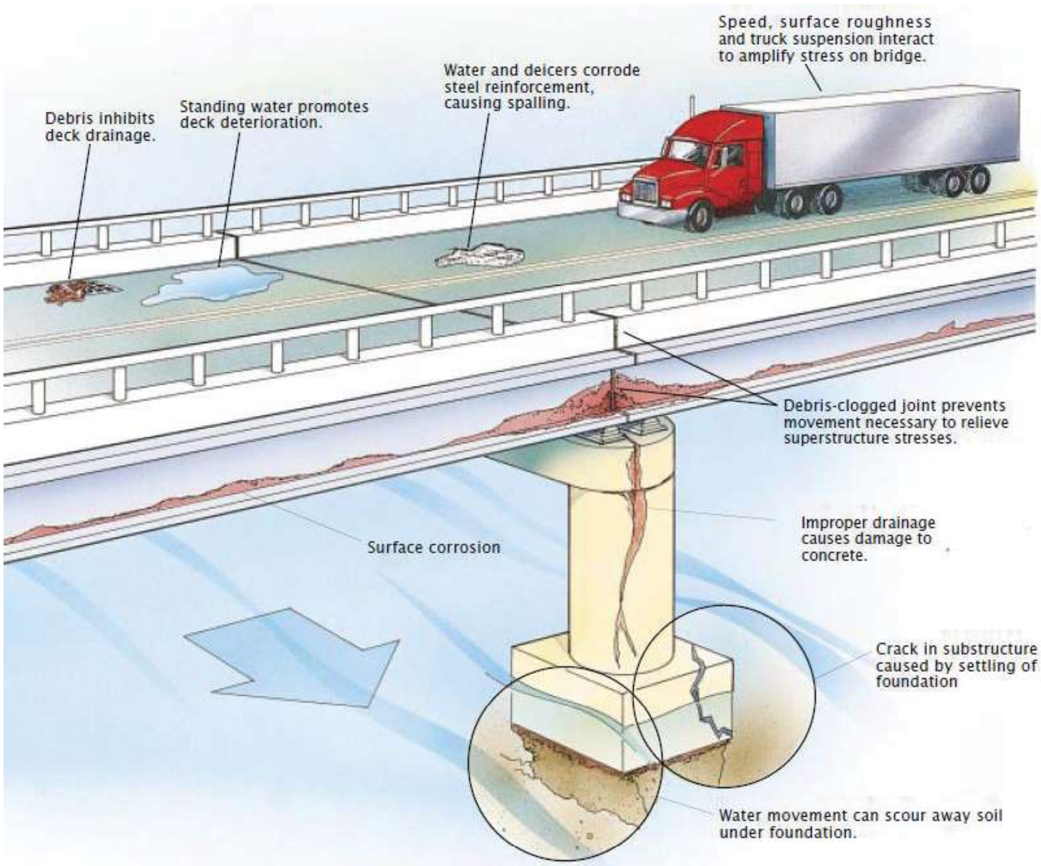
A classification of "structurally deficient" does not imply that bridges are unsafe. When an inspection reveals a safety problem, the bridge is posted for reduced loads, scheduled for repairs, or in unusual situations, closed until repairs can be completed. Structural deficiency is one of the many factors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

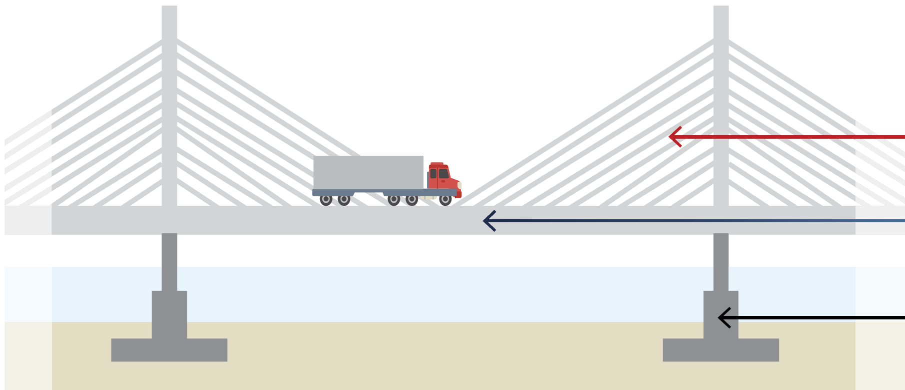


Adapted from "Why America's Bridges are Crumbling," by K.F. Dunker and B. G. Rabbat, 1993, March, Scientific American, 268, no. 3, p. 69. Permission for use courtesy of Jana Brenning, illustrator.

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 20 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:

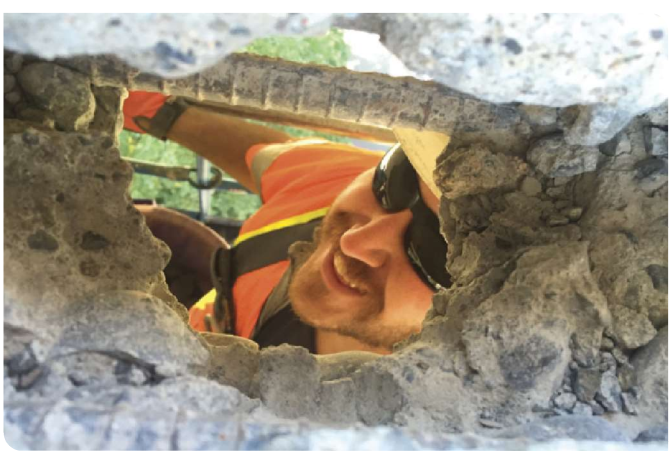
- Sealing or replacing leaking joints to minimize the deterioration of superstructure and substructure elements beneath the joints.
- Painting/coating or overcoating structural steel to protect against corrosion.
- Installing scour countermeasures to protect the substructure from undermining and failure 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.

THE COST OF MAJOR BRIDGES

The State of Oregon has approximately 7,000 bridges statewide, with approximately 2,700 on the state highway system. The majority of these bridges are small to medium in size and rarely noticed by the traveling public. A much smaller number of these are major bridges that people do recognize. Major bridges, in this context, means those bridges that are in the top 1% (27 bridges) based on the area of the roadway. The majority of these bridges cross either the Columbia or the Willamette Rivers. Almost all of the remaining bridges are located on the coastline or cross other rivers. Only the Medford Viaduct does not cross water. While these are all important bridges, 16 of the 27 carry an interstate highway and seven are border bridges. There are four bridges that carry an interstate highway and are also border bridges.

Not only are these major bridges highly visible, they are also expensive to maintain and to replace. In the fall of 2022, we programmed projects for the 2025-2027 Statewide Transportation Improvement Program. Rehabilitation projects have already been programmed which included five of these 27 bridges. The costliest project is for painting the western approach ramps of the Fremont Bridge, programmed at slightly over $103 million. This bridge was built in 1973 and by the time this project is complete, the original paint protecting the steel from corrosion on these ramps will have been in service for over 50 years. It is important to note that the aging paint protecting the steel elements on the main span over the Willamette River and the eastern approach ramps, will remain in service until future paint projects can be programmed. The Fremont Bridge has significant current and future needs, in addition to painting. The roadway driving surface has significant wear and rutting in the wheel paths, joints are deteriorated and leaking, and the bridge rail has damage from vehicle impacts. Past projects on the bridge include a $21 million project in 2019 that addressed the need for joint replacement or refurbishment, and placed a layer of concrete on a portion of the driving surface. Similar projects in 1983, 1994, 1995, 1999, and 2011 addressed a portion of the joints and restored the roadway driving surface. There have been full-depth failures of the roadway, featured in previous Bridge Condition Reports.



The hole developed on a Fremont Bridge ramp. Full depth deck failure of the roadway can be expensive for both maintenance and replacement. Photograph by Jeremy Kappers, Regioin 1 Bridge Maintenace Specialist.

The second costliest project is the seismic retrofit of the Center Street Bridge that crosses the Willamette River in Salem. This is one of two crossings over the Willamette River in Salem. This project was initially programmed using $60 million in funding identified in House Bill 2017. Presently, we estimate that an additional $40 million in funding from the State Bridge Program is needed to fully fund this project.

Two of the three remaining projects are to preserve the driving surfaces on the Interstate 5 and Interstate 205 bridges that Oregon shares with Washington. The final project is to preserve the driving surface on the U.S. 101 Young's Bay Bridge. The combined cost for these five projects is over $230 million. After subtracting House Bill 2017 funding and the shared funding from Washington State Department of Transportation for the border bridges, the remaining funding needed to complete these five projects represents approximately 25% of the total funding the State Bridge Program has to address the needs of the 2,700 state highway bridges in 2025 through 2027.

Balancing the needs of the top 1% of the state highway bridges with the need of the remaining bridges is challenging. The entire Fremont Bridge, including the extensive approach ramps on each end, has the same driving surface area as approximately 200 two-lane bridges that are 170 feet long and 40 feet wide. The Fremont Bridge is in fair condition, along with approximately 75% of the other bridges on the state highway system, based on deck area. Programming preservation projects on the Fremont Bridge, and other major bridges, does not improve their condition, but simply allows the bridge to remain in service in fair condition for much longer. There is no immediate measurable benefit for doing preservation projects on major bridges. The funds that are programmed for each preservation project could have been used to address the needs on many other smaller state highway bridges. With the aging Interstate Era bridges, and deteriorated timber bridges that are best addressed through replacement, we must use a balanced approach in programming available funding.

Fremont Bridge with one of the largest deck surface area and also paint surface area.

The current federal highway bill, the Infrastructure Investment and Jobs Act, has funds that are specifically intended for bridge replacement, rehabilitation, and preservation. However, there is a requirement that cannot be waived for each state to spend a minimum of 15% of the funding to address bridges that are not on the Federal Aid System. These bridges are typically small and are owned by cities and counties. This allows each state, and the nation, to make measureable progress in reducing the number of bridges that are in poor condition. While it is important to replace bridges that are in poor condition, doing so means there is less funding available to preserve major bridges in their current condition.

In 2011, ODOT senior leadership created the System Preservation Strategy Work Plan–Bridge. This work plan has nine strategies, with the first being "Ensure the protection of high value coastal, historic and major river crossings, and border structures." The emphasis on preserving these bridges is due to the high cost of needing to replace even a single bridge. For example, ODOT created the Bridge Preservation Unit in 1991 as a direct result of the Alsea Bay Bridge deteriorating to the point where it was not economical or practical to preserve it. The Alsea Bay Bridge was replaced in 1991 at a cost of $46.7 million. It is included in the top 1% of the largest state highway bridges.

The cost to replace a major bridge exceeds the funding available to the State Bridge Program. Current examples are the Interstate Bridge Replacement project and possibly replacing the Boone Bridge that carries I-5 over the Willamette River at Wilsonville. However, it is important to also consider the cost to replace other large bridges that are not on the top 1% of state highway bridges. For example, the I-5 Iowa Street Viaduct was replaced in 2014 at a cost of $47.8 million. This project used special funding because the total budget for the State Bridge Program in 2014 was $56.2 million. This bridge is not even close to being in the top 27, since there are over 400 bridges that are larger based on the deck area.

Yaquina Bridge, preservation of steel structure in coastal environment is important to prolong their design life.

Coos Bay Bridge, coastal bridges are particularly susceptible to accelerated corrosion from airborne oceanic salts and wildlife waste deposits that contain salts.

House Bill 2017, a $5.3 billion transportation funding package, was the most ambitious highway upgrade program in our state's history. The bill called out several specific projects across the state, like the Scottsburg Bridge replacement that was funded at $50 million. House Bill 2017 funds that were not applied to specific projects were divided between ODOT (50%), the counties (30%) and the cities (20%). Of the funding ODOT received, 40% was allocated to the State Bridge Program, 32% was allocated for seismic improvements to highways and bridges, and the remaining funds were allocated to address other needs.

Two bridges that qualified for seismic funding include the I-205 Abernethy Bridge, currently under construction, and the Van Buren Bridge in Corvallis. The Abernethy Bridge includes special funding for widening and seismic retrofit and the Van Buren Bridge will be replaced ($60 million). Both the Scottsburg Bridge and the Van Buren Bridge are well below the size needed to be included in the top 1% of the largest state highway bridges, but are also beyond the ability of the State Bridge Program to fund their replacements.

Large bridges can be very expensive and building or replacing them often takes special funding, such as House Bill 2017. This is not new for projects of this magnitude, as it took New Deal funding during the Great Depression to build the major coastal bridges on U.S. 101 (Yaquina Bay in Newport, McCullough in Coos Bay, Umpqua River in Reedsport, Siuslaw River in Florence, Alsea Bay in Waldport, and Rogue River in Gold Beach). Additional funding that is beyond the funding provided to the State Bridge Program is required to replace bridges such as the I-5 Interstate Bridge and the I-5 Boone Bridge. ODOT senior leadership has provided clear direction on the importance of preserving high value coastal, historic, major river crossings, and border structures. However, we must strike a balance between these priorities and the need to repair or replace bridges that are deteriorated or weight restricted.

As the bridge population continues to age, there is an increased probability of another major bridge, like the Alsea Bay Bridge that was replaced in 1991, deteriorating to the point where replacement is the most economical alternative. We must understand the trades offs when making decisions and learn to balance managing the needs of our major bridges while not comprising our ability to care for the overall bridge inventory.

2022 BRIDGE CONDITIONS

> **In 2022, ODOT replaced one bridge.**

ODOT's 2022 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 2022 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 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.

Deck deterioration can include cracking, scaling and surface spalling which result in safety concerns, and increased wear and tear on vehicles that use the bridge.

Superstructure deterioration can include corrosion, cracking, and fatigue damage for steel bridges.

Substructure deterioration can include damage from high water events and can result in the need to replace the bridge.

Inventory Changes

ODOT currently manages 2,771 bridges. **This year, five new bridges were added to the inventory, of which one is a replacement. The bridge that was replaced was to improve condition.** Other new bridges were added as the replacement of structures formerly not in the inventory with structures eligible to be included in the inventory. For example, there are many culverts that have openings that are too small to be included in the National Bridge Inventory. When one of these culverts is replaced with a bridge, the bridge is added to the inventory. There was also one wildlife crossing added to an existing alignment.

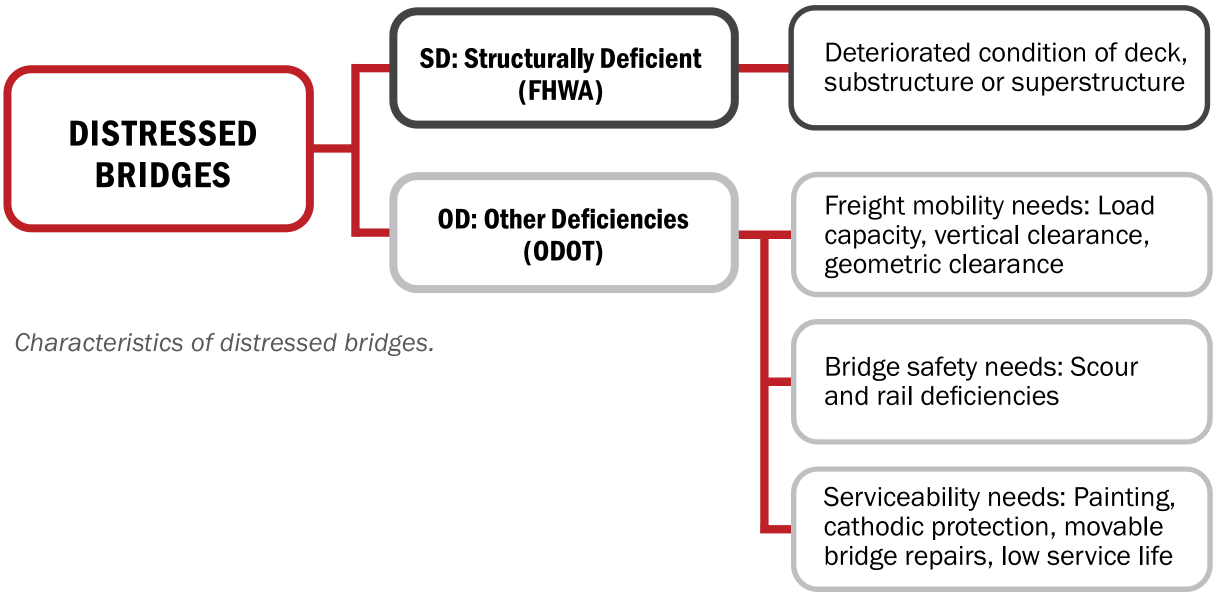
With only one new bridge replaced, ODOT continues to lose ground in the effort to manage the system. Current funding levels pay, on average, for only three bridge replacements a year. At that rate, an Oregon bridge will need to stay in service for over 900 years which is well beyond an expected service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

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.



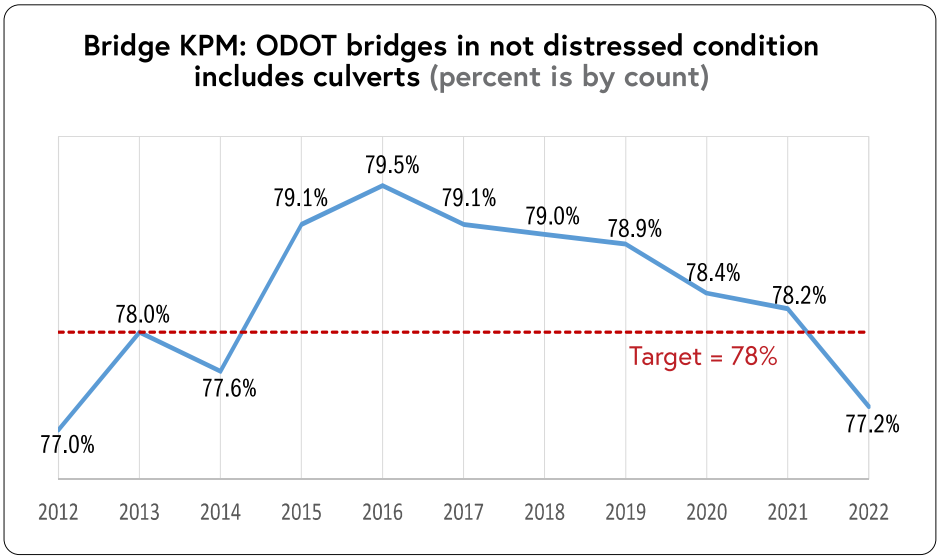
Characteristics of distressed bridges.

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.

In reviewing the chart on the next page, there is a large spike propelling Bridge KPM from a 2014 low of 77.6% to a 2016 high of 79.5%. This spike was due to the Oregon Transportation Investment Act-III and special federal funding sources that enabled a large number of bridges to be built and replaced at higher-than-normal levels for a short period of time.

During the period between 2016 through 2021, the number of ODOT bridges in distressed condition increased gradually, with a corresponding average decline of 0.25% in Bridge KPM. **However, in 2022, the Bridge KPM dropped a full percentage point to 77.2%. This is the first time since 2014 that the Bridge KPM is below the target.**

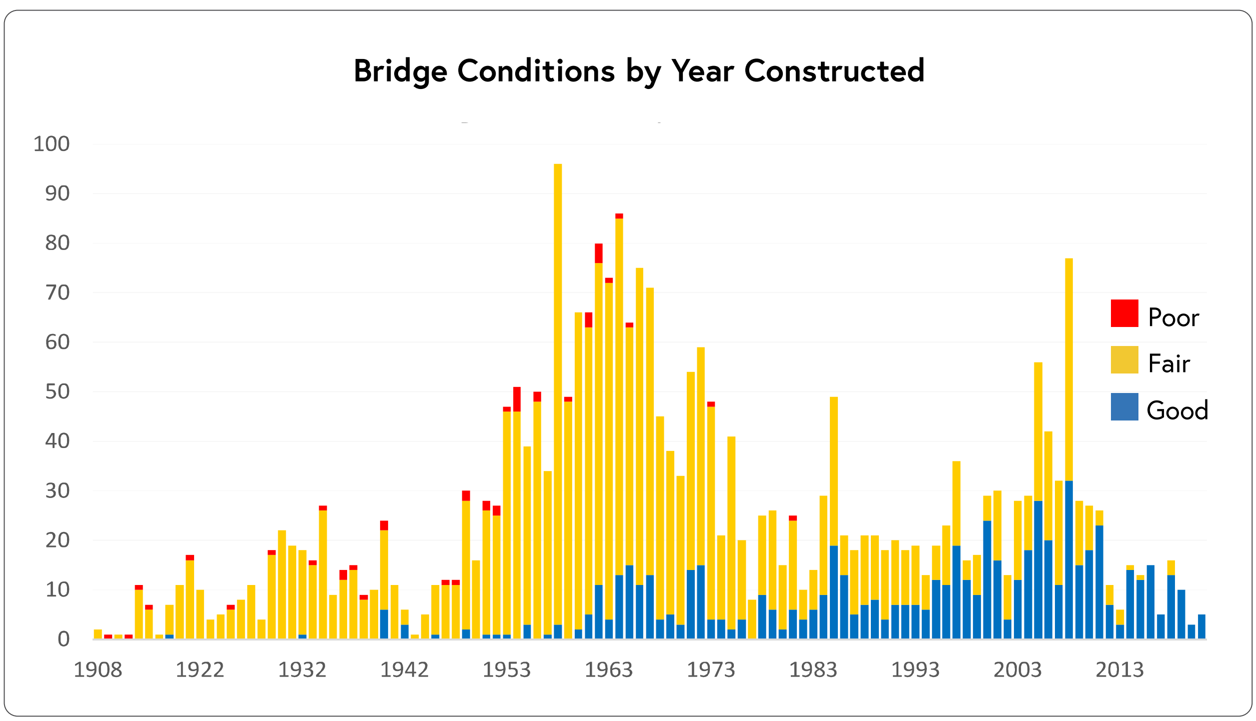
The primary cause of the significant drop in the Bridge KPM is due to changes in load rating. In 2022, ODOT load rated bridges at a higher rate than usual to meet federal requirements that all load ratings include the specialized hauling vehicles. While these bridges had load ratings, the ratings were done using older methods. ODOT now uses the same load rating method for all bridges, which can result in lower rating factors for older bridges that were designed to the standards in place at the time. The new load ratings added a load capacity deficiency to five bridges, and a low service life deficiency to 15 other bridges that had no deficiencies in prior years. While the additional funding that the State Bridge Program received as part of the Infrastructure Investment and Jobs Act (IIJA) and House Bill 2017 will have a positive effect, we anticipate that this will be more than offset by the continued deterioration of the state bridge inventory.



ODOT bridges in not distressed condition. Larger percentages are better.
In 2022, the Bridge KPM dropped a full percentage point to 77.2%.

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

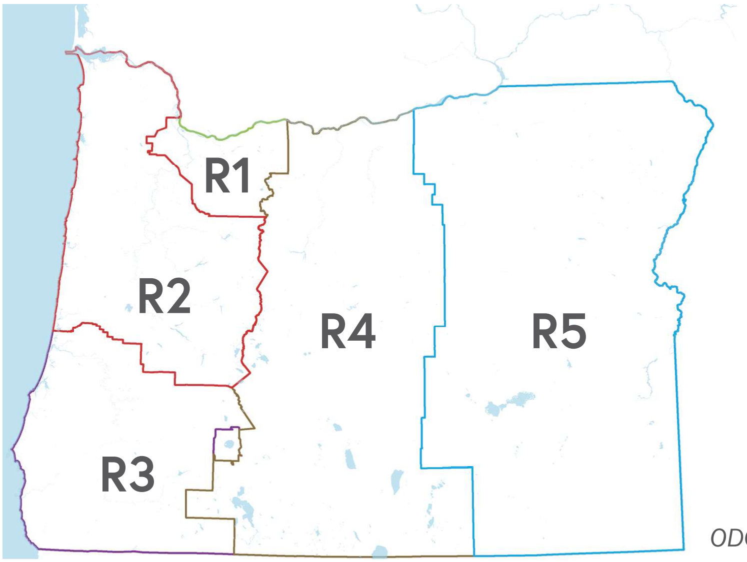
An alternate approach to understand the system needs is to compare bridge conditions by the construction year. The graphic below provides a picture of the looming wave of bridges constructed in the 1960s (now over 60 years old) that are in fair condition and approaching the end of their service lives.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



The graph above shows a large number of bridges built in 1950s and 1960s that are now 60 plus years old and most of them have exceeded their design life. Although operating in fair condition, they will eventually move to poor condition if not maintained or replaced.

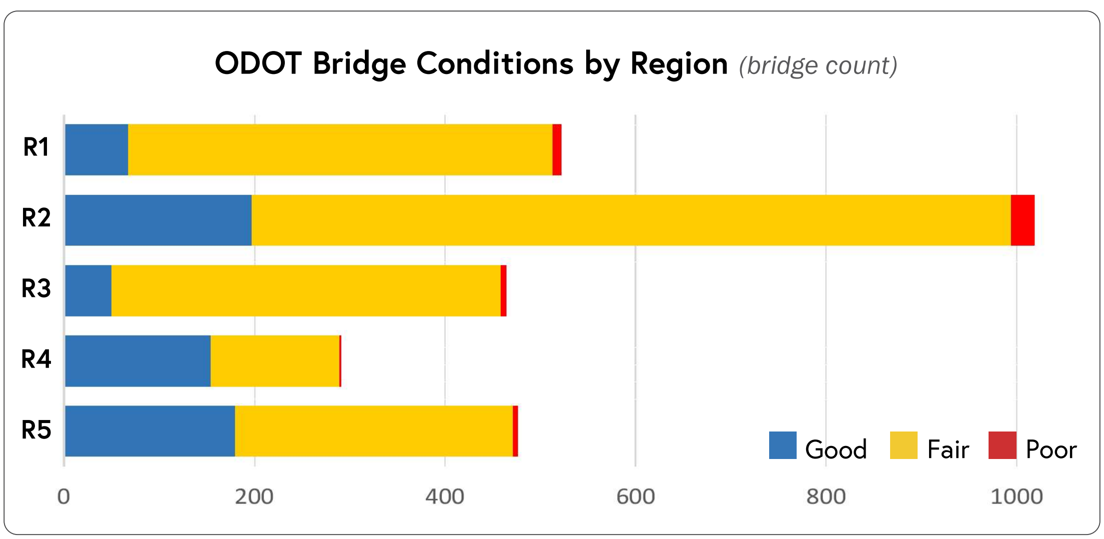
Bridge Conditions by Region

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 have more deck area than Regions 3, 4 and 5 combined.

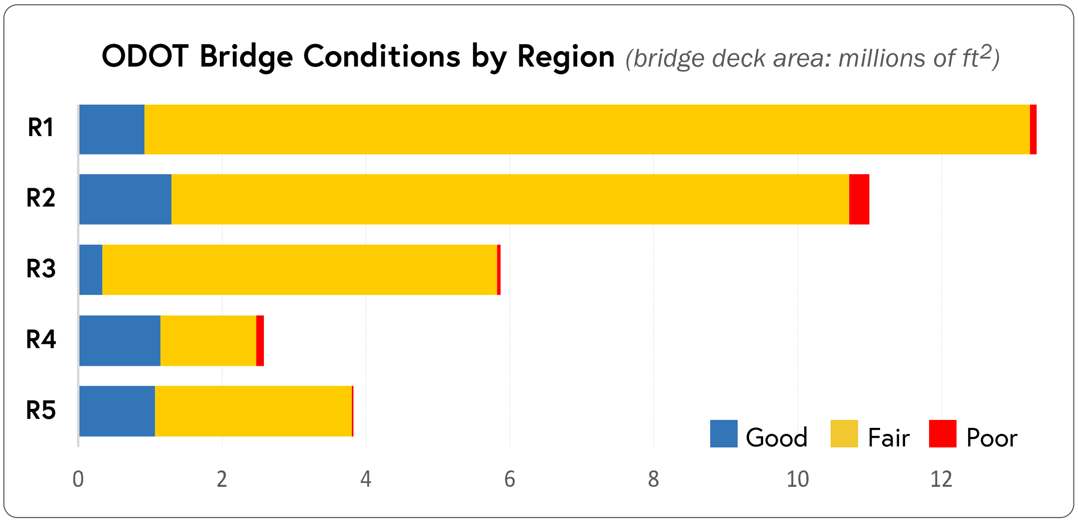


ODOT Region Map.

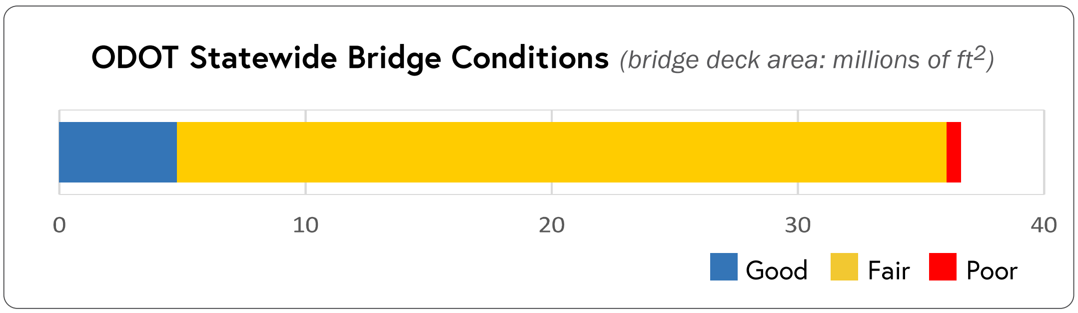
While the bridge system includes only 44 bridges in poor condition (structurally deficient), bridge conditions are slowly declining as noted by the Bridge KPM.



ODOT bridge conditions by count. Bridge total count by region is R1 - 522 | R2 - 1,018 | R3 - 464 | R4 - 291 | R5 - 476.



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

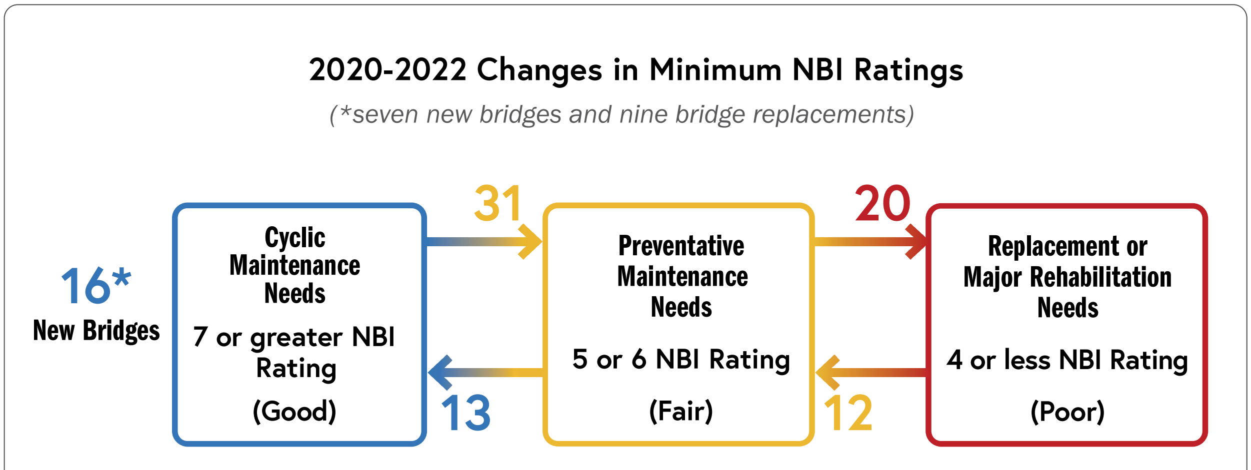


The total bridge condition statewide deck area is 36.6 mil ft^2:
Good=4.77 mil ft^2, Fair=31.28 mil ft^2, Poor is 0.55 mil ft^2

2020-2022 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 2020 to 2022 reflects bridge conditions over one full inspection cycle (24 months). In a balanced state, the number of bridges moving from blue to yellow and red (deteriorating conditions) would be equal to the number moving from red to yellow and blue (improving conditions).

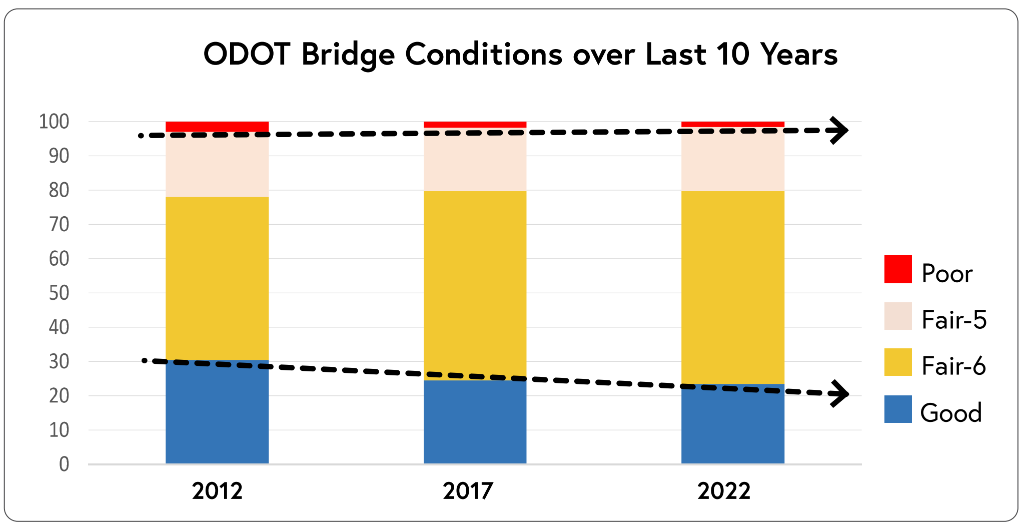
The chart shows that we are managing the poor (red) bridges reasonably well, but the number of bridges moving from good (blue) to fair (yellow), indicates that bridge preventative maintenance actions are not occurring at a rate necessary to maintain current conditions. Overall, in the last two years, 51 bridges had lower (declining) overall condition ratings versus only 25 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.

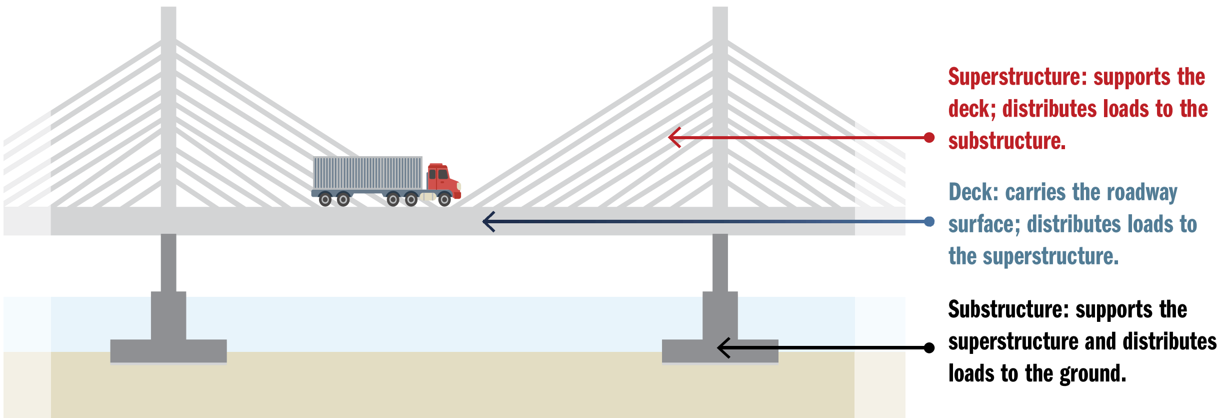


The ten year chart shows percent of good bridges continuing to move to fair condition due to aging inventory. If more bridges are not maintained or replaced, the poor inventory will continue to increase and put stress on the transportation system.

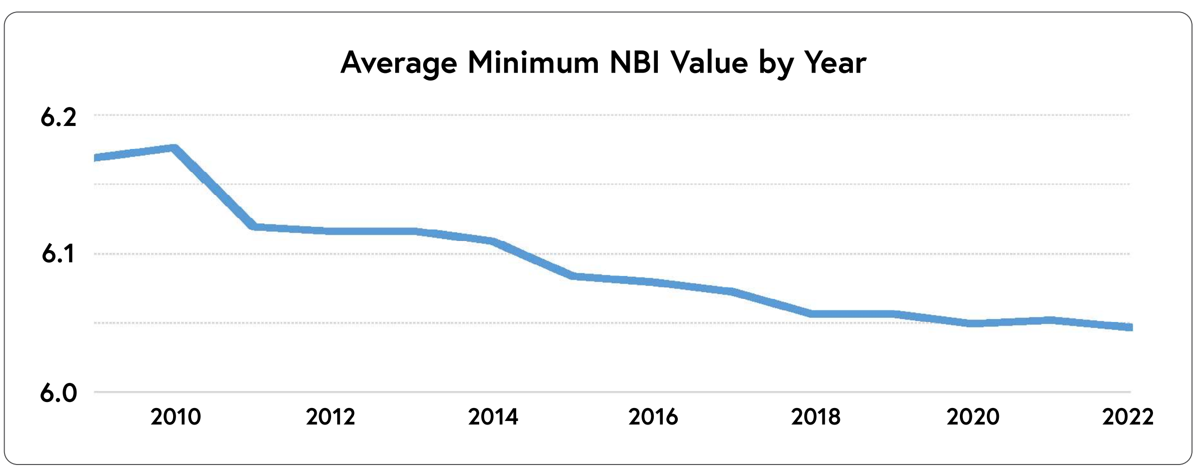
Of concern is the increasing number of bridges moving out of good condition into fair condition. The population of fair bridges continues to age and will require more and more rehabilitation and maintenance over time. Many fair condition bridges have already exceeded their service life but remain in 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 2022 to compare the overall, deck, superstructure and substructure conditions of ODOT bridges.

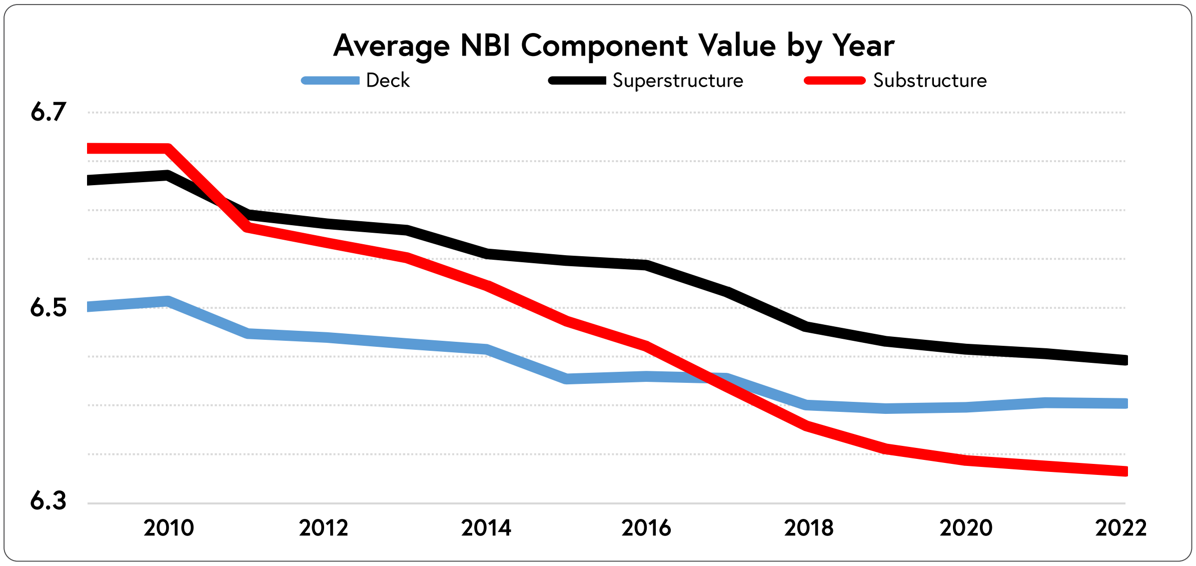


As shown in the graph, the overall NBI conditions (lowest of the superstructure, deck and substructure conditions) have declined since 2010, which would have been close to the end of the Oregon Transportation Investment Act (OTIA) work. Understanding which components of a bridge are deteriorating, is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



The yearly average NBI value (minimum of deck, superstructure and substructure) for all bridges has declined since 2010.

In this graph, the component NBI values are plotted to indicate changes over time. In 2009, substructure (red) 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.



The graph indicates that averages of all three NBI components that indicate bridge conditions have trended downward from 2010-2022, however, it is important to note that substructure decline is steeper than others. When a bridge has a poor substructure, it is generally more cost-effective to replace than to maintain it. Poor substructure condition leads to bridge postings and potentially closures, if not replaced.

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.

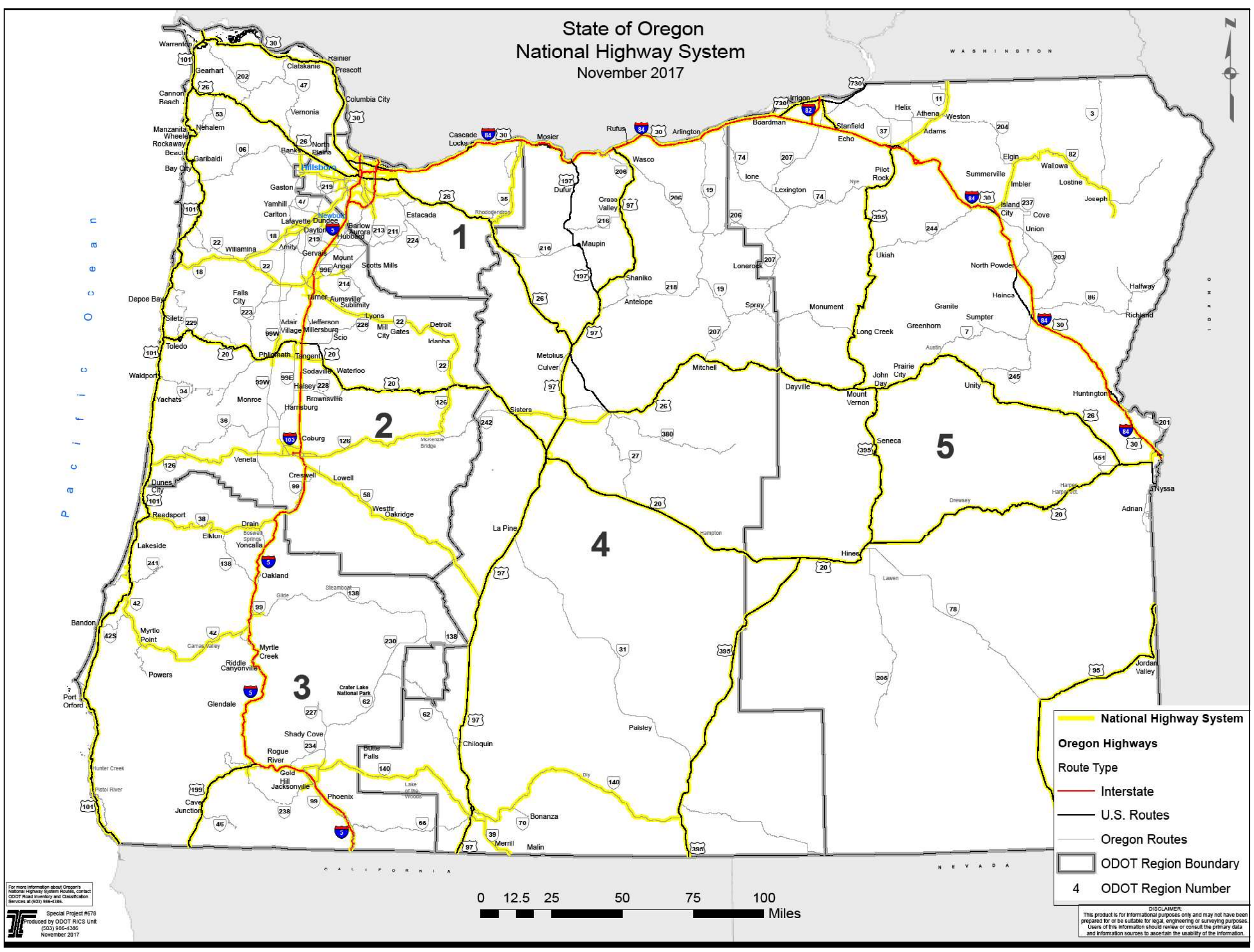
NATIONAL BRIDGE PERFORMANCE MEASURE

Condition Based Performance

The Infrastructure Investment and Jobs Act (IIJA) 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

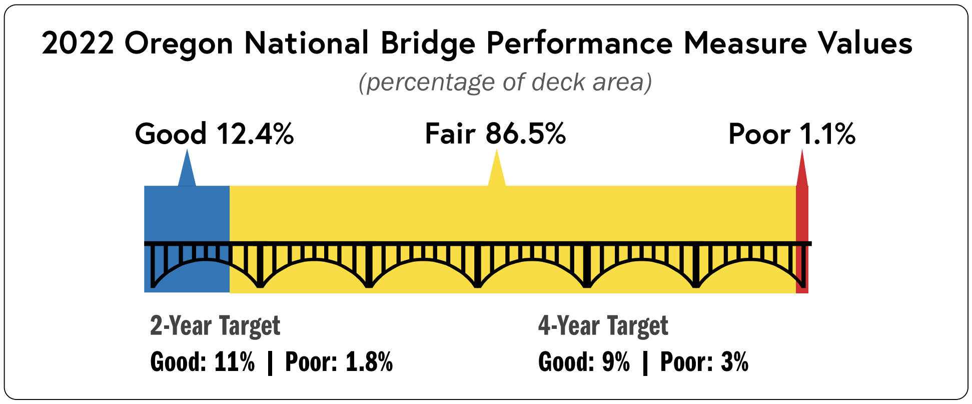
2. Percent of NHS bridges by deck area classified as in poor condition



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. However, the percentage of good bridges decreased slightly from 2021 to 2022. This decrease can be attributed to the normal deterioration of new bridges as they age, spending the majority of their service life in fair condition.

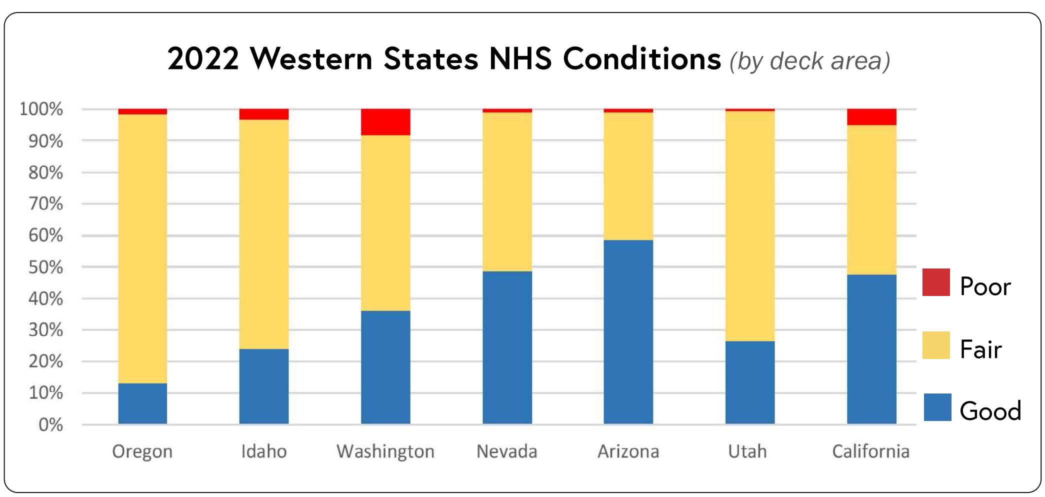


ODOT has a large inventory of aging bridges, as a result, more bridges are likely to transition to poor condition in the future.

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.

Performance Relative to Neighboring States

Compared to neighboring states, Oregon has the least quantity of NHS bridges in good condition. The graph shows northwest states' bridge conditions using 2021 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. Due to a large number of aging bridges in Oregon's inventory, some of the fair condition bridges continue to slide into poor condition due to limited funding resources required for bridge replacement and maintenance.



2022 Western States NHS Conditions *(by deck area)*

State	% Good	% Fair	% Poor
Oregon	13.2	85.3	1.5
Idaho	24.1	72.7	3.2
Washington	36.2	55.6	8.2
Nevada	48.7	50.4	1.0
Arizona	58.6	40.4	1.0
Utah	26.6	73.0	0.5
California	47.7	47.3	5.1

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

		FOCUS
1	Major Bridge Maintenance	► Funding ► Accomplishments ► Repair of Older Bridges ► Timber Substructure
2	Bridge Preservation	► Preserving Oregon's Big Bridges ► Painted Steel Bridges ► Preserving High-Volume Bridge Decks
3	Seismic Program Status	► Interstate 5 Seismic Mitigation Planning ► Design Underway for Center St. Bridge ► Southern Oregon Seismic Project Progress
4	Bridge Load Rating	► History ► Basics ► SHVs and EVs

Oscar the oscillator, largest of its kind put in to action for seismic retrofit of the Abernethy Bridge.

Recently completed Scottsburg Bridge addresses safety concerns. Photo by Bob Grubbs.

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 2021, the MBM program funded 19 projects to address urgent maintenance recommendations at a total cost of $1,776,469. Examples of these projects include repairing damaged joints that pose traffic hazards, replacing deteriorated timber members, deck repairs, and bearing replacements.

Typical Distresses Addressed by MBM

Failed Deck.

Damaged Bridge Joint.

Distressed Timber.

Frozen Bearing.

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 2021, the MBM program funded projects to seal 23 bridge decks at a total cost of $1,339,000. This work helped protect approximately 401,300 square feet of bridge deck from degradation.

Maintaining the asphaltic concrete pavement (ACP) 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 2021, the MBM program funded paving work on 31 bridges at a total cost of $2,052,500. This represents a significant expenditure for the MBM program and will be a continued challenge for the agency into the future.

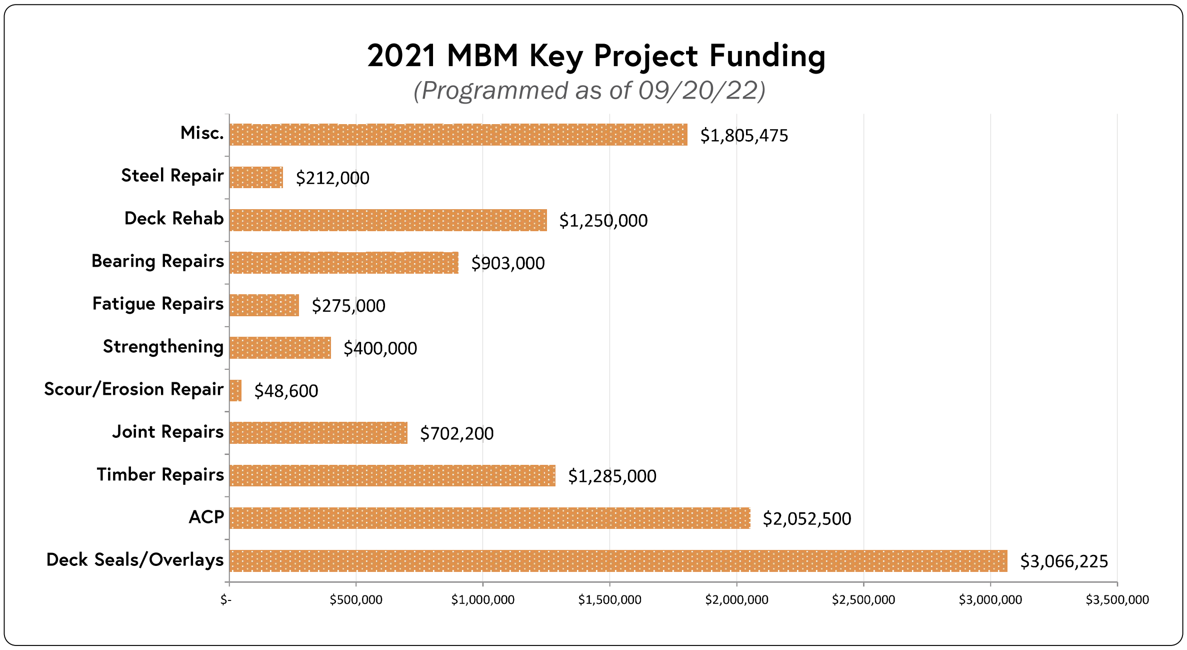
In addition to addressing urgent defects and performing preventative deck maintenance, the MBM program addressed scour repairs, deck joint repairs, timber repairs, approach repairs, bearing replacements, and maintenance on the moveable bridges. The variety and volume of work performed by the MBM program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

2021 MBM Project Accomplishments

In 2021, ODOT repaired four bridges in poor condition through the MBM program. In addition, we repaired 54 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 later in this report.



2021 annual funding distribution by project type, with about $3 million for deck seals/overlays, $2 million for ACP, and $1.25 million each for deck and timber repairs.

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.

Elk Creek - Partial Deck Replacement

The Elk Creek Bridge, on Interstate 5, had a hole develop though the concrete bridge deck. We mobilized our maintenance team to patch the hole and the traffic lane was re-opened on the same day. We developed a larger contract project to replace approximately 16% of the deteriorated concrete deck. All work was completed in less than two months after the initial hole developed.

The MBM program utilizes 100% state funds which allows the program to deliver work with the maintenance team or contract the work. This flexibility allows MBM to deliver projects in an effective and timely manner with lower overhead costs.

We anticipate more repairs of this nature as the bridge inventory continues to age and bridges exceed their original design life.

Elk Creek, replacement of damaged deck.

Elk Creek, partial deck replacement work.

Elk Creek, finished deck repair.

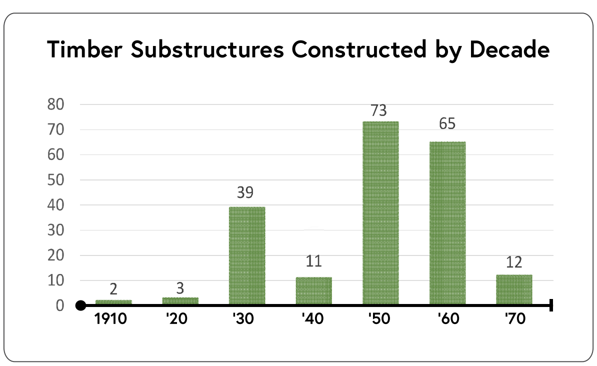
Timber Substructures Conditions - High Demand on MBM!

Oregon has 205 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.

Timber substructure

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 age, we expect that the frequency and urgency of timber substructure repairs will continue to escalate. From 2018 to 2021, MBM program completed 141 timber pile repairs and 35 timber cap repairs on 82 structures. Associated cost for the repairs totaled $4.3 million.

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 population of timber substructures continue to age, we expect the percentage of maintenance resources dedicated to repairs to substantially increase.



The horizontal axis is the decade of construction and the vertical axis is the number of bridges constructed during that decade. About 67% of the total timber bridges were built in the 1950s and the 1960s and have exceeded their 50 year design life, requiring regular maintenance to be operational.

2 Preserving Oregon's Big Bridges

It takes a lot of work to keep the biggest bridges in Oregon in working order. Much of that work is considered either routine maintenance, such as sweeping the bridge decks, or Major Bridge Maintenance (MBM), like replacing bearings. But to truly keep the bridges in tip -top shape, they also require higher cost preservation treatments. Preservation treatments are those that allow a bridge to last longer in good or fair condition, without increasing load or user capacity.

Preservation work includes steel painting, cathodic protection, deck treatments such as overlays, and other types of general repair work beyond the scope of the MBM Program. While these actions don't result in a significant change in the condition of a bridge, they prevent long-term corrosion or structural damage that would eventually lead to safety issues.

An ODOT contractor constructed a containment on the west end of the St. John's Bridge to access the concrete piers. When damaged concrete is widespread on a big bridge, concrete repairs can rise from maintenance to preservation work. Photo by Mats Halvardson.

These treatments are cost-effective measures to increase the service life of a bridge, but they can still be expensive, especially for big bridges with large deck or surface areas. As a result, big bridges typically have phased preservation work over multiple funding cycles. Big bridges in corrosive environments can often seem to be continuously under construction. The classic example of this is the Astoria-Megler Bridge.

Case Study: Preserving a Big Coastal Bridge (Astoria-Megler)

The Astoria-Megler Bridge is on U.S. 101 and crosses over the Columbia River. It is the perfect example of a big bridge. This is a border bridge with shared ownership and maintenance responsibilities between Washington State Department of Transportation (WSDOT) and ODOT as the lead agency. For a total length of more than 4 miles, it is composed of five major span groups, including: the curving concrete boxes at the Astoria end; the large, steel, continuous through truss over the main navigational channel; the steel deck trusses ramping up to the main truss; the long viaduct structure composed of precast, prestressed, concrete girders; and the simple, steel through trusses on the Washington shore over the secondary navigation channel. Each of these span types require different preservation actions on different cycles.

Over the last 15 years, WSDOT and ODOT together have spent more than $71 million on painting and other preservation-type projects, as documented in the table on the next page. These costs are generally shared with WSDOT.

A deck overlay project on just the ramp structure on the south end of the bridge is currently scheduled for 2024. Overlaying the remainder of the structure is not currently scheduled, but is expected to be needed in the next 10 years. The next painting cycle, when work starts again at the Washington trusses, should begin around 2030, depending on paint condition.

Cormorants nesting on the Astoria-Megler Bridge add salt-rich waste to the surface, accelerating corrosion. Photo by ODOT Photo Video Services.

Degradation of paint condition is driven primarily by exposure to airborne oceanic salts and accelerated by salt deposits from cormorants. Once salt-based corrosion begins in this aggressive environment, it can rapidly accelerate, creating unsafe conditions. That is why we are committed to preserving this big bridge.

Total project costs for all work on the Astoria-Megler Bridge over $100k since 2007.

Projects on the Astoria-Megler	Year	Cost
Paint Washington Trusses	2009	16,850,000
Steel Repairs	2009	170,000
Solar Navigation Lights	2011	900,000
Paint Main Truss Phase 1	2012	11,160,000
Channel Protection (Timber)	2013	120,000
Paint Main Truss Phase 2	2016	17,560,000
Paint Deck Trusses	2017	24,320,000
Astoria End Concrete Deck Overlay	2024	19,470,000

This table shows each project on the Astoria-Megler bridge with a project cost over $100,000 since 2007.

While the coastal bridges face rapid corrosion from atmospheric salt, there are many big bridges in the state with different preservation needs. For bridges off the coast, the primary cause of deterioration is typically road salt, applied to prevent ice build-up, which corrodes the bridge decks and components below the joints. Wear from tires can also be a factor. As a result, the big bridges in Portland serve as a valuable case study for bridge deck preservation.

Case Study: Preserving High-Volume Bridge Decks

By 1972, ODOT was well aware of the challenges of trying to maintain large bridge decks in high-use areas. As a result, the state bridge engineer at the time commissioned a research report to find ways to preserve these bridge decks. They identified three primary issues leading to the degradation of the bridge decks; studded tire use, road salt, and traffic volumes. All of these were particularly concerning as the bridge designs of the day only had one inch of concrete over the steel reinforcement. This was decreased even further in the ruts resulting from heavy traffic usage. The thinner the concrete layer, the faster the steel reinforcement corroded, and the sooner the deck fell apart.

The research paper looked at many potential fixes, some of which we still use today, such as asphalt overlays. These treatments require temporary bridge closures for installation and, even in 1972, ODOT found it difficult to justify the traffic impacts. In addition, most of the treatments available then had a limited lifespan. The trade-off, then as now, is that an easy treatment application likely meant a shorter lifespan and the need to reapply sooner.

THOUGHTS ON BRIDGE DECK RESURFACING

Traffic volume is the most important factor. Where traffic is reasonable, requirements are reasonable, work is accessible and time can be taken for curing, etc. More economical materials are satisfactory and can be satisfactorily applied.

Where traffic reaches the magnitude of 10,000 vehicles per lane per day - as is the case on all the bridges we are concerned with - conditions become almost impossible. The most restricting condition is that all lanes must be open for peak traffic hours.

Excerpt from 1972 paper on Portland Area Bridge Decks

Today, a typical new bridge is built with 2.5" of concrete covering the steel bars. This significantly increases the time it takes before those bars begin to corrode, but does not resolve the need to address the older bridges in the inventory. The best way to resolve this need is to add cover, either by adding new, denser concrete, or by adding an epoxy or polymer material. While the epoxy overlay goes down the fastest, it also wears out the fastest. As a result, the Bridge Preservation team is constantly evaluating bridge decks for the best treatments, trying out new materials, and providing recommendations to designers statewide.

Coring a bridge deck to determine chloride levels. This enables better decision-making for future overlays. Photo by James Garrard.

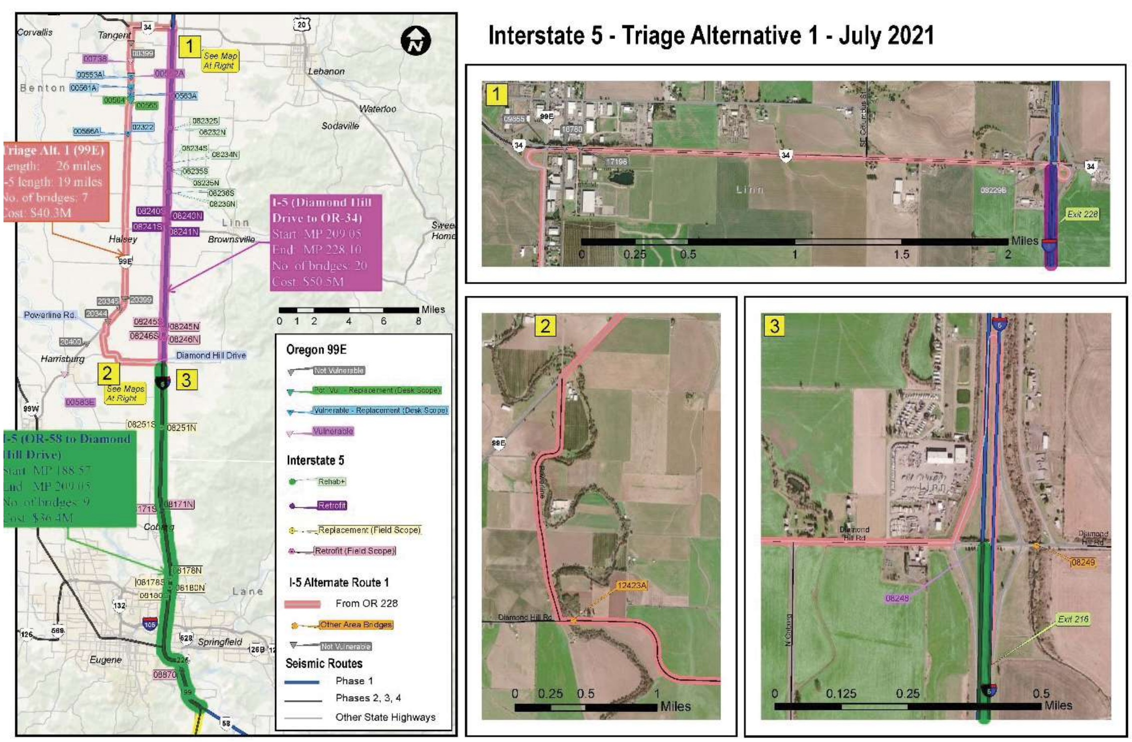
3 Seismic Program Status

With construction underway on the southern half of U.S. 97 and the Oregon 58 seismic retrofit bundle recently bid, the focus of the seismic program has finally shifted on Interstate 5. To maintain continuity, ODOT plans to start work for strengthening I-5 beginning where it intersects with Oregon 58 and moving northward.

The decision process for determining the best investment alternatives for I-5 included an active conversation between Bridge Engineering Section and Seismic Advisory Group. The Bridge Engineering Section is preparing several investment scenarios based on the projected program funds for the 2024-2027 STIP ($129 million).

One important component of these alternative scenarios was the funding split strategies between the I-5 segment and two other important projects; Oregon 22: Center St. Bridge (Salem) seismic retrofit and replacement of Bridge 02443 (I-84 westbound over Union Pacific Railroad). House Bill 2017 directly funded the first project, but during advanced investigation we developed cost estimates and determined that we needed additional funds to achieve the intended goal for this project. We identified that I-84 westbound over Union Pacific Railroad, a seismically vulnerable bridge on a Phase 1 route, needed to be replaced due to other structural deficiencies.

Another component of this evaluation was whether to strengthen both I-5 northbound and southbound at the same time and whether there were viable



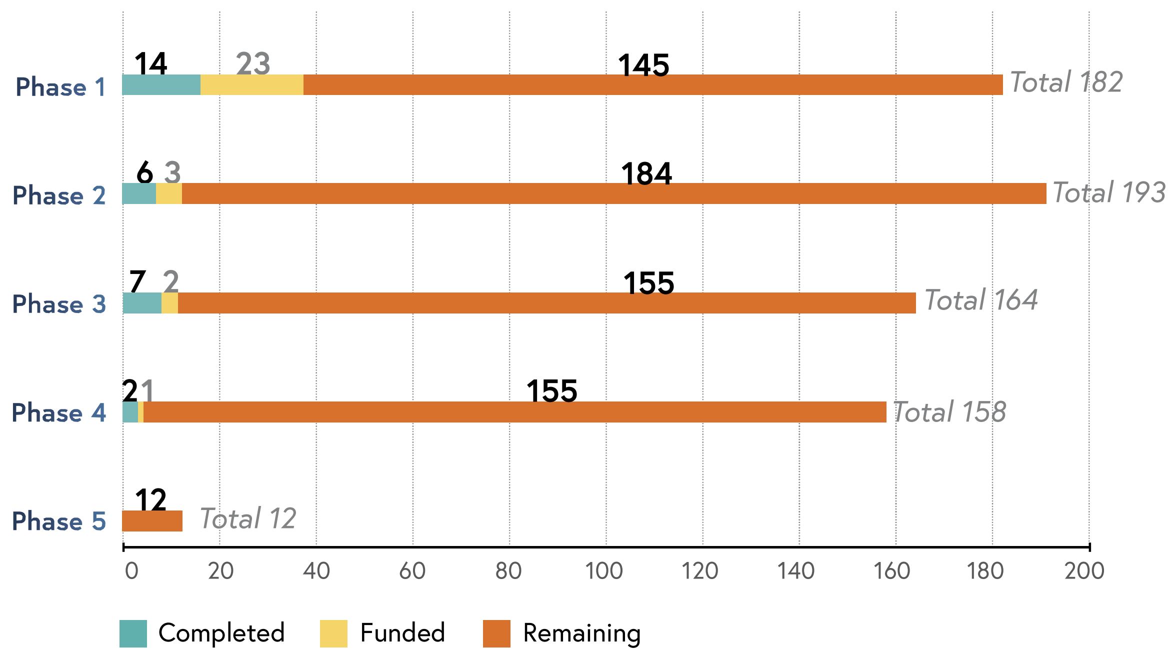
One of the investment alternatives evaluated for the I-5.

detour alternatives by using either state or local roads. Oregon 99W in particular was evaluated as a potential detour route for I-5, starting at milepost 209.05 until milepost 228.10. See the images for detour concepts evaluated during this exercise.

After a careful evaluation of all investment scenarios, the Seismic Program Advisory Group recommended that both Oregon 22: Center St. Bridge (Salem) and Bridge 02443 (I-84 westbound over Union Pacific Railroad) projects be programmed for the 2024-2027 STIP and the rest of seismic funds be invested on I-5 northbound only. Although this approach would not allow for seismic improvements on southbound at this time, it was the quickest way to provide a resilient connection between Eugene and Portland. Under emergency conditions, the traffic pattern can be altered to handle two-way traffic at a lower speed.

Region 2 Technical Center scoped 13 bridges on I-5 northbound. ODOT developed scoping estimates for both replacement and retrofit options. Using the guidelines provided in the "ODOT's Seismic Implementation: Policies and Design Guidelines," replacement appeared to be the most economical alternative for almost all bridges being scoped. Replacing existing bridges with wider structures will be considered if it eliminates the need for diversion structures.

ODOT Seismic Status



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

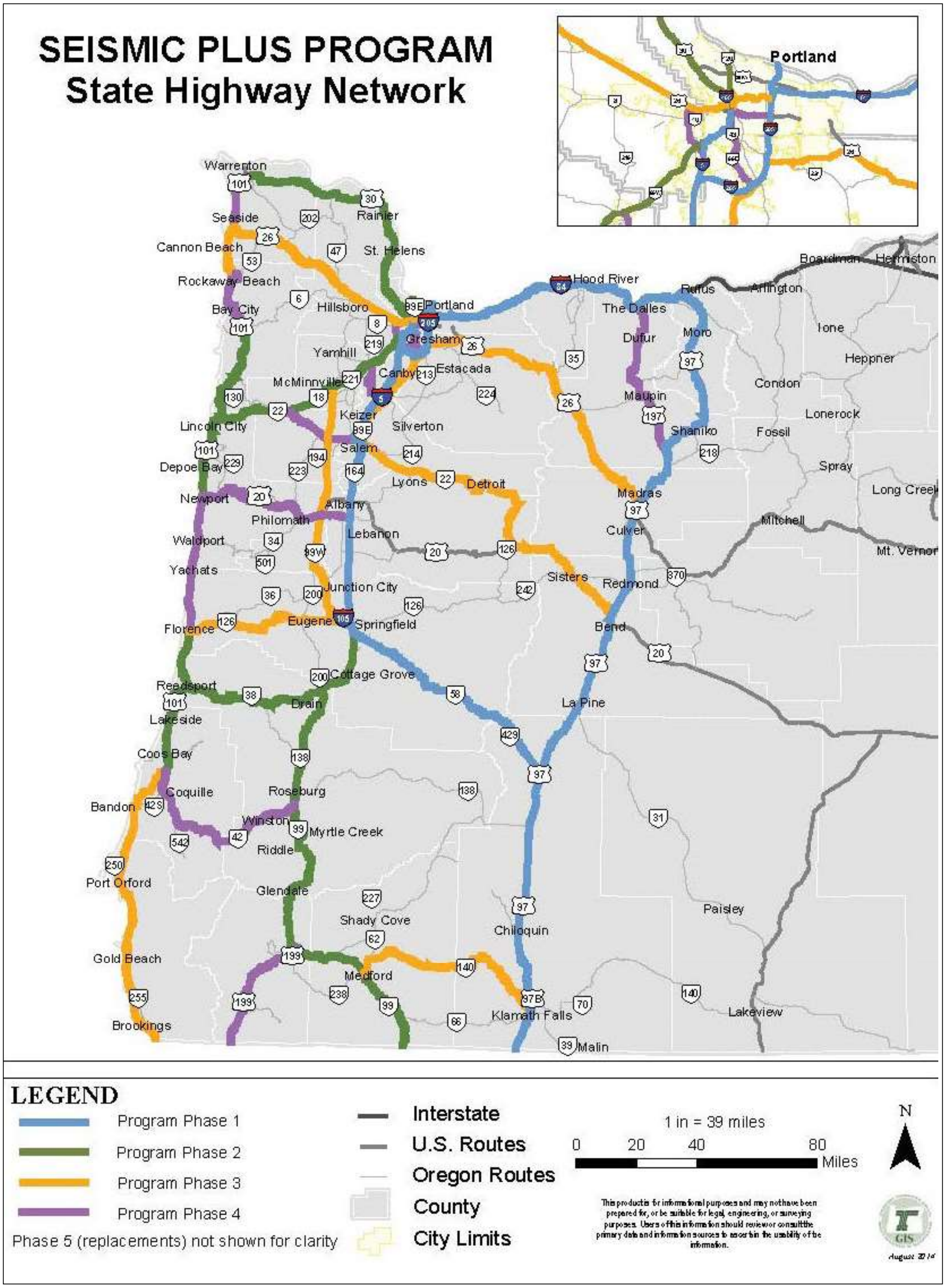
Phase 1 Provides a connection to the Redmond Airport; east-west freight movement and a north-south corridor on U.S. 97 -- the cornerstone of the program.

Phase 2 Connect the Willamette Valley with the coastal communities and Southern Oregon (Rogue Valley).

Phase 3 Adds redundancy and capacity to the transportation network already strengthened in phases 1 and 2 of the program.

Phase 4 Will finalize strengthening of all proposed Seismic Lifeline Corridors.

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



The guidelines and recommendations provided in the "ODOT's Seismic Implementation: Policies and Design Guidelines," have been followed closely for allocating seismic program funds. Addressing seismic vulnerabilities of bridges on Phase 1 routes remains the priority of the program; however, a few bridges on other program phases have either been replaced due to poor condition or retrofitted/replaced as part of projects funded directly from the House Bill 2017. (e.g. Southern Oregon Seismic Bridge Retrofit.)

Other Funded Seismic Projects

The I-205 Abernethy Bridge Project groundbreaking was the beginning of a new chapter. Not only is this bridge the most significant structure to undergo seismic retrofit to date, it will become the only reliable point for our interstate traffic to cross the Willamette River after a major seismic event affecting the Portland Metro area.

In addition to the seismic retrofit, the project includes widening the existing structure by adding one additional travel lane in each direction. Seismic design showed the need for substructure replacement for most river spans and massive ground improvement was deemed necessary for reducing the lateral soil loads on bridge foundations. Earlier seismic retrofit work on this bridge provided very minimal benefit to the current project. For example, all of the seismic isolation bearings that were installed during the previous project will be replaced as part of the current project. This was a true validation of the significant improvements that are needed for existing bridges in order to remain operational after a major seismic event.

Abernethy Bridge.

Eight more bridges along the I-205 corridor will be either replaced or seismically retrofitted in the near future, with design underway to replace both Tualatin River bridge with seismically resilient and much wider structures. Once the I-205 improvement project is done, approximately 10 miles of interstate will be added to the resilient transportation network of Oregon.

Design is now underway for the Oregon 22 Center St. Bridge project. This project will address seismic vulnerabilities of the Center St. Bridge and provide a much-needed resilient structure, not only for the city of Salem, but for emergency responders to be able to reach further west after a major Cascadia event. Although not exactly the same size as the Abernethy Bridge, complexity and the nature of seismic deficiencies make the retrofit design of Center St. Bridge as challenging as for any major structure. Poor soils, age variation for different sections of the bridge, and high traffic volume are just a few of the challenges that the project team will be facing with this project.

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 modernized for capacity or condition-based reasons.

In May 2022, Oregon 38 traffic was shifted from the old bridge to the new Umpqua River Bridge (Scottsburg Bridge). This was a big step toward making Oregon 38 a resilient route and allowing for emergency response and economy recovery after a Cascadia event. The 93-year-old bridge survived the increased traffic demand over the years, but it could have failed even under a minor seismic event.

The new Scottsburg Bridge open to traffic.

The Southern Oregon Seismic Bridge Retrofit is an additional seismic project funded by House Bill 2017. This project is divided into four separate projects. The buckling restraint bracing (BRB) is a common technology to provide seismic resilience in new multistory buildings, but it's an ODOT "first" to adapt it for bridge retrofit applications. The first project coincided with a pilot project to evaluate the cost-benefit of using the 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 (I-5 northbound and southbound over Leland Road) 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. Construction is already complete on two bridges with the completion date for the entire bundle extended to January 2024. Construction on the third project, also consisting of five bridges, was completed in November 2022. One of the bridges on the third project is supporting a detour route for several vulnerable bridges on I-5. The forth project includes replacing three bridges on another detour route for I-5. This project is currently under design, with the bid date in January 2023 and construction expected to start shortly thereafter.

The Southern Oregon Seismic Bridge Retrofit supports a strategy that focuses on mitigating seismic impacts along the I-5 south of Eugene and Oregon 140, which are key lifeline routes to and from the Rogue Valley.

Bent strengthening using buckling restraint bracing (BRB) on Southern Oregon Seismic Bridge Retrofit Project. Photo by Bob Grubbs

Most of the seismic impacts on these 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.

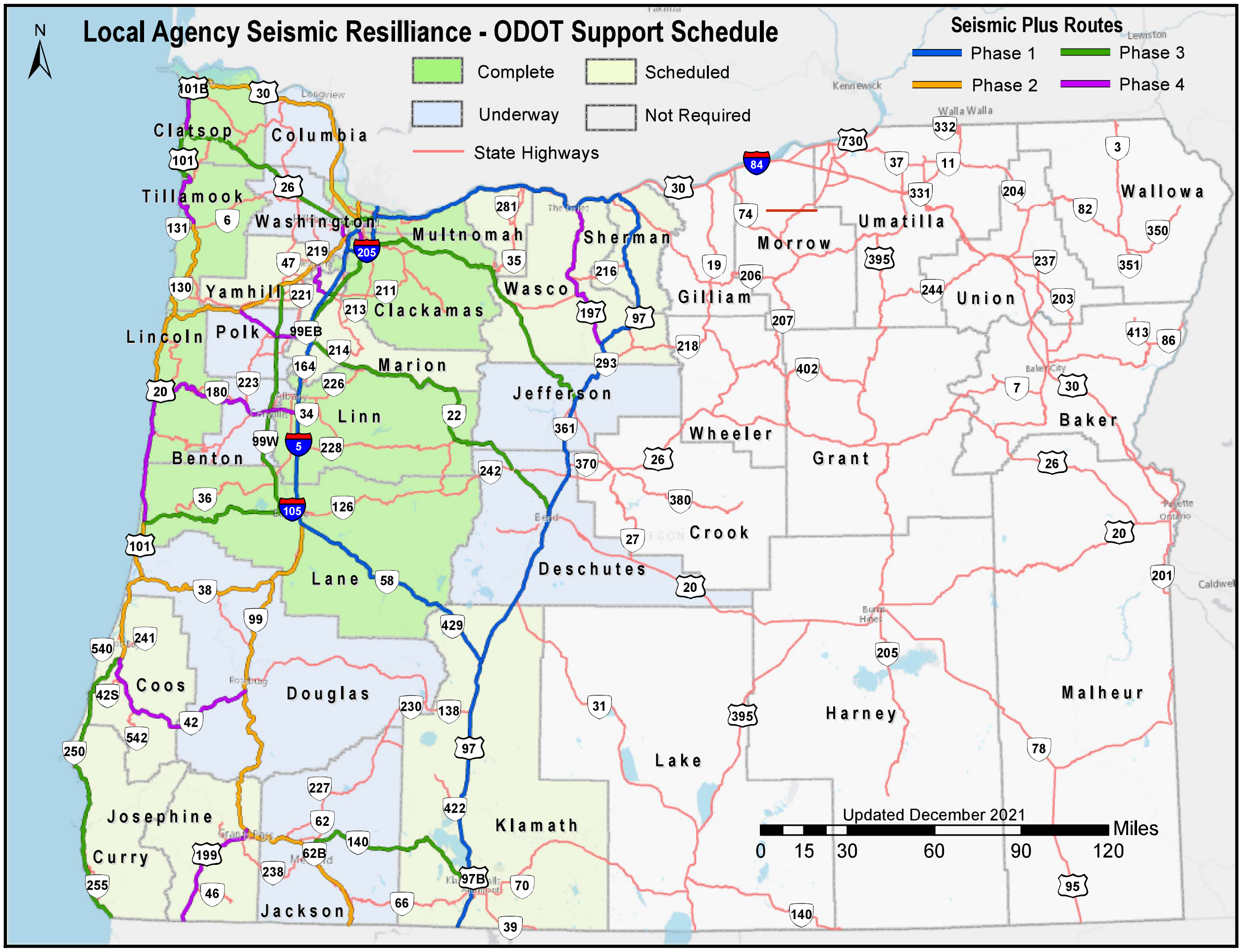
Local Agency Seismic Resilience Support

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. 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 (EVs) in all new load ratings. Due to the concentrated loading of these vehicles, there has been an increased need 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 load rating analysis determines the capability of a bridge to carry loads. 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, 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.

≤80,000 lbs GVW

Continuous Trip Permits

Log trucks, milk tank trucks, chip trucks, gasoline tanker trucks, and other semi-trucks that are heavier than legal loads.

≤105,500 lbs GVW

Single Trip Permit Loads

Non-divisible loads like vehicles hauling windmill components; self-propelled cranes.

Variable weights

Emergency Vehicle Loads

Fire trucks and other vehicles equipped to mitigate hazardous situations.

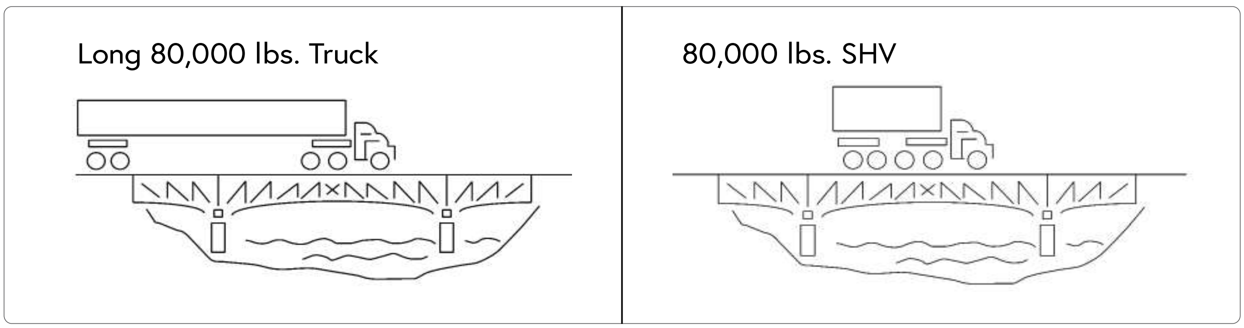
Up to 86,000 lbs GVW with short wheelbases that create highly concentrated loads.

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 SHV than for an 80,000 pound semi-truck.



This illustration shows how a short vehicle with closely spaced axles can produce higher load effects on bridges compared to a longer vehicle of the same weight that has the axles farther apart.

Because of 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 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 with 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 were required to be rated for emergency vehicles by Dec. 31, 2021, which we completed.

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.

Firetruck. (Emergency Vehicle)

The truck shown on this page is an example of the 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 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.

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, ODOT performs a load rating using a more advanced analysis 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, ODOT may test the materials 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?

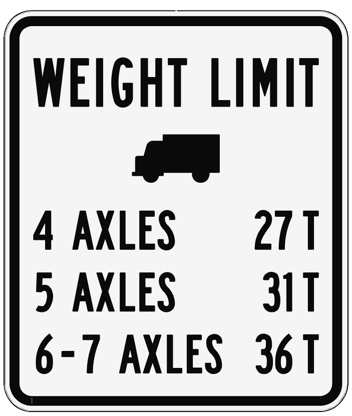
Oregon's economy depends on moving goods efficiently and communities depend on emergency vehicles having ready access to all bridges. Therefore, we make every effort to ensure bridges are safe and reliable. If a load rating indicates that one or more loads exceed the bridge capacity, ODOT uses the under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

Actions include:

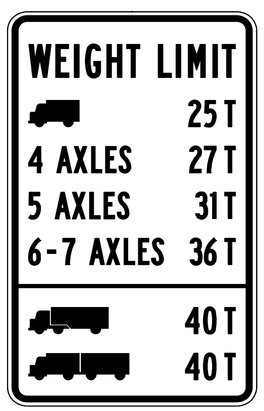
- Coordinating with local agencies, the freight industry and stakeholders including FHWA.
- Monitoring by the region bridge inspector (if not already begun.)
- Reviewing impacts of a load restriction and alternate routes.
- Assembling a response team by ODOT Maintenance to generate an action plan for state owned bridges.
- 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.

ODOT is currently on track to meet federal mandates to have all bridges load rated, and if necessary, load posted for SHVs by Dec. 31, 2022. There are many state and local agency bridges across Oregon that have already been load posted for SHVs.



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.

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.

Why a Recent Increase in the Number of Load Posted/ Restricted Bridges?

Per FHWA memorandum HIBT-10, every US state and US jurisdiction has until Dec. 31, 2022, to have every NBI bridge re-load rated to include the SHVs. In order to meet this federal deadline, over the last year ODOT has worked with our consultant engineering firms to complete the load ratings of over 1000 state and local bridges. As a result of completing so many load ratings in a relatively short time, there has been a slight increase in the number of bridges that have rated out low for legal or permit vehicles and thus required either a load posting for legal vehicles or a restriction for permit loads.

Even though these last remaining bridges to be load rated for SHVs were considered low risk due to them having existing rating factors for the traditional legal vehicles of 1.3 or greater, some of them ended up with much lower rating factors after being re-load rated. This was due to differences in current load rating methods versus previous practices. The main difference is that previous load rating methods only analyzed the maximum force locations of each member, or bridge component, that were required to be load rated within a bridge. Current load rating procedures not only analyze these same maximum force locations, but also look at every change in structural details (changes in reinforcing, material properties, and member geometries) that will have an effect on the member capacity through the entire bridge. Since our current load rating procedures are now looking at every detail that can change a member's capacity throughout the entire bridge, we often find locations on a bridge that now control the load rating that were never looked at or considered in the older load rating methods since they are not at maximum force locations. This is the reason why some bridges that had previously passed a load rating analysis are now rating out low and require a load posting/restriction. Having a relatively large number of bridges be re-load rated in a short time has resulted in an increase in load postings/restrictions when compared to previous years.

2022 TUNNEL DATA

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.

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. ODOT district maintenance crews perform tunnel drainage inspections each year.

National Tunnel Inspection Standards (NTIS) Implementation

In 2017, FHWA instituted a requirement that tunnels be inspected. Now, the National Tunnel Inspection Standards (NTIS) for the inventory, inspection and load rating of tunnels is available to the public. States are 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 2022 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.

Oneonta Tunnel Prior to Eagle Creek Fire.

Oneonta Tunnel during the Eagle Creek Fire.

Oneonta Tunnel after 2017 Eagle Creek Fire.

Oneonta Tunnel after 2017 Eagle Creek Fire.

Oneonta Tunnel after reopening

Oneonta Pedestrian Tunnel

The Oneonta Tunnel is a bicycle/pedestrian tunnel located immediately adjacent to U.S. 30 (Oregon Highway No. 100) near milepost 20.15. It is a rock tunnel originally built on the Historic Columbia River Highway. It was opened in 1914 and continued to carry traffic until it was closed in 1948 and filled with rubble while the highway alignment moved slightly to avoid the need for a tunnel altogether.

In 2009 it was restored as a pedestrian and bicycle tunnel as part of the Historic Columbia Highway State Trail. As part of the restoration it received a decorative timber lining. In 2017, the Eagle Creek Fire caused a large amount of fire damage throughout the Columbia Gorge, including the Oneonta Tunnel. The timber liner was completely consumed, turning the interior of the tunnel into an oven and damaging or destroying existing shotcrete strengthening for the rock walls. The tunnel was therefore closed.

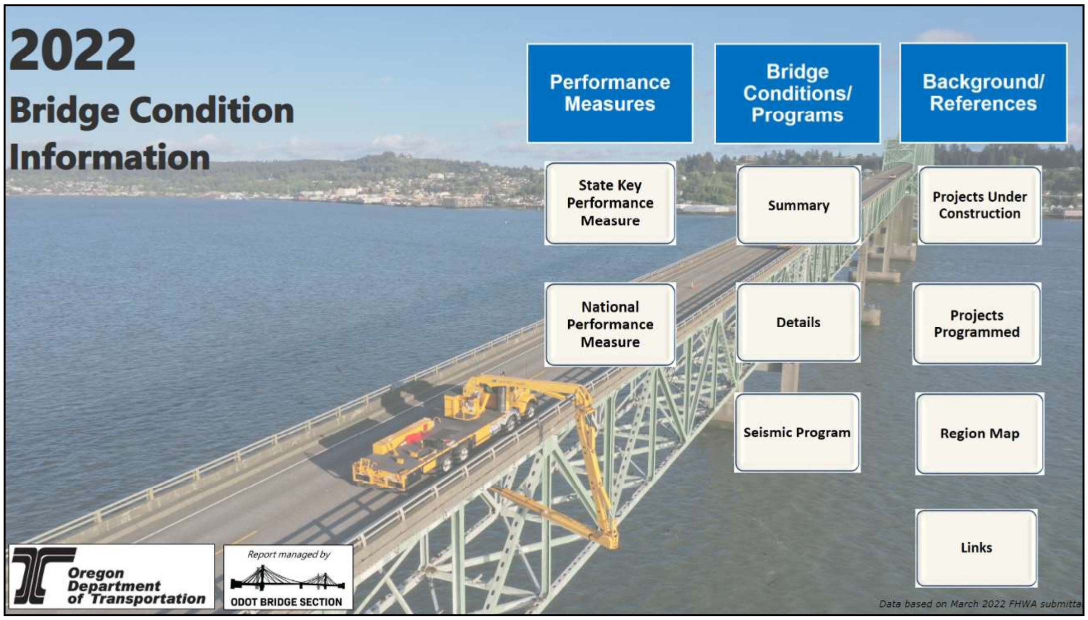
In 2020, David Evans and Associates and Conway Construction began restoration of the tunnel. The work involved scaling the rock slopes outside the tunnel to address potential rockfall, removing debris from the tunnel, strengthening the rock tunnel as needed with shotcrete and rock bolts, replacing the decorative timber liner and replacing the pavement in the tunnel. The work was completed and the tunnel reopened in May 2021.

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 2022 *(based on 2022 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	Newly Opened	ODOT (Pedestrian traffic only, to be inspected)
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 2022 Interactive Bridge Condition Report.
https://www.oregon.gov/odot/Bridge/Pages/BCR.aspx

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

2022

Bridge Condition Report
& Tunnel Data

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