Testimony of

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HIGHWAY BRIDGE INSPECTIONS

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Oregon Department of Transportation

Introduction
Chairman DeFazio and members of the Committee, my name is Matthew Garrett, and I am the Director of the Oregon Department of Transportation (ODOT). I am pleased to have the opportunity to discuss bridge inspections with you today.

In Oregon ensuring the safety and reliability of the transportation system is our top priority, and like all states we take our responsibility for inspecting bridges very seriously. Thorough bridge inspections, performed at regular intervals by individuals who have the proper training and equipment, are an important part of maintaining a transportation system that is safe and reliable. The information that is gathered from these inspections is used to develop both short term maintenance plans and long term investment strategies and is thus critical to our efforts to preserve the transportation system.

In recent years, Oregon has invested significant resources in preserving the state's bridges. The three Oregon Transportation Investment Acts (OTIA) passed by the Oregon Legislature provided a total of nearly $1.8 billion to repair and replace Oregon's bridges. The OTIA III State Bridge Program alone invested $1.3 billion in repairing cracked bridges on the state highway system. In addition, in SAFETEA-LU this committee provided Oregon a $200 million infusion of funding for the state's bridges that is being used to extend the OTIA III bridge program and meet additional unfunded needs.

The National Bridge Inspection Program
In 1968 Congress passed legislation requiring the Secretary of Transportation to create the National Bridge Inspection Standards (NBIS) and to develop a nationwide bridge inspection program. This action came in response to the collapse of the Silver Bridge in West Virginia in which 46 people died. While the initial NBIS established bridge inspection frequencies, inspector qualifications, and rating procedures, there were issues that were not addressed at that time. The failure of the Mianus River Bridge in Connecticut in 1983 highlighted the need for advanced inspections of certain steel bridges. In 1987, the failure of the Schoharie Creek Bridge in New York as a result of scour (undermining of the foundation material by water) highlighted the need for underwater inspections.

The bridge inspection program is a comprehensive set of procedures that provides a strong basis to monitor the condition of hundreds of thousands of bridges throughout the country in order to protect public safety and preserve the infrastructure that is vital to our economy and quality of life. As with many other important programs, the bridge inspection program is a partnership between the federal government and the states. While the Federal Highway Administration sets the standards and monitors states' implementation, the states actually develop and implement the programs.

Bridge Inspections in Action
There are three general types of bridge inspections: routine inspections, fracture critical inspections, and underwater inspections. During routine inspections, engineers and trained inspectors look for any signs of distress that could compromise the structural integrity of the bridge. The conditions are documented and monitored, and repairs are recommended if necessary. Inspectors may also order additional investigation if needed, such as taking samples

of the concrete deck for testing. The same process is followed on the above-deck superstructure and the substructure (foundations).

States use a number of inspection techniques. Visual inspections led by engineers are by far the most common and widely used method of inspection. In addition to documenting visible damage, degradation, and distress in structural elements, visual inspection can include quantitative measurements such as loss of steel from corrosion or the size of cracks in concrete. The benefit of visual inspections is that we can collect a large volume of data on the condition of the components of every bridge. The disadvantage is that visual inspections are costly and time consuming.

When necessary, states also use a number of non-destructive testing (NDT) techniques to supplement visual inspections.

- The Magnetic Particle method helps detect cracks in steel.
- Ultrasonic testing identifies cracks in steel that are either too small to be seen, or are beneath the surface of the metal.
- Accoustic Emissions testing measures crack growth in concrete and steel.
- Impact-Echo testing helps find delaminations (internal cracks) inside concrete.
- Resistograph measures the extent of rot or decay inside timber.

A “snooper” crane leans over the edge of a bridge to inspect elements below the bridge’s deck.

We select an NDT method depending on the type of material used in the bridge and the type of defect we suspect based on visual inspection and experience. While these techniques all have their virtues, they also have drawbacks. For example, almost all these technologies require specialized training and specialized equipment.
Some other innovative techniques include "health monitoring" of bridges using special gauges and sensors. Oregon is advanced in our use of advanced technology to assess the condition of bridges. We currently have instruments on seven bridges and have installed a device that uses air pressure to measure scour at bridge foundations on one other bridge.

While all bridges receive regular routine inspections, the level and frequency of inspections varies from bridge to bridge. Bridges designed to modern standards and in satisfactory or better condition will receive a routine inspection every two years, which is sufficient for this population of bridges. States can request Federal Highway Administration approval to inspect certain bridges—usually newer structures—at up to a four-year interval. On the other hand, older bridges may receive more frequent routine inspections based on the condition of the bridge, as well as a number of more specialized inspections based on the design.   For bridges that have deteriorated the inspection interval is reduced to one year, or in isolated cases, to an even shorter interval. The shorter inspection intervals are kept in place until repairs are made or the bridge is replaced.   In Oregon we have 78 state owned bridges and 161 non-state owned bridges, out of a total of 6626 bridges in the state, that are inspected more often than every two years.

In addition to routine inspections, bridge inspectors conduct "fracture critical" inspections of steel bridges every two years, and teams of divers conduct underwater inspections of bridge piers that are in waterways. The frequency of underwater inspections differs from state to state and depends on the bridge's condition, but the federal standards require underwater inspections at least once every five years.

Improvements to the NBIS

The bridge inspection program has been continuously modified and improved as new knowledge, technologies, and standards are incorporated. In fact, the NBIS were significantly updated and strengthened in January 2005. Several important changes were made. The update shortened the inspection interval for fracture-critical bridges to no more than 24 months. Fracture critical bridges are those that could collapse if only one part of the bridge failed. Like some states, Oregon has used a more detailed evaluation of fracture critical bridges to determine a safe inspection frequency for these bridges since 1996.

The update also increased qualifications for bridge inspectors to ensure that quality work is being done by highly skilled and well-trained professionals. Underwater inspectors are now required to have 80 hours of training, and the qualification requirements for Inspection Program Managers and Team Leaders were increased. Non-licensed engineers must now take a ten-day class and have five years experience, with most of that experience taking place directly in field inspection, to become a Team Leader.

States must also now have a quality control and assurance program in place for their bridge inspection program. The federal standards specify that the program should include periodic field review of inspection teams, periodic bridge inspection refresher training for program managers and team leaders, and independent review of inspection reports and computations.

These recent updates to the National Bridge Inspection Standards demonstrate that the Federal Highway Administration and the states are diligent in updating and advancing inspection standards. If the National Transportation Safety Board's inquiry into the cause of the I-35W bridge collapse indicates that the inspection program bears some of the blame, we would welcome additional improvements to the program. However, the states believe this is a very strong program and that we should clearly identify any deficiencies that need to be addressed before imposing additional requirements.

States Exceed Minimum Standards

The NBIS regulations set minimum requirements that all states must meet, but most states exceed the standards. The standards set a very strong foundation and then allow states to address their specific concerns by tailoring their programs. For example, Oregon has elected to inspect all state highway bridges at least six feet long, even though the federal program only requires inspecting bridges with an opening of 20 feet or greater.

Oregon also has a very strong underwater inspection program. As a state that experiences regular heavy rainfall and flooding, we face problems with bridge scour as water erodes material around bridge piers and undermines bridge foundations. Oregon's underwater inspection program is one of the oldest in the country, having been created after floods in 1964 damaged several bridges. ODOT's highly experienced underwater crew performs regular inspections of bridges subject to erosion of the river bed material. Since the inception of the underwater inspection program the dive team has identified several bridges with considerable damage to the

A member of ODOT's underwater dive team inspects a bridge's substructure.

foundation from scour. In addition, ODOT conducts underwater "sounding" of streambeds to monitor or confirm that scour is occurring on some of our bridges with scour history. When scour issues are identified, they are addressed and the bridge foundations are stabilized.

Like other states, Oregon has a robust and detailed quality assurance program to ensure that bridge inspections are accurate and complete. We adopted this program in 1994, and it far exceeds the minimum federal standards. Each year, a portion of each inspector's work is reviewed by a team that includes both headquarters personnel and other inspectors. The result has been greater consistency among inspectors working in different parts of the state. In addition to the in-house quality assurance effort, the Federal Highway Administration also takes part in reviewing individual bridge inspections and the bridge inspection process, including documentation.

ODOT has implemented several more stringent requirements for inspector qualifications. In order to become a certified bridge inspection team leader in the State of Oregon, the applicant must pass a field proficiency test to assure that they can perform the work in a competent manner. The test is an actual field inspection, which is then reviewed on site by a team of very experienced engineers to check for compliance with established standards with a very narrow margin of error. ODOT has also developed a unique performance measure that actually measures whether an inspection is acceptable or not and whether the inspector is producing an acceptable level of service.

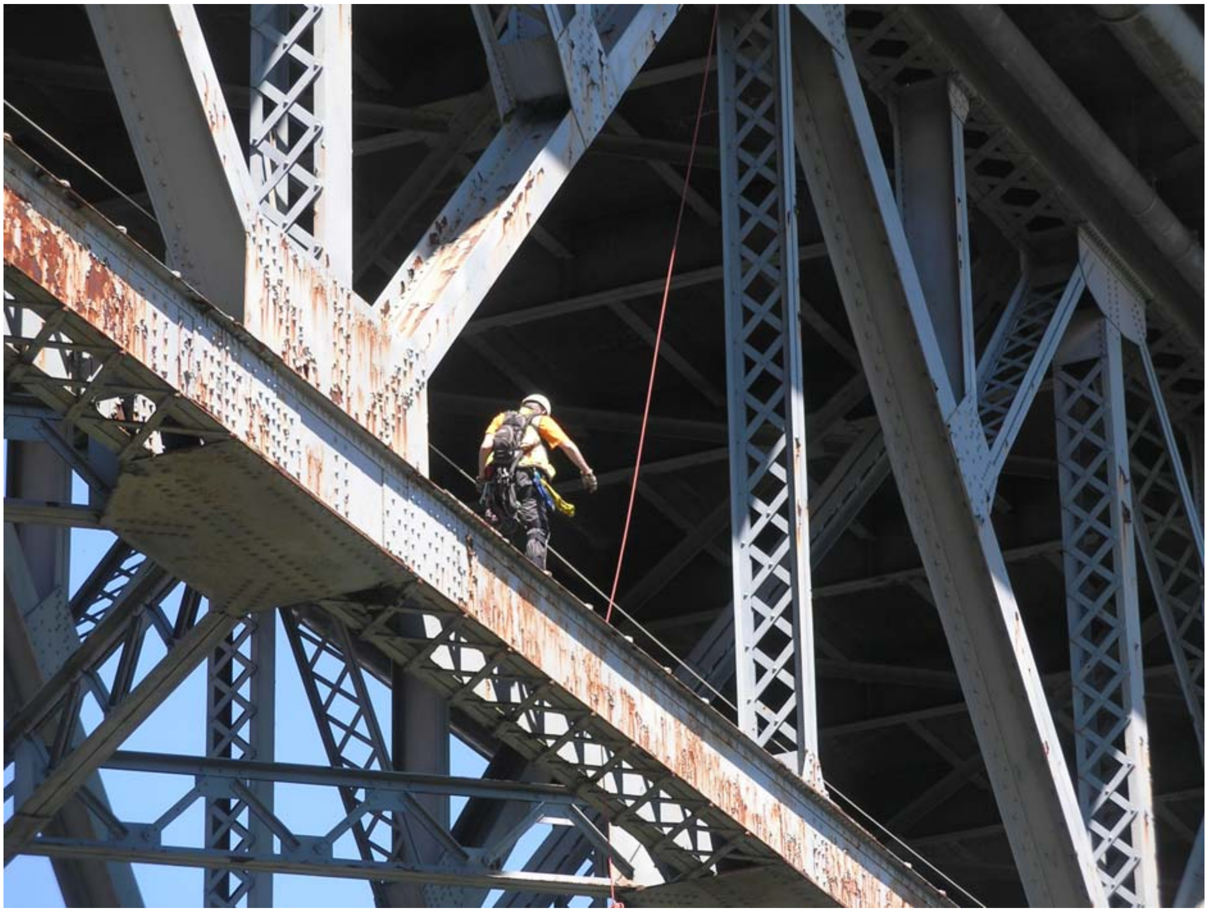
Bridge inspection requires significant resources. Federal regulations give states responsibility for the inspection of all state, local and other (non-federal) public agency bridges. In addition to ODOT's five in-house Region Bridge Inspectors and two assistant bridge inspectors, ODOT uses consultants for in-depth inspection of several major bridges and also for all local agency bridge inspections. ODOT's total cost for bridge inspections is approximately $3.7 million per year. If additional inspections are required under a revamped bridge inspection program, this cost will rise, which will reduce the funding available to repair and reconstruct bridges.

Bridge Inspection Data Drives Investments in Maintenance and Preservation

Bridge inspection data is the primary information that is stored in our bridge management system. This information is used to program bridge maintenance, rehabilitation, and replacements. Immediate concerns that are uncovered by inspections can be addressed through a combination of temporary closures, emergency repairs, and load restrictions. Bridges that are in poor condition are included in the "Critical Follow-up List." These bridges get special attention to address needs so that they can be removed from this list. For example, this summer an inspector identified deteriorated timber piles supporting a bridge that is on the National Highway System. After this discovery we inspected the bridge monthly and restricted loads restricted until repairs were completed in early October.

I would like to provide you a larger example of how the bridge inspection program helps identify and address problems. When our bridge inspectors first noted structural cracks in some of Oregon's reinforced concrete deck girder bridges that were constructed during the 1950s, we used the Bridge Inventory database to identify all bridges of this type. We then used access equipment to get an "arms length" inspection of the cracks so that they could be fully documented and we could monitor any further changes in condition. Inspections determined that the cracks were extensive, occurring in hundreds of bridges in the state. The problem would significantly impact the movement of freight because many bridges on the Interstate and other key freight routes would require weight limits if they were not repaired or replaced. This would require lengthy detours for trucks that would impose huge additional costs on the movement of freight. As a result, the economic impacts of these cracked bridges would be huge; a study ODOT prepared determined that the state's deteriorating bridges could cost the state's economy 88,000 jobs and $123 billion in lost productivity over the next two decades if left unaddressed. In order to determine which bridges would require weight limits and which needed to be repaired or replaced, we worked with Oregon State University to build full scale bridge components with 1950s details. We then tested these components to determine the loads that would cause them to fail.

These bridge inspections helped identify a major problem on our state highway system that prompted the Oregon Legislature to invest over a billion dollars in our state's bridges. The research Oregon State University conducted helped guide our investment under the OTIA III State Bridge Program. By better understanding the loads our bridges could bear we were able to repair rather than replace many bridges and take some off the critical list entirely.



An ODOT bridge inspector examines rust, corrosion, and paint failure on a state highway bridge near downtown Portland.

The OTIA III State Bridge Program and the bridge program funded through our Statewide Transportation Improvement Program (STIP) will significantly reduce the number of structurally deficient bridges on the National Highway System (NHS) in Oregon. Oregon has 206 structurally deficient bridges, and 99 of those are on the National Highway System. By 2011, state and federal investments in bridges will have eliminated 67 of these structurally deficient bridges on the NHS.

However, OTIA III addressed only a portion of one problem—cracked bridges on freight routes—at one point in time and left significant bridge needs unmet. We estimate that in Oregon over the next 25 years the gap between available bridge funding and our need for bridge repairs and replacement will reach $3.2 billion. Even with the OTIA III funding, Oregon will still have many structurally deficient bridges, primarily bridges that are not on the NHS, which may remain in service for many years. The deterioration of these older bridges will not be addressed with our current level of funding. These bridges already require a greater level of inspection effort than modern bridges that are in satisfactory condition. As the average age of Oregon's bridges—already at 50 years— continues to rise, even more resources will need to be dedicated to bridge inspection, maintenance, and management.

Conclusion
In the 40 years since the National Bridge Inspection Standards were first developed, the inspection program has matured to become a strong and comprehensive program. Bridge inspections performed to the federal standards have identified several Oregon bridges with structural and scour issues that were repaired with little fanfare or impact to the public. Oregon's inspections of steel deck truss bridges that followed the Minneapolis bridge collapse confirmed the quality of the existing inspections, because no new deficiencies were noted. The National Bridge Inspection Standards have demonstrated the flexibility to change as new concerns are identified. Any changes to the National Bridge Inspection Standards resulting from the Minneapolis bridge collapse should build on the excellent work of the past 40 years and ensure that states continue to have the flexibility to focus their programs on their particular needs.