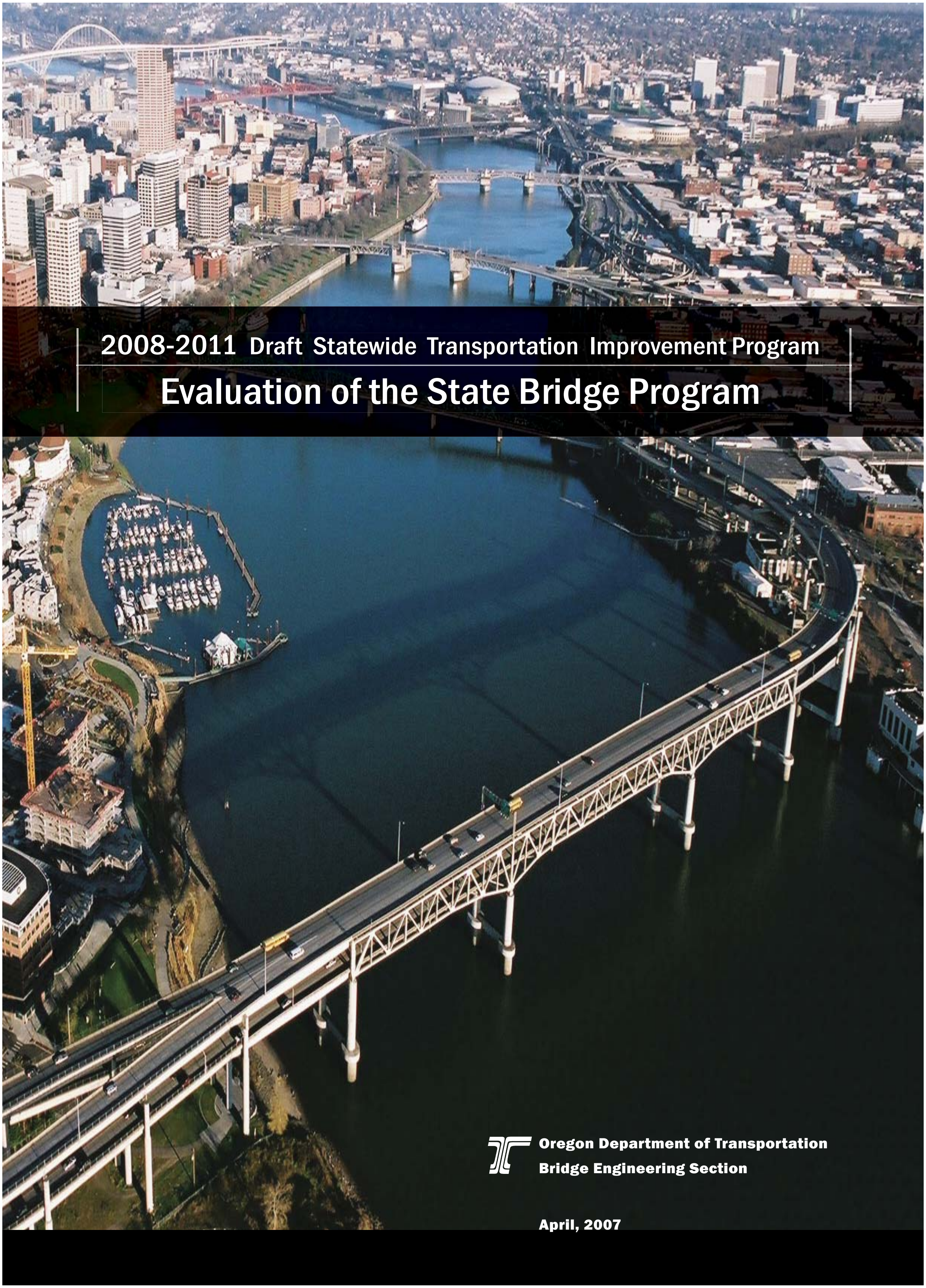

2008-2011 Draft Statewide Transportation Improvement Program

Evaluation of the State Bridge Program

Oregon Department of Transportation
Bridge Engineering Section

April, 2007

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2008-2011 Draft Statewide Transportation Improvement Program

Evaluation of the State Bridge Program

Executive Summary

This report presents an evaluation of the 2008-2011 draft Statewide Transportation Improvement Program (STIP) State Bridge Program and its projected impact on bridge conditions through the end of the program. It has been prepared to support the development of the 2010-2013 STIP. It is anticipated that the primary audience for this report is Oregon Department of Transportation (ODOT) Executive Staff and the Oregon Transportation Commission (OTC).

The life expectancy of a bridge depends on the design standards in place at the time the bridge was built, materials used, environmental and operating conditions, maintenance and preservation projects. Typically, a bridge lasts from 50 to 80 years. Significant changes have occurred in bridge design since the beginning of the interstate era in the 1950s. Design standards have changed to address the heavier, longer loads of today's truck freight industry and higher vehicle speeds resulting in greater impact loading. Significant increases in traffic volumes also have affected design standards. **Almost one third of the state's bridges are over 50 years old.** This means that many are nearing the end of their design life, and were built to standards and designs that are no longer valid for current and future traffic needs. These bridges require extensive rehabilitation and/or replacement.

As a result of planned bridge construction through 2011, including OTIA III and special funding, 96 fewer bridges will be deficient by 2011 and a total of 102 bridges will no longer be deficient by 2014. Unfortunately, continued physical deterioration of the remaining bridges combined with deferred maintenance will offset these improvements in condition, keeping overall conditions relatively flat through 2011. The Bridge Program will continue to increase the cost effectiveness of projects by fully evaluating repair versus replacement decisions.

At the expected level of investment after 2011, bridge conditions are expected to decline again through 2017.

The overriding goal of the State Bridge Program is to keep bridges in the best condition possible within the limits of available funding. In the past, bridge program funding has not allowed sufficient rehabilitation projects to occur at the most cost-effective time in the life cycle of a bridge.

The following goals for the current State Bridge Program have been identified:

- Add value to Oregon by improving the performance of state bridges along freight corridors at critical points, where people and goods are restricted or at risk because of capacity, condition or functionality issues.

- Maximize investment by building bridges that require less maintenance, have a longer life expectancy and will meet standards and community expectations well into the future.

  To accomplish this, the State Bridge Program will:

- Concentrate STIP projects for state bridges on freight and National Highway System (NHS) routes with a priority for addressing load safety and load capacity issues to assure continued route continuity.

- Allocate sufficient funding for functional and safety needs to increase overall fair or better condition rate for state bridges to 75%.

- Maintain high value structures, such as major river crossings, movable and historic bridges.

- Implement mandatory national bridge program standards.

- Continue to work towards improved performance measures that reflect Oregon conditions and OTC priorities.

Key findings of this report include:

- The 2008-2011 State Bridge Program STIP target suffered an overall reduction of $55.8 million. This represents an 18% overall reduction in our ability to repair or replace aging bridges.

- Beginning in 2010, OTIA III debt service is expected to be approximately $31 million annually and will no longer be available to the State Bridge Program through the STIP.

- During the period between 1990 and 2001, Oregon had an average construction cost index growth rate of 2.3%. Since 2004, we have experienced dramatic spikes in construction costs. In 2005, the construction cost index growth rate was 13.1%.

- According to ODOT's Chief Transportation Economist, the current Construction Cost Forecast and an assumption of 4% inflation in the State Bridge Program STIP from 2005 to 2006 and 2007 results in an unexpected loss in purchasing power of 12.93% for the two years. On a per year basis this is a 6.3% annual cost escalation "shortfall".

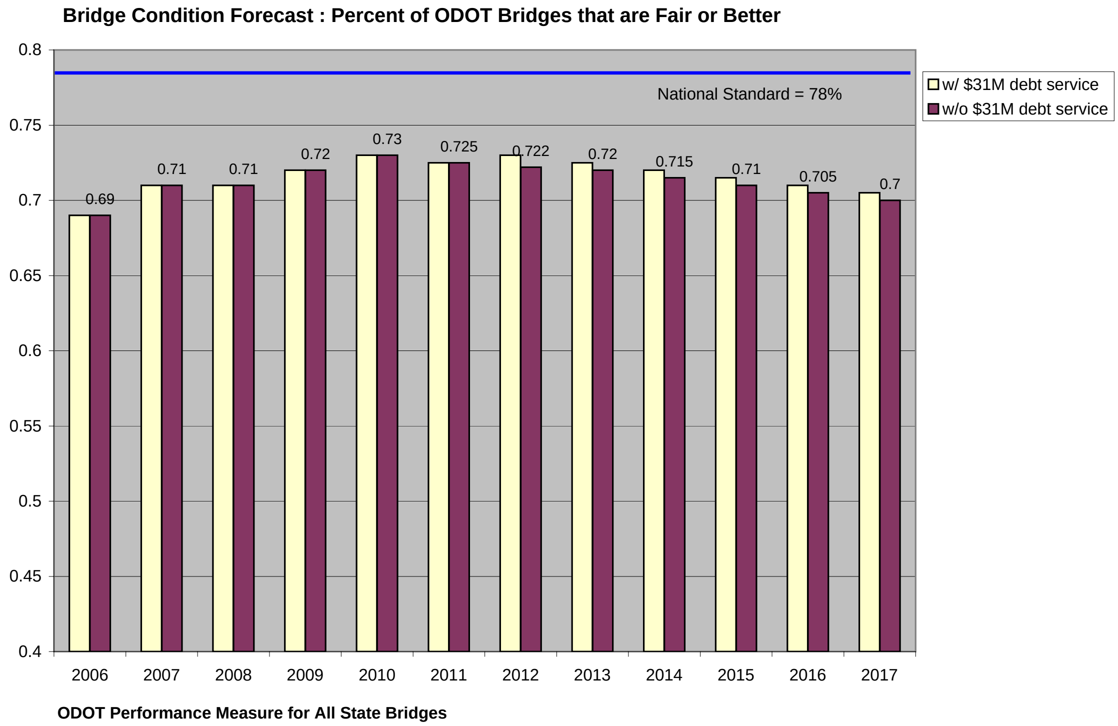
- At this rate we will be at least 75 bridges "behind schedule" in terms of scheduled replacements by the end of the OTIA III era – in spite of the huge investment of the OTIA III program.

- When Washington DOT and Idaho DOT schedule a major rehabilitation of a shared bridge, such as the Astoria Bridge, ODOT can not defer our obligation to fund our portion.

- Approximately 50% or 1,300 state bridges have not been load rated. With the implementation of Load Resistance Factor Rating (LRFR) and the creation of Oregon-specific rating factors, consultants have needed training to enable them to complete complex load ratings. Consultant load rating work is expected to exceed $1 million per year for the next six years until all state bridges are load rated.

- Bridge inspections are generally required on a two year interval. The inspection of large and complex structures is increasingly being contracted due to the limited size of the bridge inspection staff. Estimated cost of contracts is expected to be approximately $1.2 million per year.

- Current performance measures do not adequately capture all of the investment priorities established for the State Bridge Program by the Oregon Transportation Plan and the OTC.


Bridge Condition Forecast : Percent of ODOT Bridges that are Fair or Better
National Standard = 78%
w/ $31M debt service
w/o $31M debt service
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.69
0.71
0.71
0.72
0.73
0.725
0.722
0.72
0.715
0.71
0.705
0.7
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
ODOT Performance Measure for All State Bridges

Introduction

The State Bridge Program is one of the primary components of the Oregon Department of Transportation's (ODOT) Statewide Transportation Improvement Program (STIP). This report presents an evaluation of the 2008-2011 Draft STIP State Bridge Program and its projected impact on bridge conditions through the end of the program. In addition, this document describes the bridge program strategy and assumptions used during the project selection process and the resulting state bridge program STIP allocation by Region.

Although this report is primarily intended to address the State Bridge Program STIP, it is impossible to discuss the condition of state bridges and funding levels without reference to OTIA, especially OTIA III. OTIA III is a key component in ODOT's overall bridge investment strategy. However, as will be discussed in this report, OTIA III alone does not solve the problem of continued deterioration of state bridges. The purpose of this report is to support a level of investment in state bridges through the STIP, that when combined with OTIA, the Major Bridge Maintenance and District Bridge Maintenance Programs, will result in generally improving bridge conditions.

The objective of the State Bridge Program is to provide improvements (repair or rehabilitation) to extend the service life of existing facilities where possible and to replace bridges when necessary. Projects may include:

- Rehabilitation and replacement projects
- Repair or replacement of cracked girder bridges
- Maintenance and preservation
- Bridge rail replacement
- Tunnels
- Seismic retrofitting

Funding levels approved by the Oregon Transportation Commission (OTC) for 2008 and 2009 for the 2006-2009 STIP provided an average of $49.7 million per year for construction (CN) and an additional average of $14.2 million per year for preliminary engineering (PE), right of way (ROW) and utility relocation (UR) costs for a total average of $63.9 million per year.

For the 2008-2011 draft STIP, the funding levels provided by the OTC provided an average of $46.7 million per year for construction (CN) and an additional average of $5.6 million per year for preliminary engineering (PE), right of way (ROW) and utility relocation (UR) costs for a total average of $52.3 million per year.

In addition to bridge construction projects, the State Bridge Program STIP target must also fund the expenses related to bridge inventory, inspection, load rating, bridge health monitoring, the bridge management system and some program administrative costs. These costs have been increasing significantly, in large part due to the costs of bridge inspection and load rating contracts which will be discussed later in this report. The current estimate for the 2008-2011 period is approximately $5.1 million per year.

The total State Bridge Program STIP target for 2006-2009 is $314.6 million. The total State Bridge Program STIP target for 2008-2011 is $258.8 million. This reflects a reduction in State Bridge Program funding of $55.8 million.

Beginning in 2010, OTIA III debt service is expected to be approximately $31 million annually and will no longer be available to the State Bridge Program through the STIP.

This is a reduction of $27.9 million per year and represents over an 18% reduction in our ability to repair or replace aging bridges.

State Bridge Program

Bridges and the (Freight) Highway System

Roads and highways form the basic circulation system for moving from home to businesses and other destinations. According to the Oregon Transportation Plan, trucks use the system to carry about 76 percent, or more than 250 million tons annually, of commodities to destinations both in and outside the state. Oregon's highway system is part of a broader Northwest and West Coast regional, national and international transportation system. Maintaining good access to those systems and supporting federal efforts to improve them is important to Oregon.

FHWA predicts that the volume of U.S. Freight will double by 2020. By 2020, the volume of freight traffic on the U.S. road will increase by 70%. The Port of Portland indicates that Portland origin/destination freight volume will double by 2030, and that freight mobility is largely dependent on trucks. While the Portland metropolitan area is the economic hub of the state with a wide diversity of businesses and key transportation facilities, Oregon's economy is dependent on products and services from all parts of the state. The transportation system must provide connections statewide so people and goods from all areas of Oregon and North America can contribute to and benefit in the state's economic vitality. To this end, ODOT has designated the State Freight Highway System.

The State Freight Highway System plays an important role in bridge investments. Bridges can be the "weak link" in the movement of large trucks. Of particular concern is load capacity, vertical clearances and deck width.

ODOT manages the routing of heavy trucks and over-dimensional commercial vehicles through a permit system. To accommodate the gross weight, axle weight, and axle configuration of heavy trucks in Oregon, we must consider the needed funding levels for strengthening or replacing bridges with inadequate load capacity. Most Oregon bridges were designed and built in an era when today's truck loads, as well as heights and widths were not anticipated. A continued investment must be made in the state's highway bridges to increase the safety for all users and provide for improved freight mobility.

Bridge Vertical Clearance

The six key initiatives of the Oregon Transportation Plan are supported by seven goals. This first goal is "Mobility and Accessibility". Maintaining an appropriate vertical clearance is instrumental to movement of mobile homes, construction equipment, construction materials, and over-dimensional loads. While the vertical clearance for new bridges is detailed in the Highway Mobility Operations Manual, there are bridges that will remain in service for many years that are a barrier to freight. By analyzing and addressing vertical clearance issues on a corridor basis, routes can be opened up and freight moved from detour routes to main highways.

Oregon's existing transportation policy has targeted the elimination of vertical clearance pinch points to provide viable freight routes. The Bridge Section has worked with the trucking industry to determine the priority of freight routes for both improved vertical clearance measurement information and elimination of vertical clearance obstructions. The Bridge Section is developing an accurate laser-based roadway clearance measurement system. In 2006, the State of Oregon received a grant under SAFETEA-LU that will provide for the elimination of 13 vertical clearance obstructions that impede successful transport between Canada and Mexico. However, in addition to the Interstates, the bridge vertical clearance restrictions on locally important freight and feeder routes must be corrected. The vertical clearance for all new structures on the Interstate is 17 feet, 6 inches. Following the process outlined in ODOT's Mobility Manual, by agreement with the trucking industry, retrofit of the existing bridges with the SAFETEA-LU grant will be 16 feet, 6 inches. To meet federal requirements for deficient or "poor" vertical clearance on Interstate bridges, the vertical clearance must be less than 15 feet.

Bridges as Financial Assets

With the adoption of the Oregon Transportation Plan on September 20, 2006, the Oregon Transportation Commission adopted six key initiatives. Although the

State Bridge Program has an interest in each of the initiatives, we are largely driven by the first initiative – "Maintain the existing transportation system to maximize the value of the assets". Our goal is to protect the investment the state has made in these assets and assure they serve the transportation needs of the state for as long as possible. Implicit in this goal is the reduction of future costs resulting from inadequate or untimely maintenance and rehabilitation actions.

A typical asset management scenario of the state's bridge replacement needs would indicate that based on an existing inventory of 2,700 bridges and a bridge life expectancy of 100 years, a replacement schedule of an average of 27 bridges per year would be required. In the real world, the factors affecting the life expectancy of a bridge include the construction material, the construction "era", and the environment. (An additional complication is the 30 large historic bridges that are being maintained as a significant cultural resource.) Overall, the average expected life expectancy of the current inventory of ODOT bridges is likely to be much lower than 100 years.

By setting the expected life of our bridges at an optimistic 100 years, the overriding assumption is that each of the bridges in the inventory will receive:

- adequate levels of routine and preventative maintenance;
- periodic rehabilitation;
- the prompt resolution of other problems, such as presented by streambed scour and collision impact damage.

In 2011, the last year currently established, the State Bridge Program Target is $52.1 million. This is a reduction from the $79.2 million 2009 target level of $29.1 million. This reduction is not quite the full anticipated offset for repayment of the OTIA III debt service, which is expected to be $31 million annually. At this level of funding ($52.1 million) in 2011, ODOT will repair 9 bridges and replace 2 with the State Bridge Program funding. This does not include the OTIA III program which will replace 165 bridges and repair 120 bridges over a 10 year period.

At this rate we will be at least 75 bridges "behind schedule" in terms of scheduled replacements by the end of the OTIA III era – in spite of the huge investment of the OTIA III program.

The relationship, potential relationship or lack thereof, between asset management and financial reporting is a subject of interest in the Government Accounting Standards Board (GASB) Statement No. 34. According to the Oregon's Comprehensive Annual Financial Report (CAFR) Oregon has elected to depreciate infrastructure assets rather than use the "modified approach," which would report preservation costs under a qualified asset management system. In ODOT's Annual Financial Report capital assets are charged to expenditures when acquired. These assets are not reported in the financial statements, but are included in the notes to the Department's Annual Financial Report.

The 2005 State of Oregon Department of Transportation Annual Financial Report for the fiscal year ended June 30, 2005 indicates that then current value of the bridge asset was $2.7 billion dollars. If one percent of the value of the asset was allocated for routine and preventive maintenance, ODOT would budget $27 million annually. For 2011, the combined bridge maintenance and Major Bridge Maintenance target set by the OTC is $16.4 million.

As part of the implementation of GASB-34, the State Bridge Program prepared an estimated original cost for bridges constructed prior to 2003. The methodology used calculated a "theoretical replacement cost as is" (based on deck area multiplied by a cost factor), and deflated the cost estimate to the year built (or service year, whichever was later) using a deflator index table. The result has generally been referred to as "Estimated Historical Cost". Intuitively, one would expect ODOT to have original costs for bridges constructed since 2002. It is clear that a total cost new of each bridge constructed is important information for asset valuation purposes. However, there is currently no systematic and reliable means of determining and providing this information. A discussion of the best and most cost effective means of obtaining this information is needed.

Cracked Girder Bridges and the OSU Study

In 2003, the Legislature passed House Bill 2041, known as the Oregon Transportation Investment Act (OTIA) III, signed into law by Governor Kulongoski on July 28, 2003, authorizing Highway User Tax Bonds to be issued to address the problem of Oregon's cracked girder bridges and associated load restrictions on major freight routes. In anticipation of having to repair or replace state bridges, ODOT launched a Statewide Bridge Assessment. Also in 2003, ODOT commissioned Oregon State University (OSU) to conduct a ground-breaking study of cracked bridges to better understand the remaining strength and capacity of state bridges. In the interests of safety, during this period, ODOT limited loads on cracked bridges and tightened its bridge inspection crack guidelines. These initial decisions were based on guidance from the manual for Condition Evaluation of Bridges which directs that when there is severe diagonal cracking that the concrete shear strength should be taken as being zero, with all shear forces carried by the reinforcing steel.

Although the results from the OSU study confirmed that bridges with shear cracks in girders have reduced load capacity, it concluded that there is significant latent strength in these bridges. As a result, ODOT has reevaluated the scope of OTIA III Stage 2 through 5 bridges and the bridge inspection crack guidelines. As of the end of calendar year 2006, the bridge inspection data (and the bridge deficiencies determined from that data) fully reflect the implementation of lessons learned from the OSU research. This has resulted in a change in the bridge inspection "crack guidelines". All bridges have now been inspected under the new policy.

Bridges and CS^3

Through the OTIA III Bridge Delivery Program, ODOT became a leader in linking two nationally recognized philosophies: Context Sensitive Solutions and Sustainability, creating what has become known as Context Sensitive and Sustainable Solutions (CS^3).

CS^3 is:

- A philosophy that combines the principles of context sensitive design (CSD) and sustainability.

- A framework for implementing goals that reflect social values (community values; cultural, aesthetic and historic resources; and diversity), maintain safety and mobility, support economic prosperity, achieve responsible stewardship of the natural environment, and facilitate cost-effective solutions.

- A process for developing strategies that address transportation concerns in the planning, design and construction of the ODOT STIP.

At its best, CS^3 will lead to successful projects. But care must be taken to ensure that it doesn't also automatically lead to more expensive projects. As a lesson learned, the Spencer Creek Bridges provides insight into the potential downside, when care is not taken to address the **entire** project context.

In 2001, the Spencer Creek bridge replacement was programmed for $4,976,000. During the project development process there was significant stakeholder discussion of the aesthetics of the replacement structure. As the project developed through the early stages and into design, the construction cost estimate rose. The low bid for the project at the October 2006 bid opening was $19,759,575.

Bridge Inventory

The State of Oregon owns, and ODOT manages approximately 4,600 bridges and other structures. These include bridges, culverts, tunnels, viaducts, ramps, bicycle and pedestrian structures and movable bridges. Of these, approximately 2,700 structures are included in the National Bridge Inventory (NBI). The NBI includes all bridges that are potentially eligible for Highway Bridge Program (HBP) funding. The condition of bridges in the NBI is used in determining the amount of HBP funding that is made available to each state.

In order to ensure comparability of data from each state, FHWA requires that data submitted by each state be consistent with the requirements of the "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges". The guide is used by the States, Federal and other agencies in recording and coding the data elements that will comprise the National Bridge Inventory database. By having a complete and thorough inventory, an accurate report can be made to Congress on the number and condition of the Nation's bridges. The data is also used by FHWA and the Military Traffic Management Command to identify and classify the Strategic Highway Corridor Network (STRAHNET) and its connectors for defense purposes. Increasing efforts are being made to protect the nation's bridges from becoming potential terrorist targets.

The data required by the Coding Guide are an integral part of the database that meets several Federal reporting requirements, as well as our needs. A complete, thorough, accurate and compatible inventory is the foundation of an effective bridge management system.

Bridge Loadrating

Load rating is done on existing bridges to establish the amount of weight that the bridge can carry safely for a particular axle configuration. In the permitting of heavy commercial vehicles, the load raters can often select the bridges with the lowest capacity on a particular route to check rather than performing the load rating calculation on every bridge on the selected route. In the best case scenario, load rating calculations would be completed on every bridge in the state for common axle configurations and loadings. Unfortunately, approximately 50% or 1,300 state bridges have not been load rated.

In cooperation with FHWA, ODOT has established a 6 year Load Rating Plan to complete load ratings on existing bridges using contractors to supplement a limited load rating staff. In addition, design standards have been changed to require a load rating on new bridges as they are being constructed. Once all the bridges have been load rated, permits on our highway system, particularly freight routes, can be completed quickly and with a high degree of confidence. Unlike structural deficiency, load capacity is not determined by visual inspection of the bridge, but is determined by use of an approved analytical method.

With the implementation of Load Resistance Factor Rating (LRFR) and the creation of Oregon-specific rating factors, consultants have needed training to enable them to complete complex load ratings. Consultant load rating work is expected to exceed $1 million per year until all state bridges are load rated.

Bridge Health Monitoring and Load Testing

Bridge Health Monitoring and Load Testing includes the instrumentation of bridges, wireless strain measurement and development of "smart" (self-reporting) structures. Bridge health monitoring and load testing assist in the development of the STIP, as well as meeting FHWA's data requirements. With a fixed inspection budget, remote monitoring of critical elements of important bridges and automatic alerts of problems is becoming increasingly necessary. Load testing helps us to avoid the unnecessary load posting of bridges.

Bridge Inspection

The Bridge Inspection Program establishes the condition of bridges. FHWA first developed bridge inspection program regulations as a result of the Federal-Aid Highway Act of 1968. After the Surface Transportation Assistance Act of 1978 (STAA) was passed, National Bridge Inspection Standards (NBIS) were extended to bridges greater than twenty feet on all public roads. Railroad and pedestrian bridges that do not carry highways are not covered by the NBIS.

The NBIS sets the national standards for the safety inspection and condition appraisal of all highway bridges. The purpose of the NBIS is to locate and evaluate existing bridge deficiencies and ensure the safety of the traveling public.

In addition to the data collected to meet the requirement of the NBIS, ODOT bridge inspectors collect other condition data on ODOT bridges. Central to the Bridge Management System is the representation of the bridge structure as a set of structural elements. The American Association of Highway and Transportation Officials (AASHTO) has identified a set of commonly recognized (CoRe) elements. The collection of element level data provides a more exact method of describing bridge conditions than the Conditon Ratings that are required by the NBIS. Element level data has been collected by ODOT since 1994.

Bridge inspections are generally required on a two year interval. The inspection of large and complex structures is increasingly being contracted due to the limited size of the bridge inspection staff. Estimated cost of contracts is expected to be approximately $1.2 million per year.

Bridge Management System

In 1994, ODOT expanded the information gathered during bridge inspections to include "element level" data and first implemented the use of PONTIS (bridge management system software). The purpose was to establish a more exact method of describing bridge conditions than the Condition Ratings that are required to comply with the NBIS. This allowed for the collection and storage of element level inspection data. The Bridge Section is currently working to customize PONTIS for Oregon specific needs and requirements. This work has included specific deterioration models, cost models, and business rules models. Upon full implementation of all of the PONTIS modules, we will have a system that evaluates the existing non event-driven condition of bridges, predicts the rate of deterioration and suggests repair and rehabilitation options over a multi-year basis for variable funding levels.

PONTIS will be folded into the systematic project selection process currently in use by the Bridge Section. A secondary system, in addition to PONTIS will be required for the foreseeable future. The analysis of data "elements" not covered in PONTIS; the analysis of functional, event-driven needs (scour, over height hits, seismic); and the effect of current investment policies and strategies (other than dollar levels of investment) require consideration separate from the prediction of physical, deterioration based needs.

State Bridge Program Funding and Investment Strategy

ODOT's current bridge investment strategy is comprised of four parts: the OTIA III bond funded bridge repair and replacement effort; federally funded state bridge STIP projects; the state funded major bridge maintenance program; and biennial maintenance funding. In addition, during the period of the 2008-2011 STIP, special one-time funding was made available through SAFETEA-LU Projects of National and Regional Significance (PNRS) funding and bridge earmark funding.

OTIA III

The 2003 Oregon Economic and Bridge Options Report presented a strategic investment strategy to address the 1950s cracked reinforced concrete girder bridges on freight routes and to stimulate Oregon's economy. The OTIA III strategy addressed 365 cracked girder interstate and state highway bridges at a cost of $1.34 billion. The strategy called for five stages. In addition to those projects already completed, 86 bridges are expected to be repaired, replaced or under construction by 2011.

- **Stage 1** (22 bridges): Opened two border-to-border routes for heavy loads while Interstate highway bridges are under construction and/or remain load limited.

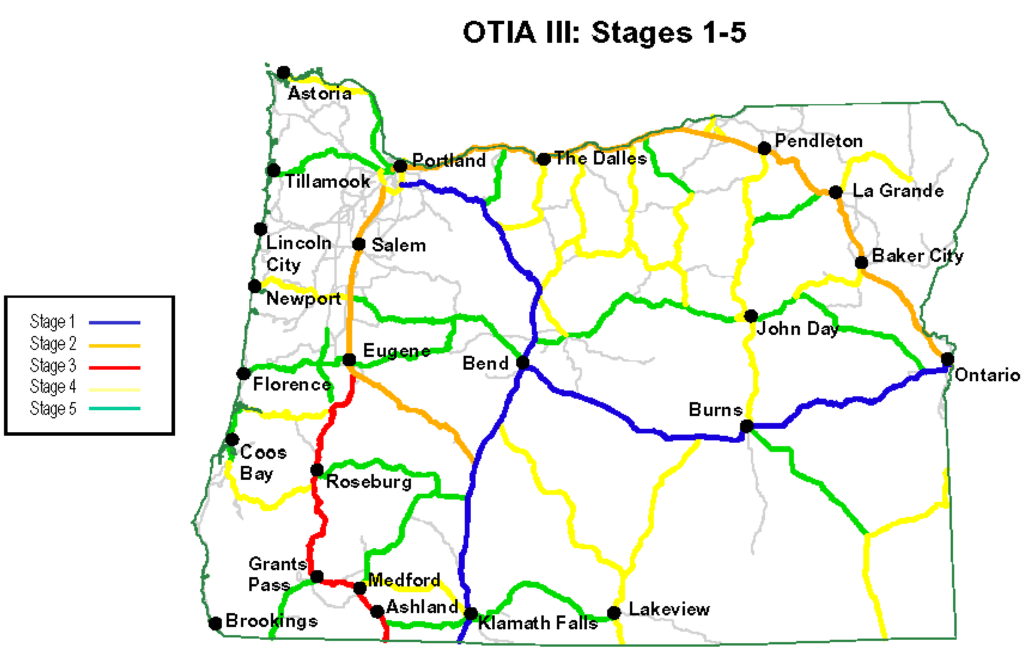
- **Stage 2** (110 bridges): Begins work on I-84 and I-5. Also addresses bridges on Highway 58.

- **Stage 3** (104 bridges): Completes the work on I-5.

- **Stage 4** (77 bridges): Improves connections between Astoria, Newport, Coos Bay, and I-5. Addresses Highway 395 and finishes work on US 97 started in Stage 1. Fixes other segments in central and eastern Oregon.

- **Stage 5** (42 bridges): Fixes Oregon 58 between Eugene and US 97 and US 126 between Eugene and Florence. Addresses US 199 and US 26 between Prineville and Ontario. Completes connection between Portland and Astoria.

The figure below shows the location of the five OTIA III stages. It should be noted that the OTIA III funding addresses bridges that are currently restricted, or may be restricted due to girder cracking, for certain vehicle classes on the identified routes. Additional bridges on designated detour routes and on other NHS highways are currently deficient and will need to be rehabilitated or replaced with State Bridge Program STIP funding, or another source to meet freight mobility and transportation needs.

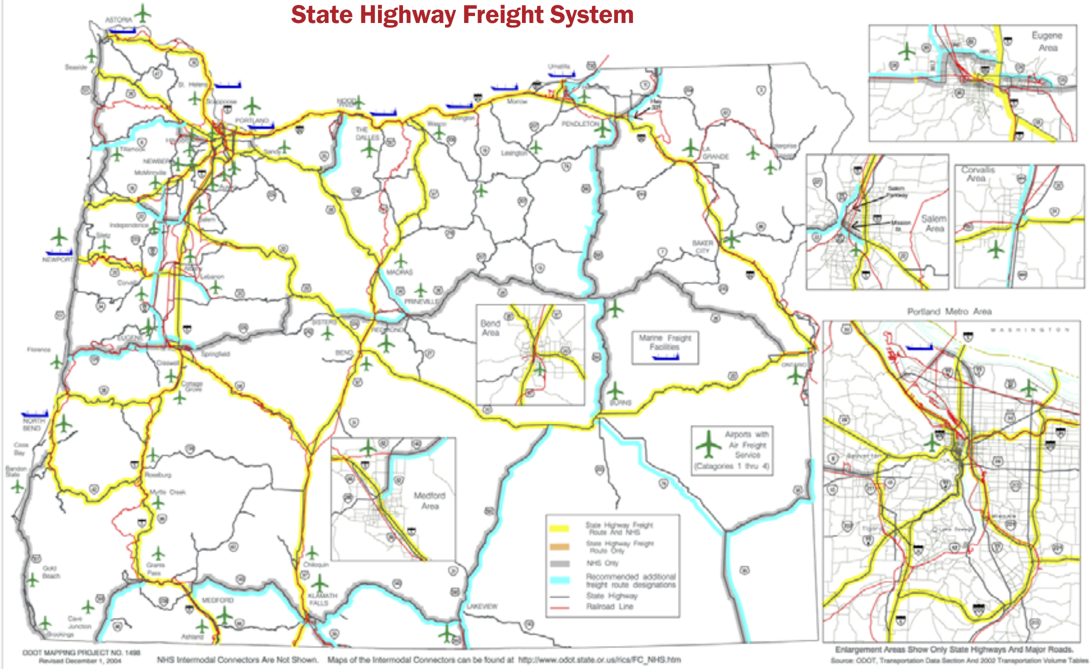


Statewide Transportation Improvement Program

The OTC has provided a total of $258.8 million for the State Bridge Program for 2008-2011. This amount reflects the reduction for OTIA III debt service repayment in 2010 and 2011.

The investment strategy for the State Bridge Program STIP which focuses mainly on maintaining freight mobility and preserving existing bridges, is consistent with the current Oregon Highway Plan. STIP projects supplement OTIA III by funding projects on OTIA III routes that remain unaddressed. Priority is given for Bridge STIP projects on the State Highway Freight and National Highway Systems that address important safety and load capacity issues. Other structural, safety, functional and preservation considerations are also weighed by the selection criteria and priorities of the State Bridge Program.

State Highway Freight System



Major Bridge Maintenance

The OTC has provided a total of $26.5 million for the Major Bridge Maintenance Program for 2008-2011.

In 1990, the State of Oregon established a Bridge Contract Maintenance or Major Bridge Maintenance (MBM) Program, to specifically address major and emergency bridge repairs. This type of work is generally beyond the scope of work normally performed by, or resources available to, ODOT Bridge

Maintenance Crew. Maintenance needs are recognized as critical but it is one of the first programs to be reduced when funds are limited. Bridges are too critical to the transportation system to allow to fail and too expensive to rehabilitate if they are allowed to deteriorate at their own pace. The MBM Program can respond quickly to fund essential maintenance and repair interventions.

District Maintenance Funding

The OTC has provided a total of $36.4 million for the Bridge Maintenance Program for 2008-2011. For 2011, the combined bridge maintenance and major bridge maintenance target set by the OTC is $16.4 million which is .06% of the 2005 value of the bridges.

Maintenance of state bridges is the responsibility of ODOT Districts. Bridge maintenance activities performed by bridge crews are a combination of routine and preventive maintenance. In addition, some work activities performed by the crews might better be classified as "operations" instead of "maintenance" in that the work does not affect the condition of the bridges.

The linkage between maintenance activities and bridge condition is captured within the Bridge Inspection process. During the course of routine or special inspections, Bridge Inspectors record maintenance recommendations, including urgent and critical recommendations, in PONTIS, the bridge management system. Some crews now have direct access to PONTIS so that they can both review the work orders and enter the actual costs for the recommended work action. Those maintenance actions that result in an improved bridge condition will be reflected in the condition ratings upon the next inspection after the improvements are completed. Although the process is new and not without flaws, it is an essential "feedback" loop for ensuring cost-effective asset management. We have begun to work with the Finance Division regarding whether the current and/or future accounting systems can better assist in this effort. Another benefit of automatically collected maintenance cost data will be to provide more accurate cost models within the bridge management system.

Special Funding

Projects of National and Regional Significance

SAFETEA-LU Section 1301, Projects of National and Regional Significance (PNRS), included a project in Oregon. This project "Bridge Repair, Replacement and Associated Improvements in the I-5 Corridor" makes a large number of individual improvements to bridges in the I-5 corridor. After consideration of the unmet needs in the I-5 corridor and consideration of department priorities and stakeholder interests, the recommended allocation of the available funding is proposed as follows:

Widening of bridges as replaced (by OTIA III)	$52.72 million
Bridges not included in OTIA III	$58.54 million
Seismic retrofit of bridges	$0 million
Reconstruction of interchanges around OTIA III bridges	$15.00 million
Modification of bridges with limited vertical clearance	$20.94 million
Total	$147.2 million

In all, a total of 23 bridges have been identified for improvement. These funds will provide improved freight mobility in the I-5 corridor, improve the carrying capacity of the corridor, and address local concerns and issues. The funding appropriately addresses FHWA concerns for the capacity of the reconstructed I-5 bridges over a 20 year horizon. It also addresses context sensitive bridge reconstruction in the most critical areas.

Bridge Earmarks

SAFTEA-LU provided earmarked funding in the amount of $10,000,000 per fiscal year for the period 2006-2009. This funding is to be used for replacement and reconstruction of State-maintained bridges in the State of Oregon. Projects for this special funding were selected along with the 2008-2011 STIP projects, using the same process. For the identification of the 12 specific projects selected for this fund source, priority was given to those projects that could be accelerated to make use of the 2006 and 2007 funding. A list of bridge earmark projects, other discretionary and bridge STIP projects can be found in Appendix A.

Increased Construction Costs

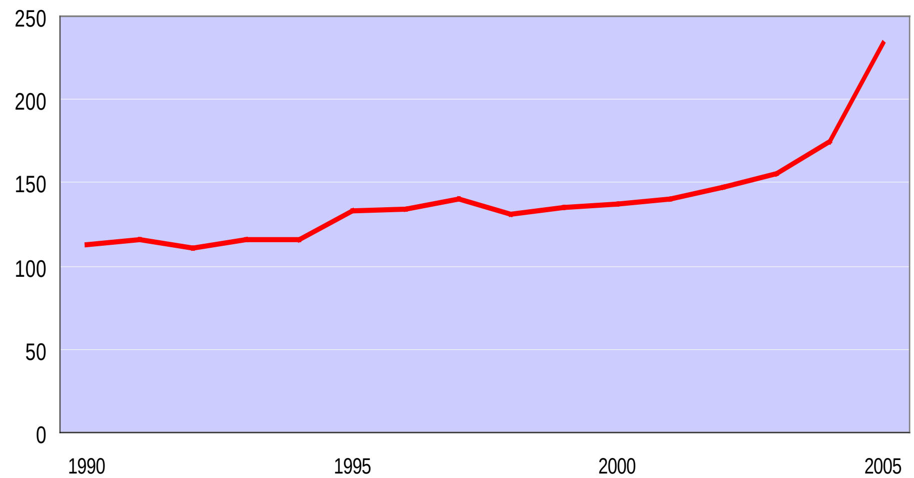
Between 1990 and 2001, there was a stable environment for construction costs, for bridges as well as other highway construction projects. This gave ODOT the ability to forecast future project costs fairly accurately. During the period between 1990 and 2005, Oregon had an average construction cost index growth rate of 2.3%. Since 2004, there have been dramatic spikes in construction costs. In 2005, the construction cost index growth rate was 13.1%. Identified reasons include: increased commodity costs; inflation increases; the sheer number of projects Oregon is letting; national weather disasters; shortages in trucks and railcars; and ample work from other sources which tends to discourage new contractors from bidding state contracts. Specifically regarding bridge projects, there are also few contractors willing and able to perform some of the specialty work required.

This tends to "stack up" projects, slow them down and increase the costs. According to ODOT's Chief Transportation Economist, the current Construction

Cost Forecast and an assumption of 4% inflation in the State Bridge Program STIP from 2005 to 2006 and 2007 results in an unexpected loss in purchasing power of 12.93% for the two years. On a per year basis this is a 6.3% annual cost escalation "shortfall", on top of real program cuts.

Historical Construction Cost Index

(1995-2005)



Bridges Under Construction

Table of STIP Bridges Currently (As of 3/13/07) Under Construction Contract

Key #	Section	# of Bridges	1998-2001 STIP CN	2000-2003 STIP CN	2002-2005 STIP CN	2004-2004 STIP CN	2006-2009 STIP CN	Contract Amount	% Chg
09350	OR99E: MLK/Grand	2	$20,333,000	$27,992,000	$32,059,000	$32,059,000	$45,785,000	$78,337,637	+285.3
09668	OR31: Silver Creek Bridge	1	$896,000	$0	$1,103,000	$1,103,000	$0	$1,029,491	+14.9
10058	US101: Spencer Creek Bridge	1	$4,776,000	$4,776,000	$5,752,000	$5,822,000	$10,300,000	$22,679,760	+374.9
10473	I84: Pleasant Valley Itchg	2	$0	$4,846,000	$5,452,000	$9,561,000	$0	$15,429,773	+218.4
10617	US101: Tenmile Creek & Big Ck	2	$0	$0	$0	$2,920,000	$3,595,000	$5,204,326	+78.2
10746	Tualatin R (PH)	1	$0	$0	$3,891,000	$3,741,000	$0	$5,512,954	+41.7
11797	OR36: Lingo Slough	1	$0	$0	$0	$3,662,000	$3,662,000	$1,852,942	-49.4
11816	US199: E/W Fk Illinois Rvr	4	$0	$0	$2,492,000	$8,187,000	$0	$17,558,761	+604.6
11851	OR99: N Umpqua Rvr (OW)	1	$0	$0	$7,019,000	$7,019,000	$7,675,000	$12,039,523	+71.5
11887	OR201: N Ontario Intchg	1	$0	$0	$11,743,000	$6,818,151	$9,459,000	$16,628,973	+41.6
11950	OR202: Lyons/Ford/BC	3	$0	$0	$1,999,000	$4,370,000	$0	$5,183,823	+159.3
12131	US101: Rock Creek Br	1	$0	$0	$2,499,000	$2,715,000	$3,415,000	$4,201,284	+68.1
12794	OR34: Willamette Rvr (Van Buren)	1	$0	$0	$0	$1,240,000	$1,240,000	$2,964,886	+139.1
13000	I-5: Bear Ck NB/SB Br	2	$0	$0	$0	$6,500,000	$6,500,000	$10,670,000	+64.2
14149	US97: Willowdale-Madras Br	1	$0	$0	$0	$0	$2,106,000	$2,793,070	+32.6
14165	OR126: Crooked Rvr	1	$0	$0	$0	$4,050,000	$0	$3,703,843	-8.6
14180	US30: Lewis & Clark (Longview)	1	$0	$0	$0	$0	$10,600,000	$17,057,712	+60.9
14506	OR19/ OR402: NFJD (K & M)	2	$0	$0	$0	$0	$4,858,000	$6,734,583	+38.6
TOTALS		28						229,583,341	

Bridge Special Issues

The management of bridge structures and the allocation of funding for projects are complicated by the many unique challenges that the bridge inventory presents.

Load Capacity

Weight restricted bridges represent one of the greatest barriers to freight mobility. Although the OTIA III program has gone a long way towards solving the issue of cracked and load restricted bridges on the Interstate corridors, other impediments to freight mobility have gone unaddressed. The challenges of restricted freight mobility must also be met on locally important freight corridors and feeder routes.

Vertical Clearance

Maintaining an appropriate vertical clearance is instrumental to successfully transporting freight through and within the State of Oregon. The movement of mobile home, construction material, construction equipment, and many other types of freight critical to Oregon's economy are greatly restricted due to insufficient vertical clearance on many routes. Vertical clearance on some of Oregon's key freight corridors has slowly eroded as pavement preservation efforts have added additional layers of asphalt under structures.

Bridge Rails

ODOT is required to upgrade substandard rails to meet the national safety standards when the bridge is repaired beyond a certain threshold. Without funding for a bridge rail program, both OTIA III and Interstate Maintenance (IM) projects will continue to be required, under an existing agreement with FHWA, to replace substandard rail in addition to the original scope of work, increasing the costs for these projects. Since crash resistant rails typically weigh more than the substandard rails that are in place, a rail upgrade can involve much more than just the rail. The total cost to provide a crash worthy rail may result in a decision to replace a bridge that otherwise could be repaired and remain in service for many years. This strategy also does not address the most deficient rails on bridges with a history of accidents.

Painting and Cathodic Protection

Oregon has 382 steel bridges that need to be painted every 25 years. Due to the size of some of the significant bridges and limited funding available, bridge painting projects usually occur one or two at a time. Some of the largest bridge painting commitments we have are shared with Washington and Idaho. The expense of keeping our commitments on bridges such as the Astoria-Megler and Longview make it especially difficult to find the funding for other painting needs. Few alternatives exist to prolonging the life of these large structures. As the Columbia River Crossing project has demonstrated, the replacement of these structures is cost prohibitive. The life expectancy of concrete coastal bridges has been demonstrated to be prolonged with the installation of cathodic protection systems.

Seismic

Many existing bridges on Oregon's highway system were not designed to resist forces generated by large earthquakes. These bridges may be in risk of collapse. Earthquakes do happen in Oregon. The 1993 Scotts Mills earthquake caused 30 million dollars in damages. Also in 1993, a series of three earthquakes in Klamath Falls resulted in 10 million dollars in damage to bridges. These earthquakes were considered crustal events. Seismologists believe subduction zone events occur in this region approximately every 350 years and that there is evidence to suggest that a subduction zone event could occur at any time. To mitigate this risk, ODOT has begun to strengthen bridges to resist earthquake forces on a priority basis. The phase 1 seismic retrofit is a cost efficient method to mitigate the seismic deficiencies of structures. When funding is made available, our next priority for phase 1 retrofits is 56 vulnerable bridges on four lifeline routes, one north-south (I-5) and three east-west (I-5 to coast from Newport-Waldport; Seaside to Portland; and I-5 to coast from Coos Bay-Roseburg). The phase 1 retrofit will allow bridge structures to resist small to moderate earthquakes without significant damage, thereby minimizing the hazard to life and to maintain mobility after a seismic event.

Scour

Scour is the removal of the soil and rock, that support bridge foundations, by fast moving water during floods. In the 1990s, FHWA required states to determine which bridges are scour critical. This work has been completed in Oregon and our scour critical bridges have been identified. The next phase of the federal requirement is to develop a Scour Action Plan for scour critical structures. Some of the bridges have unknown foundation depths and may be eliminated from the Scour Action Plan upon further investigation. Scour critical structures can be corrected by protection, repair or replacement of the bridge. It is anticipated that MBM funding will pay for a portion of the protection and repair. OTIA III will replace a number of the scour critical bridges. The remainder, approximately 200, need to be addressed.

Historic Bridges

The State Historic Preservation Office (SHPO) is the permitting agency for all bridges that are designated as historic structures. SHPO also determines which bridges are to be evaluated and potentially placed on the historic list. Many bridges, in addition to our coastal, movable and border bridges are on the historic structure list. In many cases, replacement is not an option and preservation of the existing structure and rehabilitation of the existing elements is the only option. If preventive maintenance is deferred, or if the condition of the bridge is allowed to deteriorate significantly, then the rehabilitation project will be both more extensive and very expensive.

Border Bridges

Oregon has a number of large bridges that are jointly owned with Washington or Idaho. We share in the cost of maintenance and rehabilitation. When Washington DOT and IDOT schedule a major rehabilitation of a shared bridge, such as the Astoria Bridge, ODOT can not defer our obligation to fund our portion.

Movable Bridges

Movable bridges are necessary when clearance for marine craft (ships and boats) is not available. The mechanical and electrical equipment on these bridges must be periodically replaced to insure that the systems remain in working order and navigation and trade are not impeded. Typically, shipping has been operating on the waterway before the highway was built and retains the right of way on the water. If a movable bridge will not operate to allow for passage of marine traffic, then the waterway takes precedence and could cause a roadway closure until the bridge operation is restored.

Timber Bridges

Timber can be an excellent material for bridges, especially for routes with low traffic volumes located in dry climates. While there are few bridges on the state highway system that use timber for all load carrying members, there are many concrete bridges that are supported by a timber foundation. The lifespan of timber elements is reduced by decay, splits, and insect damage. Replacing deteriorated timber elements, adding timber load carrying members, placing steel supports, or making temporary repairs to keep timber bridges in service is a considerable drain on maintenance funding. While most timber bridges are smaller structures, two exceptions are the Newbury and Vermont Street viaducts in Portland.

Tunnels

Tunnel projects are rare but expensive. Oregon has nine major highway tunnels that are maintained by the Bridge Program. Six of these were constructed between 1930 and 1940 with timber lagging used for structural support lining. In the last 10 years the Bridge Program has completed major reconstruction of three of the tunnels, replacing the timber lining using rock bolts and shotcrete. A major reconstruction of another tunnel lining is scheduled for 2008. The remaining two have significant needs that will be handled in the Major Bridge Maintenance Program until a major reconstruction can be funded. Tunnels drainage systems require cleaning and routine maintenance twice each year. Inspections by a multi-disciplinary team are conducted every two years, except for the two which still need major reconstruction, which are inspected each year. Detailed, in-depth inspections by a specialty consultant firm are planned every ten years. Each of these nine tunnels is located in an area where there would be a very significant impact to traffic and freight mobility if a failure occurred or a temporary closure was required. The detour lengths are very long, except for the two Vista Ridge Tunnels on the Sunset Highway, which carry the highest ADT of any of the nine major tunnels.

Bridge Needs Backlog and Costs

One view of bridge needs backlog and costs relies on the analysis the federal government uses in apportioning funding for bridge repair and replacement to the states. In apportioning HBP funds among the states, the Secretary of Transportation bases the distribution of funds on an inventory of all highway bridges on any Federal-aid system or public road: classified according to serviceability, safety, essentiality for public use; determined eligible for replacement or rehabilitation; and estimating the cost of replacing each bridge with a comparable facility or rehabilitating the bridge.

Each deficient bridge is placed into one of four categories. The square footage of deficient bridges in each category is multiplied by a cost factor and the total cost in each State divided by the total cost of deficient bridges in all States determines each state's apportionment.

A review of the historical data from this analysis reveals an increase in the number of deficient State bridges and costs over time. This view of State bridge deficiencies includes all State owned (NBI) bridges, both on and off the National Highway System (NHS). However, HBP funding eligibility criteria require that to be considered for the classification of deficient bridge for apportionment purposes, a structure must be of bridge length (greater than 20 feet) and not constructed or had major reconstruction within the past 10 years.

Year	# Deficient State Bridges	Estimated Cost to Repair or Replace
1996	518	$242,017,880
1997	512	$270,809,000
1998	511	$400,351,919
1999	514	$324,191,057
2000	544	$370,920,580
2001	558	$406,647,124
2002	620	$474,358,780
2003	650	$546,513,352
2004	731	$638,764,044
2005	695	$676,111,754
2006	623	$748,628,027

This chart reflects increases, over the last ten years, in the number of deficient state bridges and the estimated cost to repair or replace those bridges. (It should be noted that these costs are based on an average unit cost applied to existing deck area and do not include any estimate for new standards or design and other costs associated with construction projects.)

There are 2,700 state owned (NBI) bridges, potentially eligible for HBP funding. Based on an (optimistic) bridge life expectancy of 100 years, a replacement schedule of an average of 27 bridges per year would be required to keep pace with this expected life span and prevent the backlog of bridge needs from continuing to grow.

Note- The increase in 2004 was due, in large part, to a change in cracked girder inspection guidelines. By 2005, the guidelines were revised based on the OSU study. Many bridges that had become "deficient" due to the policy will have reverted to "not-deficient" by the end of calendar year 2006. However, the decrease in deficient bridges due to the guideline change is not significant enough alone to offset the overall deficiency decrease due to continued deterioration of Oregon's bridges. In the analysis, it can be seen as a temporary dip in the condition of Interstate bridges.

State Bridge Program Goals

In the last decade, three selection processes have been used to establish a priority for bridge projects. Until the mid-90s, the Regions selected bridges based on investment strategy and attempted to match the schedule for preservation and modernization projects in the area. This system was replaced by one that considered the bridge needs or "worst first" system which prioritized the bridges based on fixing the worst bridge first regardless of the location. Currently, the bridges are programmed based in consideration of the State's priority to fund projects important to freight mobility using a corridor based strategy. This strategy considers routes instead of individual bridges and considers that the critical bridge on a particular route will control the allowable truck load on the route regardless of the condition of the other bridges along the route.

The following goals for the current State Bridge Program have been identified:

- Add value to Oregon by improving the performance of state bridges along freight corridors at critical points, where people and goods are restricted or at risk because of capacity, condition or functionality issues.

- Maximize investment by building bridges that require less maintenance, have a longer life expectancy and will meet standards and community expectations well into the future.

To accomplish this, the State Bridge Program will:

- Concentrate STIP projects for state bridges on freight and NHS routes with a priority for addressing load capacity and safety issues to assure continued route continuity.

- Allocate sufficient funding for functional and safety needs to reduce overall fair or better condition rate for state bridges of 75%.

- Maintain high value structures, such as major river crossings and movable bridges.

- Implement mandatory national bridge program standards

- Continue to work towards improved performance measures that reflect Oregon conditions and OTC priorities.

State Bridge Program Allocations

The following table provides funding detail for bridge construction projects included in the 2008-2011 draft STIP. Additional funding provided for 2008 and 2009 by the OTC enabled the program to add additional projects in those years. An effort was made to move forward as much of the work as possible. However, many major bridge projects require significant lead time, especially if right of way is needed or the environmental permitting process is extensive. The information in the table shows project totals by phase and year.

2008-2011 State Bridge Program STIP Projects by Phase

	2008	2009	2010	2011
PE	$14,976,422	$9,022,000	$4,080,000	$4,080,000
RW	$2,474,302	$1,583,000	$1,999,000	$1,020,000
CN	$49,374,212	$53,034,197	$49,089,000	$44,352,662
UR	$250,205	$45,000	$4,000	$0
Total	$67,077,149	$63,686,206	$55,174,010	$49,454,673

It should be noted that OT or "other" funding not shown here but included in the draft 2008-2011 STIP are the costs of supporting the State Bridge Program and include inventory, inspection, load rating, bridge management system, bridge health monitoring, program development and other asset management related costs. Planned expenditures for each of the 2009-2011 and 2011-2013 bienniums are approximately $10.2 million and although these are operating budget costs, they have traditionally been accounted for within the State Bridge Program STIP target.

Additional detail on the projects selected and the OTC's Bridge Project Criteria Statewide Summary Report can be found in Appendix B.

State Bridge Program Project Selection Process

During the development of the 2006-2009 STIP, ODOT reorganized the structure of the department. Bridge design functions were moved from the headquarters unit to the regions, and a separate organization was created to deliver the OTIA III projects. The experienced structural managers who had been instrumental in the development of previous State Bridge Programs left the department for jobs with consulting firms. In the wake of the reorganization, the Bridge Section began the selection process for the 2008-2011 STIP. Our intention was to modify the systematic process used in earlier STIP cycles, to use element level data, and incorporate the lessons learned from the OTIA III program regarding the importance of a corridor-based approach.

In December 2005, the OTC took action to delay the impact of the repayment of the bonds on the State Bridge Program until 2010. Meanwhile, State Bridge Program managers were working to identify an ideal program funding framework and funding level as well as program goals that would guide future investment decisions.

The project selection process was developed by the Bridge Program to ensure that projects are selected in a manner that will help accomplish program goals.

The process provides a consistent means for identifying and prioritizing bridge projects at the statewide level with the full involvement of the Regions, Areas and Districts in the process.

The OTC requires that State Bridge Program projects be identified through the Bridge Management System process and support the policies of the Oregon Highway Plan.

Process Summary

The project identification and selection process used in the development of the 2008-2011 STIP followed these steps:

1. Development of program goals, framework and investment hierarchy by the Bridge Section.
2. Development of bridge screening criteria and application of bridge management system tools by the Bridge Section.
3. Initial review and prioritization by Bridge Section engineering specialists.
4. Review of draft problem bridge lists by Regions/Areas/Districts.
5. Second stage review and prioritization by Bridge Section engineering specialists.
6. Compilation of operational and structural scores with the assistance of District (Maintenance) Managers.
7. Overlay of priority bridges on State Highway Freight System.
8. Development of preliminary projects, paper scopes and preliminary program of projects by Bridge Section.
9. Joint Bridge Section/Region project delivery meeting.
10. Review and field scoping of proposed projects by Regions.
11. Final project selection within program financial constraints.

Additional detail on the project selection process and the criteria that was used during the development of the 2008-2011 STIP can be found in Appendix C.

State Bridge Program Evaluation

Investment by Highway Classification

ODOT has multiple highway classification systems in use, and so the definition of a mutually exclusive hierarchy, particularly for comparison of performance measures is challenging. Many aspects of the State Bridge Program remain driven largely by federal requirements. The allocation of federal bridge program funds relies on the number of deficient bridges and the criteria for measuring this is established by FHWA. Annually, FHWA reports the number of deficient bridges by state based on each state's data submittal. Bridges are grouped into bridges on and off the National Highway System. Bridge condition data submitted by ODOT is used to determine Oregon's apportionment of HBP funds, although not necessarily ODOT's State Bridge Program STIP target.

As reported earlier, the Oregon Freight Highway System, seismic lifeline and detour routes are also extremely important in the consideration of the bridge program project priorities. Some ODOT highway programs use the Interstate, State, Region and District hierarchy, making cross program comparisons challenging. There are also some issues with route numbering when attempting to overlay some of the classification systems, as the bridge data is not fully ITIS compatible.

The federal performance measurement is "deficient bridges"- based on a condition evaluation of "poor". Bridges can be classified as structurally deficient, functionally obsolete or not deficient. Structural bridge deficiencies are a more serious concern than functional deficiencies and structural deficiency is indicated when both types of deficiencies exist.

Other highway and planning programs within ODOT make use of a performance measure of "fair or better". Although the official ODOT Highway Division performance measure is currently "NHS Bridges Not Deficient", so that it is consistent with the federal definition (it is the complement), for this report "fair or better" (FOB) is used with the same meaning and criteria as "not deficient" or "not poor". This will enable easier comparison across program lines.

These caveats out of the way, it is possible to demonstrate that the major portion of State Bridge Program funds are spent on the higher priority routes. The table below shows the total 2008-2011 State Bridge Program investment in bridges by highway classification.

Highway Classification	% State Bridge Funds	$ State Bridge Funds
Interstate	23%	$54 million
Other NHS	49%	$115 million
Non-NHS	28%	$65 million
All Highways	100%	$234 million

As discussed earlier, ODOT's bridge strategy includes important pieces not included within the State Bridge Program STIP. The OTIA III program will result in the largest bridge construction program in Oregon since the Interstate Highways were built. Although not exclusively limited to the Interstates, bridge needs within both the I-5 and I-84 corridors will largely, although not entirely, be met by the OTIA III bridge projects planned and under construction. As a result of planned bridge construction through 2011, including OTIA III and special funding, 133 fewer bridges will be deficient by 2011 and a total of 149 bridges will no longer be deficient by 2014. Unfortunately, continued physical deterioration of the remaining bridges combined with deferred maintenance will offset these improvements in condition, keeping overall conditions relatively flat through 2011. At the expected level of investment after 2011, bridges conditions will begin to decline.

Interstate

The Interstate received over 20 percent of the State Bridge funds, which equates to $54 million over the four year period of the 2008-2011 STIP. For this investment, 12 bridges will be repaired and replaced, with a resulting average project cost of $4.5 million.

Bridge conditions on the Interstate will continue to fall short of the 75% fair-or-better performance goal throughout the period, in spite of the massive investment in bridges through the OTIA III bonds and other special one-time funding sources. Bridge conditions on the Interstate vary considerably by Region. This holds true at all levels of the highway hierarchy.

	Measured % FOB		Projected % FOB	
	2005	2006	2007	2011
Region 1	70%	68%	67%	
Region 2	68%	74%	76%	
Region 3	39%	53%	61%	
Region 4	73%	74%	78%	
Region 5	88%	83%	82%	
All	69%	70%	71%	72.5%

National Highway System

The National Highway System, other than the Interstate, received nearly fifty percent of the State Bridge funds, which equates to over $115 million over the four year period of the 2008-2011 STIP. For this investment, 30 bridges will be repaired and replaced, with a resulting average project cost of $3.8 million. The performance measure of all NHS routes, including the Interstate is shown below. There is considerable variation in Regional conditions.

	Measured % FOB		Projected % FOB	
	2005	2006	2007	2011
Region 1	70%	68%	67%	
Region 2	63%	65%	67%	
Region 3	57%	62%	67%	
Region 4	78%	80%	85%	
Region 5	88%	87%	88%	
All	70%	70%	72%	72.5%

Note- includes Interstate routes

Non-National Highway System (Other State Bridges)

State bridges other than those on the National Highway System, including the Interstate routes, received over twenty-five percent of the State Bridge funds, which equates to over $65 million over the four year period of the 2008-2011 STIP. For this investment, 34 bridges will be repaired and replaced, with a resulting average project cost of $1.9. The performance measure of all Non-NHS routes is shown below. Performance measures system averages are lower than the Interstate and NHS, but there is still considerable variation in Regional conditions.

	Measured % FOB		Projected % FOB	
	2005	2006	2007	2011
Region 1	62%	62%	62%	
Region 2	61%	62%	63%	
Region 3	63%	61%	78%	
Region 4	81%	82%	84%	
Region 5	81%	87%	85%	
All	67%	68%	69%	70.5%

Regional Analysis

In 2001, ODOT created a Bridge Strategy Task Force. The Task Force sought to explain the emergence of the cracked concrete bridges and identified strategies to address them. In the process, the Task Force condemned the use of "worst-first" approach to choosing bridge repair and replacement projects and recommended that a "corridor-based" strategy be used instead. The final recommendation of the Task Force focused on Oregon's two major Interstate routes (I-5 and I-84) in the interest of returning full load carrying capacity to the nearly 675 miles of Oregon's Strategic Highway Network (STRAHNET).

In the wake of OTIA III, the Bridge Section began the selection process for the 2008-2011 STIP. Our intention was to modify the systematic process used in earlier STIP cycles and incorporate the lessons learned from OTIA III regarding the importance of a corridor-based approach.

The fair-or-better performance measure is a lagging indicator-bridges are generally inspected on a two year cycle and there is also a year lag in the data reporting process. However, the data below show a definite, if slow, convergence towards average bridge conditions in all Regions. This is an expected result of a truly "statewide" State Bridge Program.

Region 1 bridge conditions:

Region 1 has 568 ODOT NBI bridges which is 22% of the state total. The deck area of these 568 bridges is 13,628,019 square feet, which is 39% of the state total.

	Measured % FOB		Projected % FOB	
Region 1	2005	2006	2007	2011
Interstate	70%	68%	67%	
NHS	70%	68%	67%	
Non-NHS	62%	62%	62%	
All Region 1	66%	65%	65%	66.5%

Region 2 bridge conditions:

Region 2 has 860 ODOT NBI bridges which is 34% of the state total. The deck area of these 860 bridges is 9,602,003 square feet, which is 28% of the state total.

	Measured % FOB		Projected % FOB	
Region 2	005	2006	2007	2011
Interstate	68%	74%	76%	
NHS	63%	65%	67%	
Non-NHS	61%	62%	63%	
All Region 2	62%	64%	65%	66.5%

Region 3 bridge conditions:

Region 3 has 402 ODOT NBI bridges which is 16% of the state total. The deck area of these 402 bridges is 5,273,333 square feet, which is 15% of the state total.

	Measured % FOB		Projected % FOB	
Region 3	2005	2006	2007	2011
Interstate	39%	53%	61%	
NHS	57%	62%	67%	
Non-NHS	63%	61%	78%	
All Region 3	59%	62%	66%	67.5%

Region 4 bridge conditions:

Region 4 has 274 ODOT NBI bridges which is 11% of the state total. The deck area of these 274 bridges is 2,577,103 square feet, which is 7% of the state total.

	Measured % FOB		Projected % FOB	
Region 4	2005	2006	2007	2011
Interstate	73%	74%	78%	
NHS	8%	80%	85%	
Non-NHS	81%	82%	84%	
All Region 4	79%	78%	85%	85%

Region 5 bridge conditions:

Region 5 has 428 ODOT NBI bridges which is 17% of the state total. The deck area of these 428 bridges is 3,734,541 square feet, which is 11% of the state total.

	Measured % FOB		Projected % FOB	
Region 5	2005	2006	2007	2011
Interstate	88%	83%	82%	
NHS	88%	87%	88%	
Non-NHS	81%	87%	85%	
All Region 5	84%	86%	87%	87%

Statewide bridge conditions by highway classification:

	Measured % FOB		Projected % FOB	
Statewide	2005	2006	2007	2011
Interstate	69%	70%	71%	
NHS	69%	70%	72%	
Non-NHS	67%	68%	69%	
All	68%	69%	71%	72.5%

State Bridge Program Performance Measures

Under the agency mission "to provide a safe, efficient transportation system that supports economic opportunity and livable communities for Oregonians", for budgetary purposes, ODOT has adopted a performance measure for bridge condition. This measure is the percent of state bridges that are not deficient. This measure has been in use since 1998. This performance measure is similar, but not the same as the measure reported by the FHWA for all states on deficient NHS bridges. This has been the cause of some confusion in the past. Although the percentage differences may seem minor, they are significant. In addition, as investment policies favor the higher level highway classifications, a growing disparity can be expected to result between the NHS and Non-NHS conditions. We should not lose sight of this difference. A detailed look at the nature and location of Oregon's bridge deficiencies is necessary for good decision making.

In addition to the FHWA, the trade magazine "Better Roads" has been tracking bridge conditions since 2000. All 50 states self-report on the condition of "interstate and state bridges" and "city/county/township bridges".Unlike the FHWA data, the condition report may not based directly on federally accepted data, definitions may vary and there may be some manipulation and greater chance of reporting error.

"Better Roads" is the only national source of comparable data on the condition of "state" bridges as compared to the federal measure of "NHS" bridges. (ODOT defines "state" bridges as bridges owned and maintained by any state agency-this definition includes some bridges not managed by ODOT.) This data can be used to compare the ranking of Oregon to other states in the condition of state owned bridges. Like the FHWA measure, Betters Roads uses "deficient" bridges. The number of fair-or-better bridges can be determined by subtracting the percentage of deficient bridges from 100. Federal definitions of the types of bridge deficiencies: structurally deficient and functionally obsolete can be found in Appendix D.

Generally, a bridge is considered to be functionally deficient if the deck, superstructure or substructure has been inspected and rated in "poor" or lower condition according to specific criteria found in the "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges" issued by the FHWA. Generally, a bridge is determined to be functionally obsolete on the basis of "serious" or lower appraisal according to the Coding Guide for one of the following factors: deck geometry (deck width), underclearances (vertical clearance), approach roadway alignment or structural condition.

The FHWA differentiates between structurally deficient (SD) and functionally obsolete (FO) deficiencies in their reporting; Better Roads does not. We do know this information and it is an important distinction for investment purposes. It should be noted that all performance measure data included in this report is based on deficient bridge "counts" as opposed to deficient "deck area". The FHWA uses both measurements.

Fair or Better Comparison, National Average and Nearby States:

	Measured % FOB			
Interstate and State Bridges	2003	2004	2005	2006
Oregon	68%	68%	68%	69%
Washington 80%	74%	73%	72%	
Idaho	79%	78%	77%	77%
California	86%	86%	86%	86%
Nevada	95%	96%	97%	97%
All States	78%	78%	78%	78%

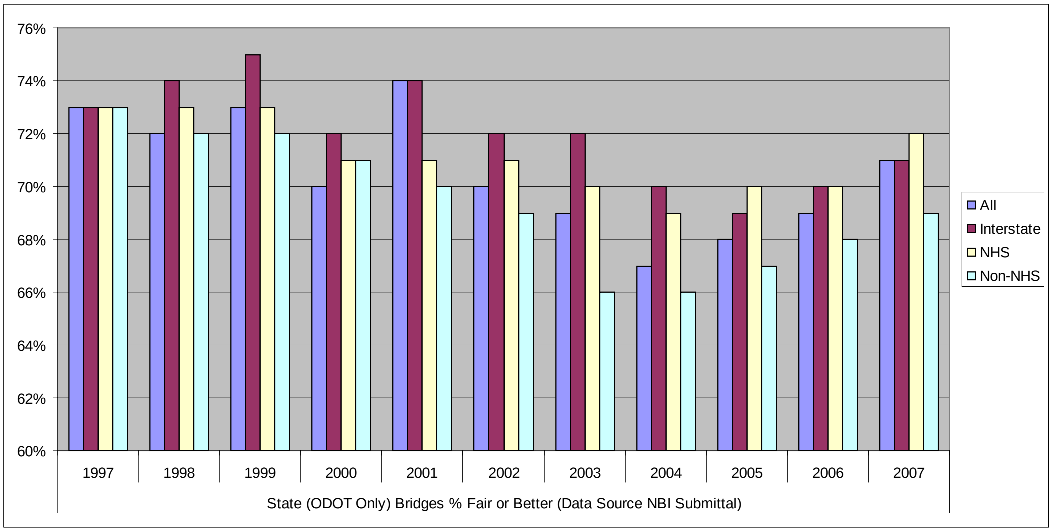
Source: Better Roads

	Measured % FOB			
NHS Bridges	2003	2004	2005	2006
Oregon	70%	68%	68%	70%
Washington	70%	70%	70%	70%
Idaho	79%	77%	75%	75%
California	74%	74%	73%	73%
Nevada	84%	85%	86%	86%
All States	79%	80%	80%	80%

Source: FHWA

Statewide Analysis

In its work with Cambridge Systematics, Inc., the ODOT Highway Division has been developing a high-level model for performance management. After considering Highway Division Goals and Desired Outcomes, Cambridge recommended a system of recommended performance measures. For each outcome, "lagging" and "leading" performance indicators were identified. Lagging indicators reflect the desired outcomes, and are used to assess whether efforts to improve performance have been successful. Leading indicators are intended to provide information that helps managers take corrective action.



Under the goal of "Preserve and Maintain the Highway System" and outcome of "Highway system condition that allows for safe and efficient movement of people and goods", the recommended performance measure (lagging) is "Bridges Not Deficient". Under a second outcome of "Asset condition maintained at sustainable levels", two measures, one leading and one lagging have also been discussed. These are "Asset Sustainability Ratio (ASR)" and "Bridge Health Index".

Asset Sustainability

Ratio-Asset Sustainability Ratio is defined as the ratio of current versus "ideal state" accomplishment or investment level. The ideal state level is the average annual quantity of work or funding required (not necessarily current spending) to maintain the conditions over the long term. Although this measure holds some possibility for cross-system comparisons, to date little work has been completed to develop this concept.

Bridge Health Index

This index is a function of the condition of each individual bridge element on a structure, the cost of replacing it, and its relative importance. It is calculated on a scale of zero to 100 for each bridge or the system overall. In theory the health index can be rolled into good, fair and poor categories. The Bridge Health Index is a measure of some interest to the State Bridge Program as it could have many uses. At this point it is difficult to interpret the Bridge Health Index reliably. Confidence in the meaning of this measure is still an issue as there is no reliable benchmark. For additional information on the Bridge Health Index, please see Appendix E.

Recommendations for Future Bridge Performance Measurement

The federal definition for Structural Deficient, while it may be related to a deficiency in load capacity, does not fully capture ODOT's progress (or lack thereof) in eliminating the number of load posted and restricted bridges. Most structurally deficient bridges can be expected to have load capacity issues, but not all bridges deficient in load capacity are also structurally deficient. It is important to note however, that in spite of an overall improvement in bridges "fair or better" in 2007, there is a greater percentage of structurally deficient bridges today than in 1997. This means that we have experienced a disproportionate reduction in bridges which are Functionally Obsolete. This is more likely an unplanned consequence of OTIA III bridge replacements, than the result of a concerted policy choice.

The number of load posted and restricted bridges is a more direct measure of the OTC's policy in support of freight mobility. Similarly, the federal definition for Functional Obsolescence is composed of key elements of interest such as width and vertical clearance. However, the federal standard for a bridge with deficient vertical clearance is less restrictive than the definition ODOT has worked out with its stakeholders. Therefore, the federal measure of deficiency for functional obsolescence does not adequately reflect the true picture of the suitability for commerce of Oregon's bridge population.

Bridges "not deficient" or "fair or better" may be a reasonable overall measure, although as we have demonstrated, there is considerable variability depending on the level of the highway hierarchy and regional differences. In addition to this measure, ODOT should consider specific measures aimed at reducing the number of load posted and restricted bridges and bridges that do not meet ODOT's standards for vertical clearance. Additional measures should be considered that measure bridge rail, scour and seismic vulnerabilities.

Conclusions

The State Bridge Program has taken several financial "hits" to its STIP target for 2008-2011. These factors are:

- The 2008-2011 State Bridge Program STIP target suffered an overall reduction of $55.8 million. This represents an 18% overall reduction in our ability to repair or replace aging bridges.

- Beginning in 2010, OTIA III debt service is expected to be approximately $31 million annually and will no longer be available to the State Bridge Program through the STIP.

- Construction contract costs have increased due to a number of extraordinary factors.

- Individual project costs have escalated due to the number of "signature" bridges desired by stakeholders.

- General inflationary factors continue to erode the effectiveness of the programmed dollars.

Several short term investments will enable the State Bridge Program to "break-even" in bridge condition through at least 2011. However, after 2017, bridge conditions will deteriorate at an increasing rate. Factors influencing this decline include:

- Nearly one third of state NBI bridges are currently over 50 years old.

- Inadequate funding for maintenance and replacements does not allow the bridge population to keep pace with expected deterioration.

- There are a large number of bridges in the 1950s cohort that can be expected to become deficient together.

Progress continues to be made in the development of analytical tools and measures that will allow for improvements in targeted investment in deficient bridges. Changes in performance measures will enable the State Bridge Program to better measure the affects of overall investment policies on bridge condition.

APPENDICES

Appendix A :

New State Bridge Projects (Including PNRS and Discretionary)

Appendix B :

Bridge Project Criteria Statewide Summary Report

Appendix C :

A Review of The Oregon State Bridge Program Project Selection Process for The 2008-2011 Statewide Transportation Improvement Program

Appendix D :

Classification of Deficient Bridges

Appendix E :

Status of Bridge Health Index at ODOT

APPENDIX A

Reg	Key #	Bridge ID	Section (Project Name)	Work Description	2006	2006 Phase	2007	2007 Phase	2008	2008 Phase	2009	2009 Phase	2010	2010 Phase	2011	2011 Phase	Total Project Cost	Program
1	14792	00744B	OR8: DAIRY CREEK BRIDGE #00744B	Joint repair; AC overlay; Rail retrofit & seismic retrofit.							$ 165,000	PE			$ 1,757,000	CN	$ 1,922,000	Draft STIP
1	14793	02010	OR99W:PACIFIC HWY W OVER SW MULTNOMAH BL (#02010)	Deck overlay; Repair & strengthen beams, caps & columns.							$ 51,000	PE			$ 562,000	CN	$ 613,000	Draft STIP
1	14794	02120	OR213: MILK CREEK BRIDGE #02120	Replace bridge #02120.			$ 560,000	PE	$ 209,000	RW	$ 4,063,000	CN					$ 4,832,000	Draft STIP
1	14795	02135A	OR213: MT SCOTT CREEK & UPRR BRIDGE #02135A	Rehab with rail retrofit; Strengthen RCDGs.			$ 64,000	PE			$ 552,000	CN					$ 616,000	Draft STIP
1	14796	02164	US26: NORTH FORK QUARTZ CREEK BRIDGE #02164	Replace bridge #02164			$ 744,000	PE	$ 12,000,000	CN							$ 12,744,000	Draft STIP
1	14797	03140A	OR202: NEHALEM RIVER (BANZER) BRIDGE #03140A	Replace bridge #03140A.			$ 551,000	PE	$ 3,859,000	CN							$ 4,671,000	Draft STIP
1	14797	03140A		Replace bridge #03140A.			$ 261,000	RW										
1	14798	07164	OR99E: PARTIAL VIADUCT (SB OVER HILLSIDE) BR 07164	Bridge rehab.					$ 60,000	PE			$ 544,000	CN			$ 604,000	Draft STIP
1	14799	09403	I-205: WILLAMETTE R (GEO ABERNETHY) BRIDGE #09403	Deck overlay; Repair deck joints.					$ 707,000	PE			$ 13,491,000	CN			$ 14,198,000	Draft STIP
1	14800	S8588E	I-5: PACIFIC HWY SB OVER UPRR (BRIDGE #S8588E)	Rehab with deck overlay & joint repair.					$ 552,000	PE			$ 5,743,000	CN			$ 6,295,000	Draft STIP
1	14833	09555	I-205: COLUMBIA RIVER (GLENN JACKSON) BR #09555	Repair & replace bad deck joints.			$ 52,000	PE	$ 1,283,000	CN							$ 1,335,000	Draft STIP
1	14838	02673	US26: WEST FORK DAIRY CREEK BRIDGE #02673	Replace bridge #02673.			$ 381,000	PE	$ 2,925,000	CN							$ 3,425,000	Discretionary
1	14838	02673		Replace bridge #02673.			$ 119,000	RW										
1	14949	08197	I-5: SW IOWA STREET VIADUCT BR #08197	Deck rehab			$ 3,116,000	PE			$ 39,965,000	CN					$ 43,081,000	PNRS
1	14949	08197	I-5: SW IOWA STREET VIADUCT BR #08197	Widen bridge. Rehab deck.							$ 2,675,000	CN					$ 2,675,000	Discretionary
	Subtotal Region 1				$ -		$ 5,848,000		$ 21,595,000		$ 47,471,000		$ 19,778,000		$ 2,319,000		$ 97,011,000	
2	14036	06836A	I-5: MCKENZIE R-GOSHEN GRADE-OTIA BUNDLE 215	Widening	$ 6,886,000	CN											$ 6,886,000	PNRS
2	14036	08175N/S	I-5: MCKENZIE R-GOSHEN GRADE-OTIA BUNDLE 215	Widening	$ 9,932,000	CN											$ 9,932,000	PNRS
2	14037	08233N/S	I-5: SODOM DITCH-CALAPOOIA R BUNDLE 216	Widening			$ 5,746,000	CN									$ 5,746,000	PNRS
2	14183	07949C	US101: COLUMBIA RIVER (ASTORIA-MEGLER) BR #07949C	Paint deck girders/thru truss. Joint proj w/ WSDOT. ODOT is lead. Cost is ODOT share.					$ 300,000	PE			$ 17,459,000	CN			$ 17,759,000	Draft STIP
2	14259	08329	I-5: WILLAMETTE RIVER BRIDGE-BUNDLE 220	Widening & Aesthetics							$ 30,152,000	CN					$ 30,152,000	PNRS
2	14801	01430A	US101: BIG CREEK BRIDGE #01430A	Cathodic protection; Repair cracks; Strengthen crossbeams.					$ 399,000	PE			$ 1,000	UR	$ 785,000	CN	$ 1,185,000	Draft STIP

Reg	Key #	Bridge ID	Section (Project Name)	Work Description	2006	2006 Phase	2007	2007 Phase	2008	2008 Phase	2009	2009 Phase	2010	2010 Phase	2011	2011 Phase	Total Project Cost	Program
2	14802	01481	US101: NECANICUM RIVER (SKIBERENE) BR #01481	Widen bridge; Repair cracks in girders, caps & columns; Scour protection.							$ 263,000	PE	$ 6,000	RW	$ 2,652,000	CN	$ 2,922,000	Draft STIP
2	14802	01481											$ 1,000	UR				Draft STIP
2	14803	01597	OR213: BUTTE CREEK (JACKS) BRIDGE #01597	Replace bridge #01597.							$ 250,000	PE	$ 9,000	RW	$ 3,278,000	CN	$ 3,537,000	Draft STIP
2	14804	01820	US101: YAQUINA BAY BRIDGE #01820 REPAIR	Repair steel on bridge (stringer flange, spandrels, stringer ends, weld repairs, etc.)					$ 605,000	PE					$ 9,529,000	CN	$ 10,134,000	Draft STIP
2	14805	01830	OR99E: PUDDING RIVER RELIEF CHANNEL BR #01830	Repair cracks in caps & columns; Seismic retrofit; Retrofit rails.					$ 111,000	PE	$ 32,000	RW	$ 1,490,000	CN			$ 1,633,000	Draft STIP
2	14806	02601	US26: NECANICUM RIVER (BLACK) BRIDGE #02601	Retrofit rails; Repair spalls in deck & columns; Strengthen caps; Seismic retrofit.							$ 63,000	PE	$ 6,000	RW	$ 686,000	CN	$ 756,000	Draft STIP
2	14806	02601											$ 1,000	UR				
2	14807	04117A	OR222: WILLAMETTE RIVER (JASPER) BRIDGE #04117A	Historic rehab; Raise existing portals; Scour protection.							$ 53,000	PE			$ 446,000	CN	$ 499,000	Draft STIP
2	14808	04660A	US101: THREE RIVERS (HEBO) BRIDGE #04660A	Repair cracks in beams; Seismic retrofit; Rail retrofit; PPC deck overlay.							$ 56,000	PE	$ 6,000	RW	$ 615,000	CN	$ 678,000	Draft STIP
2	14808	04660A											$ 1,000	UR				
2	14809	05041	OR153: SALT CREEK (ASH SWALE) BRIDGE #05041	Replace bridge #05041.							$ 298,000	PE	$ 695,000	RW	$ 13,460,000	CN	$ 14,453,000	Draft STIP
2	14835	07949A	US101:COLUMBIA R (ASTORIA-MEGLER) BR#07949A PAINT	Paint deck girders/thru truss. Joint proj w/ WSDOT. ODOT is lead. Cost is ODOT share.			$ 45,000	PE	$ 5,553,000	CN							$ 5,598,000	Draft STIP
2	14837	02138	OR99W:PAC HWY W OVER CORP (BRIDGE #02138)	Deck overlay; Repair deck joints.			$ 138,000	PE			$ 1,159,000	CN					$ 1,297,000	Draft STIP
2	14839	00419A	OR99W: LOCKE CREEK BRIDGE #00419A	Replace bridge #00419A.			$ 360,000	PE	$ 74,000	RW	$ 1,396,000	CN					$ 1,832,000	Discretionary
2	14839	00419A							$ 2,000	UR								
2	14842	02001	OR22: SALT CREEK BRIDGE #02001	Replace bridge #02001.			$ 155,000	PE	$ 28,000	RW	$ 3,709,000	CN					$ 3,892,000	Discretionary
2	14843	02015	OR22: GOOSENECK CREEK BRIDGE #02015	Replace bridge #02015			$ 301,000	PE	$ 50,000	RW	$ 5,490,000	CN					$ 5,841,000	Discretionary
2	14844	08074	OR22: 72ND AVENUE SE O'XING (BRIDGE #08074)	Raise bridge #08074.			$ 188,000	PE	$ 2,338,000	CN							$ 2,687,000	Discretionary
2	14844	08074					$ 161,000	RW										
2	14845	08077	OR22: ALBUS ROAD SE OX'ING (BRIDGE #08077)	Raise bridge #08077.			$ 224,000	PE	$ 2,827,000	CN							$ 3,533,000	Discretionary
2	14845	08077					$ 482,000	RW										

Reg	Key #	Bridge ID	Section (Project Name)	Work Description	2006	2006 Phase	2007	2007 Phase	2008	2008 Phase	2009	2009 Phase	2010	2010 Phase	2011	2011 Phase	Total Project Cost	Program
2	14846	08473	OR22: CORDON ROAD SE O'XING (BRIDGE #08473)	Raise bridge #08473.			$ 268,000	PE	$ 3,484,000	CN							$ 3,782,000	Discretionary
2	14846	08473					$ 30,000	RW										
2	14953	08223	I-5: SANTIAM HWY O'XING (BR #08223)	Vertical clearance			$ 150,000	PE			$ 3,572,000	CN					$ 3,722,000	PNRS
2	14977	00570, 00608	OR99E: NORTH HARRISBURG BRIDGE REPLACEMENTS	Replace bridges 00570 & 00608					$ 4,417,000	CN							$ 4,417,000	Discretionary
2	15234	08118, 08130, 08224, 08228	I-5: BRIDGE VERTICAL CLEAR IMPROVEMENTS (AREA 4)	Vertical clearance			$ 1,035,000	PE	$ 88,000	RW	$ 5,326,000	CN					$ 6,449,000	PNRS
2	15235	08689D, 08186	I-5: BRIDGE VERTICAL CLEAR IMPROVE (EUG-SPRING)	Vertical clearance			$ 821,000	PE	$ 44,000	RW	$ 4,239,000	CN					$ 5,104,000	PNRS
2	15236	08167, 08170, 08173B, 09174, 07741A	I-5: BRIDGE VERTICAL CLEAR IMPROVEMENTS (AREA 5)	Vertical clearance			$ 812,000	PE	$ 110,000	RW	$ 4,146,000	CN					$ 5,068,000	PNRS
	Subtotal Region 2				$ -		$ 5,170,000		$ 20,430,000		$ 60,204,000		$ 19,675,000		$ 31,451,000		$ 136,930,000	
3	10964	08677N/S	I-5: SOUTH MEDFORD INTERCHANGE	Replacement	$ 5,600,000	CN											$ 5,600,000	PNRS
3	11783	08890N/S	I-5: N ASHLAND-12TH STREET (MEDFORD) RESURFACING	Add deck work	$ 2,100,000	CN											$ 2,100,000	PNRS
3	13711	07824	I-5: GRANT SMITH ROAD O'XING (BR #07824)	Vertical clearance			$ 600,000	CN									$ 600,000	PNRS
3	14047	07953B	I-5: MYRTLE CREEK-TRI CITY-BUNDLE 306	Replacement	$ 7,000,000	CN											$ 7,000,000	PNRS
3	14810	00380	OR66: NEIL CREEK BRIDGE #00380	Replace bridge #00380.			$ 284,000	PE	$ 74,000	RW			$ 1,543,000	CN			$ 1,901,000	Draft STIP
3	14811	01245B	OR234: ROGUE RIVER (DODGE) BRIDGE #01245B	Strengthen cracked beams; Repair cracked caps; Rail retrofit.					$ 73,000	PE	$ 19,000	RW	$ 398,000	CN			$ 490,000	Draft STIP
3	14812	03780	OR99: SISKIYOU HWY OVER COR (STEINMAN) BR #03780	Clean & repair cracked walls; Repair spalled girders.					$ 34,000	PE	$ 9,000	RW	$ 186,000	CN			$ 229,000	Draft STIP
3	14813	07338	OR138: CALAPOOIA CREEK (ROCHESTER) BRIDGE #07338	Replace bridge #07338.			$ 457,000	PE	$ 31,000	RW	$ 4,311,000	CN					$ 4,851,000	Draft STIP
3	14813	07338							$ 52,000	UR								
3	14814	07667	I-5: GARDEN VALLEY ROAD OXING (BRIDGE #07667)	Repair cracked caps & x-beams; Replace rail; Deck overlay.			$ 146,000	PE	$ 1,000	UR	$ 748,000	CN					$ 895,000	Draft STIP
3	14815	07767	US101: EUCHRE CREEK BRIDGE #07767	Replace bridge #07767.			$ 400,000	PE	$ 2,741,000	CN							$ 3,224,000	Draft STIP
3	14815	07767					$ 31,000	RW										
3	14815	07767					$ 52,000	UR										

Reg	Key #	Bridge ID	Section (Project Name)	Work Description	2006	2006 Phase	2007	2007 Phase	2008	2008 Phase	2009	2009 Phase	2010	2010 Phase	2011	2011 Phase	Total Project Cost	Program
3	14816	08718	US101: MYERS CREEK BRIDGE #08718	Deck overlay; Rail retrofit; Joint repair; Repair cracked concrete superstructure.			$ 189,000	PE	$ 1,235,000	CN							$ 1,435,000	Draft STIP
3	14816	08718					$ 10,000	RW										
3	14816	08718					$ 1,000	UR										
3	14847	08281	OR42: EB O'XING US101 NB (BRIDGE #08281)	Raise bridge to 16'6"; Retrofit rails.			$ 174,000	PE	$ 45,000	RW	$ 947,000	CN					$ 1,166,000	Discretionary
3	14950	09260A	I-5: PACIFIC HWY OVER FRONTAGE RD (BR #09260A)	Deck work			$ 60,000	PE									$ 760,000	PNRS
3	14950	09260A					$ 700,000	CN										
3	15186	07632 & Various	I-5: WINCHESTER BR/DEL RIO RD (INTERCHANGE RAMPS)	Interchange ramps	$ 3,700,000	PE	$ 4,300,000	RW			$ 7,000,000	CN					$ 15,000,000	PNRS
	Subtotal Region 3				$ 18,400,000		$ 7,404,000		$ 4,286,000		$ 13,034,000		$ 2,127,000		$ -		$ 45,251,000	
4	12740	02147	OR140: OC&E OVER BNSF (DAIRY) BRIDGE #02147	Replace bridge #02147.							$ 370,000	PE	$ 97,000	RW	$ 2,012,000	CN	$ 2,479,000	Draft STIP
4	14179	00849A	US97: COLUMBIA RIVER (BIGGS RAPIDS) BRIDGE #00849A	Deck repair/replace. Joint proj with WSDOT. WSDOT is lead. Cost is ODOT share.	$ 250,000	PE	$ 6,500,000	CN									$ 6,750,000	Discretionary
4	14817	00332	OR206: DESCHUTES RIVER BRIDGE #00332	Repair cracking in beams; retrofit rail; Deck overlay; Post tension girders			$ 409,000	PE	$ 2,334,000	CN							$ 2,743,000	Draft STIP
4	14819	05018A	OR207: JOHN DAY RIVER BRIDGE #05018A	Repair deck joints; Repair cracks in RCBC; Retrofit rails.			$ 127,000	PE			$ 724,000	CN					$ 851,000	Draft STIP
4	14832	06741	OR39: ALAMEDA AVE PARTIAL VIADUCT BRIDGE #06741	Replace bridge #06741.			$ 175,000	PE	$ 46,000	RW	$ 952,000	CN					$ 1,173,000	Draft STIP
4	14836	01959	OR422: WILLIAMSON RIVER BRIDGE #01959	Deck replacement; New rails.			$ 166,000	PE	$ 44,000	RW	$ 903,000	CN					$ 1,113,000	Draft STIP
	Subtotal Region 4				$ 250,000		$ 7,377,000		$ 2,424,000		$ 2,949,000		$ 97,000		$ 2,012,000		$ 15,109,000	
5	14695	00700	US30: BURNT RIVER & UPRR BRIDGE #00700	Deck overlay; Rail retrofit; Repair girders, caps, joints; Repair truss & bearings.					$ 268,000	PE	$ 23,000	RW	$ 1,663,000	CN			$ 1,954,000	Draft STIP
5	14697	00778A	OR74: WILLOW CREEK (COURTHOUSE) BRIDGE #00778A	Place riprap along Bts 2 & 3; Replace joint seals.			$ 42,000	PE	$ 38,000	RW	$ 112,000	CN					$ 236,000	Draft STIP
5	14697	00778A							$ 44,000	UR								
5	14830	00624A	US730: UMATILLA RIVER (UMATILLA) BRIDGE #00624A	Deck overlay; Joint repair; Bearing replacement; Girder & floor beam repair.							$ 210,000	PE	$ 65,000	RW	$ 1,566,000	CN	$ 1,886,000	Draft STIP
5	14830	00624A									$ 45,000	UR						

Reg	Key #	Bridge ID	Section (Project Name)	Work Description	2006	2006 Phase	2007	2007 Phase	2008	2008 Phase	2009	2009 Phase	2010	2010 Phase	2011	2011 Phase	Total Project Cost	Program
5	14831	08431	US30: GRANDE RONDE R & UPRR (ORO DELL) BR #08431	Deck overlay; Joint repair; Rail retrofit; Box girder & concrete cap crack repair.							$ 243,000	PE	$ 95,000	RW	$ 2,288,000	CN	$ 2,626,000	Draft STIP
	Subtotal Region 5				$ -		$ 42,000		$ 350,000		$ 633,000		$ 1,823,000		$ 3,854,000		$ 6,702,000	
	TOTAL ALL				$ 18,650,000		$ 25,841,000		$ 49,085,000		$ 124,291,000		$ 43,500,000		$ 39,636,000		$ 301,003,000	
	TOTAL Draft STIP				$ -		$ 4,904,000		$ 32,653,000		$ 45,826,000		$ 43,500,000		$ 39,636,000		$ 166,519,000	
	TOTAL DISCRETIONARY				$ 250,000		$ 9,343,000		$ 16,190,000		$ 14,217,000		$ -		$ -		$ 40,000,000	
	TOTAL PNRS				$ 35,218,000		$ 17,340,000		$ 242,000		$ 94,400,000		$ -		$ -		$ 147,200,000	
					$ 35,468,000		$ 31,587,000		$ 49,085,000		$ 154,443,000		$ 43,500,000		$ 39,636,000		$ 353,719,000	

APPENDIX B

State Bridge Program
2008-2011 Construction STIP
Bridge Project Criteria Statewide Summary Report

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Project Selection Process

The State Bridge Program is a statewide program managed by the Bridge Engineering Section. Candidate projects that will rebuild or extend the service life of an existing bridge (including replacement) are identified through the use of a Bridge Management System, consistent with the Oregon Transportation Commission's (OTC) project eligibility criteria for this program. The project eligibility criteria are a first screen so that additional efforts can be focused to determine which projects will be evaluated further. Projects must satisfy these eligibility criteria, at a minimum, before they are given additional consideration.

For the 2008-2011 STIP development cycle, 1,200 (out of 2,800) bridges were identified as having significant structural or functional needs by the Bridge Management System. The Bridge Engineering Section used an iterative, collaborative process involving engineering and other technical specialists to narrow the initial list to 160 "most needy" bridges. Oversight, assistance and Regional coordination was provided by the ODOT Bridge Leadership Team.

Prioritization factors are established by the OTC to ensure consistent consideration of the relative merits of candidate projects. The project prioritization factors established by the OTC for the State Bridge Program are:

- Support of the Bridge Options Report;
- Support of Oregon Highway Plan policies; and
- Leverage of other funds and benefits.

For the development of the 2008-2011 STIP, particular emphasis was given to selecting projects that were consistent with the "corridor-based" strategy of the Bridge Options Report and were located on the Oregon State Highway Freight System or National Highway System. (The application of each factor to the final candidate projects of the State Bridge Program is addressed below.) Beyond these top priority projects, and within the financial constraints of the program, projects were also selected to address load capacity and safety issues, and other structural and functional needs on the remainder of the system. As a result, 38 projects statewide are recommended to the OTC for inclusion in the 2008-2011 STIP for the State Bridge Program.

Public Involvement Process

The OTC will make the final selections for all projects included in the STIP. The Commission considers the advice and recommendations that it receives from Area

Commissions on Transportation (ACTs), Metropolitan Planning Organizations (MPOs) and regional and statewide advisory groups. ACTs have a primary role of making recommendations to the OTC regarding project selection for projects of local or Regional significance. ACTs may choose to review projects for other STIP programs that have advisory committees or processes in place, including the State Bridge Program which determines project eligibility based on criteria established by the OTC and a management system. The ACT may advise ODOT on any special circumstances or opportunities that apply to these other proposed projects.

The final, financially constrained proposed State Bridge Program for the 2008-2011 STIP was provided to the ODOT ACT representatives during June, 2006. Early draft programs were made available to the Regions through the Bridge Leadership Team in January, 2006. Two regions, Region 1 and Region 5, took advantage of the opportunity for early public involvement.

Bridge projects were included as a part of Region 1's overall early public involvement outreach efforts for the drafting of the 2008-2011 STIP. Region 1 developed and shared candidate bridge lists and bridge program information. Copies of the documents were made available on-line and were also shared at four Region 1 public involvement meetings held in Portland, Hillsboro, Hood River and Oregon City during January and February, 2006.

Region 5 provided Bridge Program Updates to the North East Area Commission on Transportation (NEACT) and the South East Area Commission on Transportation (SEACT) during March, 2006.

All of the Regions have plans to review the proposed 2008-2011 STIP with the ACTs and MPOs, as applicable, within their Regions during the summer of 2006. This schedule is consistent with the STIP development timeline. In addition to the ACT and MPO presentations, public involvement for the 2008-2011 STIP includes a formal public review process which begins with the distribution of the draft STIP document in September, 2006. Final approval of the 2008-2011 STIP by the OTC is anticipated in August, 2007.

Project Eligibility

Project identified through the Bridge Management System: All of the 2008-2011 Construction STIP state bridge program projects were identified through the Bridge Management System.

Project will rebuild or extend the service life of an existing bridge: All of the 2008-2011 Construction STIP state bridge program projects rebuild or extend the service life of an existing bridge.

Project Prioritization

Support of the Bridge Options Report: Half of the 2008-2011 Construction STIP state bridge program projects are located on NHS or the Oregon Highway Freight System routes, consistent with the "corridor-based" strategy of the Bridge Options Report (BOR). Most of the remainder (an additional 32%) resolve load capacity issues on routes that "feed" the National Highway System or Oregon Highway Freight System. Addressing load capacity issues is also a major component of the BOR. Freight mobility, primarily for bridges this means resolving load capacity and vertical clearance issues, is the largest category of the state bridge program.

Support of OHP policies: The State Bridge Program STIP for 2008-2011 supports the following OHP policies:

- 1A- by applying the state highway classification system to guide program priorities for investment. Some criteria currently in use in the Bridge Management System use different condition thresholds depending on the functional classification of the highway route of a deficient bridge. In general, the State Bridge Program goals favor STIP projects on freight and NHS routes in its investment hierarchy.
- 1B- because the rehabilitation and replacement of state-owned bridges will help maintain the mobility and safety of the highway system, enhance livability and economic competitiveness by extending the useful life of a bridge or reducing the possibility of the failure of a bridge due to deterioration or other unsafe conditions.
- 1C- by concentrating state bridge projects on freight and NHS routes to address load capacity and safety issues, while also giving priority to bridges with structural condition and functional problems on the remainder of the system.
- 1G- by maintaining and improving existing infrastructure.
- 2A- by continued program coordination with Washington State regarding improvements to the bi-state Columbia River bridges.
- 2F- as the replacement and rehabilitation of state-owned bridges improves safety for all users of the highway system.
- 4A- by concentrating state bridge projects on freight and NHS routes and by addressing load capacity issues on these routes and the connecting road system.

Leverage of other funds and benefits: The best opportunities for leverage of other funds that the proposed program of state bridge projects may be able to take advantage of are internal to ODOT. In some cases, selected bridge projects may be combined with other (usually Preservation) projects which can save traffic control, mobilization and other costs that would be incurred if the bridge was bid separately. Bridge projects typically result in community benefits such as public safety and enhanced bicycle and pedestrian access, since the project often includes widening existing bridges or replacement using full shoulder widths. In addition, bridge replacement projects have collateral environmental benefits. New bridges are designed and constructed with greater sensitivity to the riparian habitat than was previously the case with older design and construction considerations. Increasingly, animal habitat features, such as bat boxes, are designed and constructed into the bridge structure itself. With a shift in focus from "worst first" to a "corridor-based" approach, the State Bridge Program is contributing significantly to a reduction in freight movement restrictions, and supporting continued economic development within Oregon.

Conditions of Approval and Other Relevant Information: None

APPENDIX C

A REVIEW OF THE OREGON STATE BRIDGE PROGRAM PROJECT SELECTION PROCESS FOR THE 2008-2011 STATEWIDE TRANSPORTATION IMPROVEMENT PROGRAM

Part of the overall challenge of effective bridge management to a highway transportation agency is the timely identification, planning and scheduling for construction of bridge replacement and rehabilitation projects. The Oregon Department of Transportation (ODOT) has struggled with this challenge for the last decade.

There are approximately 4,600 bridges on the Oregon State Highway system that are owned and managed by ODOT. Of these, approximately 2,600 are National Bridge Inventory (NBI) bridges that are eligible for Highway Bridge Program (HBP) funding, formerly Highway Bridge Rehabilitation and Replacement (HBRR) funding. Until 1996, selection of ODOT bridges for rehabilitation or replacement was driven by modernization and preservation projects developed by the five geographic Regions. The Federal Highway Administration (FHWA) sufficiency rating and the American Association of State Highway and Transportation Officials (AASHTO) design standards were the factors determining whether a bridge project would be placed in the four year Statewide Transportation Improvement Program (STIP).

A review of bridge conditions in 1994 and 1995, in particular on the Oregon Coast Highway, revealed that the condition of bridges which were not on routes programmed for modernization was becoming seriously deteriorated. It was during this time that ODOT expanded the information gathered during bridge inspections to include “element level” data. This is a more exact method of describing bridge conditions than the Condition Ratings that are required by the National Bridge Inventory Standards. Since bridges are on a two-year inspection cycle, and the element inspection procedures were still evolving, the element data was incomplete and could not be used in a logical statewide method for identification, ranking and selection of bridges within the STIP.

In 1995, ODOT, with the support of the FHWA Oregon Division, initiated a systematic project selection process which integrated element level inspection and other data to evaluate bridges on a statewide basis for inclusion, due to all possible reasons, in the STIP. This process was used in the development of the 1998-2001 and 2000-2003 STIP’s. The result of this selection process was that bridges in the most deteriorated condition were given priority, regardless of the importance of the route they were on. This selection method became known as “worst first”.

Although ODOT had now created a rational system for making bridge investment decisions, a volatile combination of continued limited annual bridge construction funding, the large magnitude of unmet needs, concern over girder cracking in reinforced concrete deck girder (RCDG) bridges designed in the late 1940s through the 1960s, and a coalition of other political and economic forces resulted in an entirely different approach to the bridge problem.

In 2001, ODOT created a Bridge Strategy Task Force. The Task Force sought to explain the emergence of the cracked concrete bridges and identified strategies to address them. In the process, the Task Force condemned the use of “worst-first” approach to choosing bridge repair and replacement projects and recommended that a “corridor-based” strategy be used instead. The final recommendation of the Task Force focused on Oregon’s two major Interstate routes (I-5 and I-84) in the interest of returning full load carrying capacity to the nearly 675 miles of Oregon’s Strategic Highway Network (STRAHNET).

ODOT completed an “Economic and Bridge Options Report” in 2003. This report identified 365 cracked girder state bridges on major interstate or state highways that were in critical need of repair or replacement. In 2003, the Legislature passed House Bill 2041, known as the Oregon Transportation Investment Act (OTIA) III, signed into law by Governor Kulongoski on July 28, 2003, authorizing Highway User Tax Bonds to be issued to address the problem of Oregon’s cracked girder bridges and the associated load restrictions on major freight routes. Included in this legislation was $1.3 billion to repair or replace 365 state bridges with cracked girders. Since the OTIA III program will reduce the amount of bridge work that the State Bridge Program will be responsible for, a sizeable amount of the $1.3 billion will come from the State Bridge Program. The planned payback schedule from the State Bridge Program is $31 million per year for 25 years. Originally, the repayment of the bonds was scheduled to begin in 2008, but the repayment is currently postponed until 2010.

The OTIA III program will result in the largest bridge construction program in Oregon since the Interstate Highways were built. However, there are many routes that are not included in the OTIA III program. There is a statewide need of approximately $1.7 billion for critical bridge needs not on OTIA routes. These needs must be addressed at the same time that the State Bridge Program will face reductions due to the repayment of the OTIA bonds.

During the development of the 2006-2009 STIP, ODOT reorganized the structure of the department. Bridge design functions were moved from the headquarters unit to the regions, and a separate organization was created to deliver the OTIA III projects. The experienced structural managers who had been instrumental in the development of previous State Bridge Programs left the department for jobs with consulting firms. In the wake of the reorganization, the Bridge Section began the selection process for the 2008-2011 STIP. Our intention was to modify the systematic process used in earlier STIP cycles and incorporate the lessons learned from the OTIA III program regarding the importance of a corridor-based approach.

In December 2005, the OTC took action to delay the impact of the repayment of the bonds on the State Bridge Program until 2010. Meanwhile, State Bridge Program managers were working to identify an ideal program funding framework and funding level as well as program goals that would guide future investment decisions.

Process Summary

The project identification and selection process used in the development of the 2008-2011 STIP followed these steps:

1. Development of program goals, framework and investment hierarchy by the Bridge Section.
2. Development of bridge screening criteria and application of bridge management system tools by the Bridge Section.
3. Initial review and prioritization by Bridge Section engineering specialists.
4. Review of draft problem bridge lists by Regions/Areas/Districts.
5. Second stage review and prioritization by Bridge Section engineering specialists.
6. Compilation of operational and structural scores with the assistance of District (Maintenance) Managers.
7. Overlay of priority bridges on State Highway Freight System.
8. Development of preliminary projects, paper scopes and preliminary program of projects by Bridge Section.
9. Joint Bridge Section/Region project delivery meeting.
10. Review and field scoping of proposed projects by Regions.
11. Final project selection within program financial constraints.

Step 1 – Development of Program Goals, Framework and Investment Hierarchy

In the face of a wide-spread perception that OTIA III had solved the state bridge problem, State Bridge Program managers felt a need to clarify the framework and priorities for the State Bridge Program STIP and to predict the effect of proposed funding levels for the program on state bridge performance measures. Although the managers developed a sense of adequate funding levels for each element of the new program framework, it was clear from the outset that funding levels would not be adequate to address all of the high priority bridge needs remaining after completion of the OTIA projects. Therefore, in addition to program goals, the managers identified a priority hierarchy to guide project selection in the face of inadequate resources. State Bridge Program goals and the investment hierarchy are shown in Table 1. See Appendix A for a matrix of the State Bridge Program framework.

Table 1

State Bridge Program Goals and Investment Hierarchy

Our investment decisions will be based on these goals:

Improve state bridges by eliminating

- Freight Mobility Restrictions (load, width or vertical clearance)
- Poor Structural Condition (deterioration, damage and scour)

Maximize investment by building bridges that:

- Require less maintenance with longer life expectancy
- Meet standards and community expectations well into the future

To accomplish this, the State Bridge Program will:

- Concentrate STIP projects for state bridges on freight and NHS routes to address load capacity and safety issues.
- Give priority of remaining funding to achieve 92% fair or better structural condition, and 75% functional and structural condition.
- Preserve high value structures, such as major river crossings and movable bridges.

Step 2 – Development of Bridge Screening Criteria and Application of Bridge Management System Tools

This step bears the most resemblance to the pre-OTIA STIP selection process. It was developed to provide an alternative to the Sufficiency Rating which is a poor basis for comparison of condition specific problems or vulnerabilities. Different criteria, with a clear relationship to each observable problem and risk, were needed. ODOT and FHWA saw the need to both develop the criteria and the process to consistently apply the criteria to determine if and why a structure should be repaired, rehabilitated or replaced. The idea was the structures with similar needs could then easily be compared. In addition, the goal was to create a comprehensive system which considered both predictable deterioration and functional, event-driven needs.

The categories ODOT uses include those from the NBI: Substructure, Superstructure and Deck Condition. Major categories for vulnerability, Seismic and Scour, were added. Categories for safety deficiencies, Bridge Rail and Deck Width, were added. Restrictive use categories, Load Capacity and Vertical Clearance (Underclearance) were included. Protection of investment categories, Paint (corrosion protection for steel structures) and Coastal Bridge (corrosion protection and correction for reinforced concrete structures) were included as were Movable Bridges.

Each category relates to a significant feature that is both visually and conceptually distinct. Any specific bridge may have multiple categories of work required. Selection criteria, or threshold conditions, which determine how urgently the work is needed, are used to rank bridges for consideration within categories. In addition to element level data, ODOT has a number of data sources to describe and prioritize specific information categories. These include databases on seismic vulnerability, scour vulnerability, steel bridge paint system, coastal bridges, bridge rail risk assessment and load rating. The criteria used have evolved over time and reflect the various applicable data sources. The current criteria are described in Table 2. In addition to the criteria, ODOT developed a mechanism for linking the data collections into a comprehensive system for review of bridge data and application of the criteria.

<u>Table 2</u>

Category	**Criteria**
Substructure	NBI Substructure Rating <=4 AND Substructure Element CS 4>0; OR

	Settlement Smart Flag is ON
Superstructure	NBI Superstructure Rating <=4 AND Superstructure Element CS 4>0; OR Superstructure Element = Tunnel AND Superstructure Element CS 3>0; OR Steel Smart Flag is ON
Deck Condition	NBI Deck Rating <=5 AND Deck Element CS=>3 AND Functional Class = Interstate AND ADT >10,000; OR NBI Deck Rating <=4 AND Deck Element CS=>3 AND Functional Class = Freeway AND ADT > 5,000; OR NBI Deck Rating <=4 AND Deck Element CS=>3 AND Functional Class = Arterial; OR NBI Rating <4 AND Element CS=>4; OR Modular Joint Assembly AND Element CS=>3
Seismic	Seismic DB Group = 1A AND Ground Acceleration >=0.19 AND Lifeline Factor >1.1 AND Recovery Factor >1.2 AND Rank <100; OR Seismic Group = Special AND Ground Acceleration >=0.19 AND Lifeline Factor >1.1 AND Recovery Factor >1.2 AND Rank <100
Scour	Scour Critical DB Bridge <=3 AND Spread Footing Erodible = 1 AND Scour History = 1; OR NBI Channel Rating <=4; OR Scour Smart Flag is ON
Bridge Rail	Rail Study DB (Site Risk) >2.5 AND NBI Bridge Rail Rating =0; OR Rail Study DB (Site Risk) >Null AND Rail Element CS3>10
Deck Width	NBI Deck Geometry <4 AND Bridge Length <200’ AND ADT >6,000 AND Approach Width > Roadway Width + 8’; OR NBI Deck Geometry <4 AND Bridge Length < 200’ AND ADT >6,000 AND (Approach Width > Lanes-on *12’) + 8’
Load Capacity	NBI Open Status = D,E,P,K,R; NBI Temporary Repairs = T; OR NBI Posting <=3; OR Load Rating DB for Permit Trucks <0.98
Vertical Clearance	NBI Minimum Clearance <16’5” AND NBI Truck Network = 1; OR NBI Minimum Vertical Underclearance <16’; OR Traffic Impact Smart Flag is ON
Paint	Paint DB Condition <4 AND Structure Length > (Reg 1 = 1000’ / Others 800’); OR Overall Paint System Element CS>0; OR Pack Rust Smart Flag is ON
Coastal	Coast DB Corrosion Cracks > 3; OR Coast DB Delaminations >3; OR Coast DB Spalls >3
Movable Bridges	Movable Bridge DB Condition <=5

Notes:

1. There are NBI ratings for the deck, superstructure, and substructure. An NBI rating of 4 describes a “poor” condition in which there is advanced section loss and other deterioration. An NBI rating of 3 describes a “Serious” condition where primary structural elements have been affected by deterioration.
2. “CS” is the Condition State of the individual bridge elements. If there is no deterioration, the element is considered to be in Condition State 1. The most serious Condition State is 5. However, not all elements have all condition states.

3. For bridge rails, the NBI rating is either a “1” (Meets Standards) or a “0” (Does not meet Standards).
4. “Smart Flags” are used by the inspector to report the condition assessment of deficiencies that are not modelable. These are treated like a bridge elements.

Step 3 – Initial Review and Prioritization by Engineering Specialists

Of 2,600 State Bridges, 1,200 were “trapped” by one or more of the criteria, or threshold conditions. The Bridge Section convened a committee of its engineering specialists with knowledge in the areas of steel, concrete, seismic, scour, load rating, bridge inspection, bridge rails, coastal and movable bridge technology and issues. After eliminating bridges that were already programmed for work, the group evaluated lists for each problem area ranked by the criteria in Table 2. The group selected 117 bridges for further evaluation.

Step 4 – Review of Draft Problem Bridge Lists by Regions/Areas/Districts

After the initial internal review and ranking process was completed, “short lists” were prepared for review by Regional staff including Technical Center bridge engineers, area managers and district maintenance managers. Each Region was asked to rank the projects within their boundaries and to make note of other high priority problem bridges that might have been missed. Additional bridges proposed by the Regions had to meet the same initial threshold criteria (i.e., on the initial list of 1,200 problem bridges) or their addition had to be vetted by the Region Bridge Inspector (as in the case of more current condition data). This review process resulted in a second stage review of 160 bridges.

Step 5 – Second Stage Review and Prioritization by Engineering Specialists

During the second stage review, the Bridge Section’s engineering specialists undertook an intensive process of reviewing bridge inspection reports, bridge plans and all other relevant technical data in order to determine the highest priority of the bridges and to suggest alternative solutions. An engineering specialist in cost estimating was added to the group in order to provide estimates for the alternative rehabilitation and replacement solutions. As a result of extensive analysis and discussion, the committee suggested preferred solutions and recommended broad categories of priority based on need and condition.

Step 6 – Compilation of Structural and Operational Scores

As during a previous STIP cycle, the Bridge Section developed structural and operational scores for potential bridge projects. The structural condition score for each bridge was calculated by the Bridge Section as the data was readily available from the NBI and other databases. However, the operational score contains factors that require local knowledge. Important traffic generators such as mills, product distribution centers and other large businesses may raise the importance of restoring the load carrying capacity of some of these bridges over others. Lack of suitable detour routes is another factor that can have a great impact on local communities. While the load carrying capacity of bridges on a detour route can be determined, special geometry limitations may exist that eliminate a particular route from being considered viable. To provide the operational scores for each priority bridge, the Bridge Section enlisted the assistance of the District (Maintenance) Managers. Bridge maintenance crews have daily involvement with the state's bridge inventory and can often provide the best current information on bridge and local conditions. For details on the factors included in the structural and operational scores, please refer to Appendix B.

Step 7 – Overlay of Priority Bridges on State Highway Freight System

For bridges, freight mobility is based on clearance requirements and load restriction. Permits are issued for particular routes that include multiple bridges. The bridge with the lowest capacity to safely carry the load will often determine if the permit can be issued. To support the concept of route continuity, bridges evaluated by the Bridge Section's engineering specialists, and considered of particular merit for rehabilitation or replacement, were super-imposed on a map of the State Highway Freight System, recently expanded by the OTC. Those bridge projects which, if accomplished, would open up a route segment for freight movement that would otherwise be restricted due to either clearance or load issues were deemed of top priority for inclusion in the State Bridge Program STIP.

Step 8 – Development of Preliminary Projects, Paper Scopes and Program of Projects by Bridge Section

Once the relative priority of problem bridges began to emerge more clearly, the focus of the Bridge Section was to identify preliminary (paper) scopes and estimates for a list of preliminary projects. This is the point at which bridge problems became possible bridge projects. The task of arranging the highest priority projects into a program of projects, financially constrained for each year of the STIP would, in the current Bridge Section organization, fall to the Bridge Program Manager. Due to a vacancy in this critical position, the State Bridge Engineer performed the function of selecting and arranging the preliminary projects into a constrained STIP schedule.

Step 9 – Joint Bridge Section/Region Project Delivery Meeting

After an internal process of review and revision by managers and other members of the STIP development team, a day long meeting was convened jointly with members of the Bridge Section and ODOT's Bridge Leadership Team. The Bridge Leadership Team is comprised of bridge engineers from each Region's Technical Center. The primary role of the Regions in the State Bridge Program STIP is project delivery. Under the current organizational arrangement, Technical Center staff will design or contract for the design of each bridge project. Regional staff, including Region Managers, Area Managers, project managers and project leaders, is responsible for the remaining steps in project delivery and the day-to-day management of the construction contracting process. Once a commitment to a project is made by the Bridge Section, the role of the Bridge Section in the project is largely limited to the resolution of scope, scheduling and financial issues that arise during the completion of the projects by the Regions. Because of this organizational arrangement, it is crucial to begin the process of delivery of the State Bridge Program with agreement between the Bridge Section and the Regions about the projects and their timing.

Step 10 – Review and Field Scoping of Proposed Projects by Regions

The result of the joint Bridge Section – Bridge Leadership Team meeting was a list of projects to be field scoped by each Region. At this point, the workload shifted from the Bridge Section to the Regions. At the conclusion of the three month period allocated to this part of the process, each Region returned revised estimates and in some cases, revised scopes or delivery schedules to the Bridge Section.

Step 11 – Final Program Selection Within Financial Constraints

The results of the field scoping and estimating process required a second round of adjustments to the proposed program of projects for the STIP. Again the Bridge Section returned to its program goals and investment hierarchy for guidance in making the final selections. A second joint meeting between the Bridge Section's STIP development team and the Bridge Leadership Team was held to determine a final draft 2008-2011 State Bridge Program STIP.

Conclusion

In the wake of a period of adjustment after the reorganization process and changes in ODOT policy direction, the Bridge Section established a "new normal" in the development of the State Bridge Program STIP for 2008-2011. The process will continue to evolve in response to additional organization and policy changes. Also, element level data will be included in a much more systematic way as we use the built-in analysis capability of PONTIS, the Bridge Management System. PONTIS is currently used only for data storage as the models for deterioration and project selection are in the process of being modified for Oregon-specific conditions. It is anticipated that the current process and PONTIS will run simultaneously for at least one STIP development cycle in order to check the initial results received from PONTIS against the knowledge of the Bridge Section's technical engineering and program specialists. A secondary system, in addition to PONTIS will be required for the foreseeable future to assist with the analysis of the functional, event-driven needs which are not currently included in PONTIS.

APPENDIX D

Classification of Bridges in Poor Condition

Using the Pontis Database Tables

General Qualifications

In order to be considered for either the structurally deficient or functionally obsolete classification,

Inventory Route status 5A (*Pontis:* ***roadway.on_under***) must be coded **"1"** and
Item 49 (*Pontis:* ***bridge.length***) must be coded numeric and equal to or greater than 000020 (*Pontis:* ***6.0***).

Structurally Deficient (Determined first)

1. A condition rating of **4** or less for

Item 58 (*Pontis:* ***inspevnt.dkrating***) — Deck
or
Item 59 (*Pontis:* ***inspevnt.suprating***) — Superstructure
or
Item 60 (*Pontis:* ***inspevnt.subrating***) — Substructure;
or
Item 62 (*Pontis:* ***inspevnt.culvrating***) — Culvert and Retaining walls. **But only** if the last two digits of Item 43 (*Pontis:* ***bridge.designmain***) are coded 07 or 19.

Or

2. An appraisal rating of **2** or less for

Item 67 (*Pontis:* ***inspevnt.strrating***) — Structural Condition
or
Item 71 (*Pontis:* ***inspevnt.wateradq***) — Waterway Adequacy. **But only** if the last digit of Item 42 (*Pontis:* ***bridge.servtypund***) is coded 0,5,6,7, 8 or 9.

Any bridge classified as structurally deficient is excluded from the functionally obsolete category described below.

Functionally Obsolete (Determined second)

1. An appraisal rating of **3** or less for

Item 68 (*Pontis:* ***inspevnt.deckgeom***) — Deck Geometry;
or
Item 69 (*Pontis:* ***inspevnt.underclr***) — Underclearances **Note:** Item 69 applies only if the last digit of Item 42 (*Pontis:* ***bridge.servtypund***) is coded 0, l, 2, 4, 6, 7 or 8.
or
Item 72 (*Pontis:* ***inspevnt.appralaign***) — Approach Roadway A1ignment.

Or

2. An appraisal rating of **3** for

Item 67 (*Pontis:* ***inspevnt.strrating***) — Structural Condition
or
Item 71 (*Pontis:* ***inspevnt.wateradq***) — Waterway Adequacy. **But only** if the last digit of Item 42 (*Pontis:* ***bridge.servtypund***) is coded 0,5,6,7, 8 or 9.

APPENDIX E

STATUS OF BRIDGE HEALTH INDEX AT ODOT

INTRODUCTION

The concept of the Bridge Health Index originated with the California Department of Transportation (CALTRANS). The purpose was to create a single number to measure the performance of bridge maintenance and rehabilitation, a number that would solely reflect the structural condition of the bridge. The NBI Sufficiency Rating was deemed not to be satisfactory because the Sufficiency Rating is based in part on non-structural (functional) criteria and CALTRANS wanted a measure that was more objective than the Sufficiency Rating.

Most states, including California, use element level inspection, i.e. rating the structural condition of each individual component (element) of a bridge separately. Every time a bridge is inspected, each element is assigned to one of several condition states that describe the nature and extent of damage to or deterioration of that element. Inspection of each element is intended to be as repeatable and objective as possible. Only structural criteria are included in element condition descriptions. Therefore, CALTRANS created a performance measure based on element level data and called it the California Health Index.

WHAT IS THE HEALTH INDEX?

The Health Index is a way to compare a bridge in its best possible condition with the bridge's current condition. It does this by combining all the elements in a bridge as if they were in their best possible condition states, combining all the elements in their present condition states and comparing the two totals.

In order to do this, a method was created to directly compare and combine such disparate elements as a spread footing and 200 feet of bridge rail. CALTRANS assigned weights to the elements according to the economic consequences of element failure. An element quantity multiplied by this economic weight becomes a dollar amount, which allows different types of elements to be easily compared and summed together.

The data CALTRANS used to calculate the Health Index are:

- Total quantity of each element in the bridge, reported by element
- Number of condition states for each element
- The quantity of each element in each condition state.
- Either:
    Element Failure Cost (Element Agency Failure Cost + Element User Failure Cost)
    Or
    Element Replacement Cost * Element Weighting Factor

These data are used to calculate:

- Weighing factor for each condition state
- Total element value (TEV) for the quantity of each element
- Current element value (CEV) for the quantity of each element
- Health Index (Σ CEV/Σ TEV)

The actual calculations are:

$$HI=(\Sigma CEV/\Sigma TEV) * 100$$
$$TEV=TEQ * (EWF*ERC)$$
$$CEV=\Sigma(QCS_i*WF_i) * (EWF*ERC)$$

Where:

HI=Health Index
CEV=Current Element Value
TEV=Total Element Value
TEQ=Total Element Quantity
EWF=Element Weighting Factor
ERC=Element Replacement Cost per Unit of Element
QCS=Quantity in a Condition State
WF=Weighing Factor for the Condition State, See Table 1

WF for each Condition State Based on No. of Possible Condition States					
Number of Condition States	Condition State 1 WF	Condition State 2 WF	Condition State 3 WF	Condition State 4 WF	Condition State 5 WF
5	1	0.75	0.5	0.25	0
4	1	0.6667	0.3333	0	NA
3	1	0.5	0	NA	NA

Table 1

Note: In the above equations and the seven step explanation, the option using Element Replacement Cost * Element Weighting Factor was used. This option is currently the default option PONTIS uses to calculate Health Index.

EXAMPLE HEALTH INDEX CALCULATION

For example, here is a calculation of a Health Index for Bridge Number 04678, Alder Creek, Highway 32 at MP 7.32.

This Bridge has the following elements:

Br. No. 04678 Elements	
Element No	Element Name
38	Bare Concrete Slab
205	R/Conc Column
215	R/Conc Abutment
234	R/Conc Cap
331	Conc Bridge Railing
325	Traffic Impact Cond
326	Deck Wearing Surface
358	Deck Cracking Smart Flag
359	Soffit Smart Flag
361	Scour Smart Flag

Table 2

Note: The lowermost 5 elements in the above table are separated from the other elements as they are not used in calculation of the Health Index. ODOT uses some elements such as smart flags to allow tracking of distress conditions which are not included in the standard condition state language for elements because they follow different patterns of deterioration or are not deterioration driven, and are measured in a different way. Examples are “event” related bridge damage caused by scour or accidents. So, although helpful, these are tracking tools, not actual physical elements, however they do provide information in addition to the actual condition state of physical element or elements. However, the Health Index is calculated based on the condition states of the physical elements. In PONTIS, smart flags and similar elements, not being physical elements, are assigned an ERC of $0.

First, the information for each element needed for calculating the health index for Bridge Number 04678 is gathered:

Information for Calculating Br. 04678 Health Index									
			Quantity in Each Condition State						
Element	TEQ	Unit	State 1	State 2	State 3	State 4	State 5	EWF	ERC
38	111.48	sq.m.	0.00	111.48	0.00	0.00	0.00	9	$1,292
205	10.00	ea.	3.60	0.40	0.00	0.00	NA	15	$6,000
215	2.00	ea.	2.00	0.00	0.00	0.00	NA	8	$30,000
234	2.00	ea.	2.00	0.00	0.00	0.00	NA	12	$30,000
331	26.82	m.	21.46	5.36	0.00	NA	NA	3	$1,640

Table 3

Then, TEV and CEV must be calculated for each element. The CEV calculations incorporate the appropriate WF values from Table 1. The TEV and CEV calculations for Element 331 are presented below as a sample calculation, all the TEV and CEV values are presented in Table 4 below.

Sample TEV, CEV calculation for element 331.

TEV=TEQ * (EWF*ERC) = 26.82 * (3 * $1,640) = $131,954.40

$CEV=\Sigma(QCS_i*WF_i) * (EWF*ERC)=$
[(24.46 * 1) + (5.36 * 0.5) + (0 * 0)] * (3 * $1,640) = $118,768.80

TEV, CEV Calculations							
		QCS * WF					
Element	TEV	State 1	State 2	State 3	State 4	State 5	CEV
38	$1,296,289.44	0.00	83.61	0.00	0.00	0.00	$972,217.08
205	$360,000.00	3.60	0.27	0.00	0.00	NA	$348,001.20
215	$480,000.00	2.00	0.00	0.00	0.00	NA	$480,000.00
234	$720,000.00	2.00	0.00	0.00	0.00	NA	$720,000.00
331	$131,954.40	21.46	2.68	0.00	NA	NA	$118,768.80

Table 4

Finally the TEV and CEV values for the elements are totaled and the Health Index is calculated.

ΣTEV= $2,988,243.84:
ΣCEV= $2,638,987.08:

HI= ($2,638,987.08/ $2,988,243.84) * 100 = **88.3**

ESTIMATE OF THE HEALTH INDEXES OF OREGON BRIDGES

Health Indexes for Oregon bridges owned or maintained by ODOT and listed on the NBI were calculated using element replacement costs determined in expert elicitations performed in 2006 for PONTIS cost models. NBI length culverts were included. The element weighing factors which are the default multipliers in PONTIS were judged to be acceptable to ODOT and were used to calculate CEV and TEV. Heath Indexes were calculated for a total of 2,667 bridges using data from a snapshot of the PONTIS database produced in January 2007. The values are reported below:

Health Index, Oregon NBI Bridges		
Health Index	No. Bridges	% Bridges
90-100	1612	60.4
80-89	538	20.2
70-79	343	12.9
60-69	123	4.6
50-59	32	1.2
40-49	15	0.6
30-39	2	0.1
20-29	1	0.0
10-19	1	0.0
0-9	0	0.0
	2,667	100%

Table 5

Source Data: Jan. 2007 PONTIS Snapshot, 2006 Oregon PONTIS Cost Data

ANALYSIS OF TABLE RESULTS

Based on the Health Index data reported above, the average Health Index of Oregon's state owned or maintained NBI bridges is 89.6%. Currently, there is no valid benchmark for assessing how "good" or "bad" this average is. But, as a departure point for comparison, the projects selected for the 2008-2011 draft Statewide Transportation Improvement Program (STIP) have an average Health Index of 78. However, it is important to remember that only structural bridge elements are included in the Health Index and that many of the important factors used in selecting bridges for the STIP- substandard deck width and vertical clearance deficiencies, as two examples- are not represented in any manner in the calculation of the Health Index. An additional factor is that Bridge paint condition is only partially reflected in current PONTIS data, and at this time, bridge painting and corrosion protection needs would not be adequately accommodated by the Health Index.

Another consideration is that ODOT has moved its bridge project selection policies away from solely "worst first" considerations. While the structural condition of Oregon bridges is of great concern and there is a need to address both structural condition and functional deficiencies when considering candidates for the STIP, the following factors must also be taken into account:

- the importance of the route to transportation mobility in general;
- the possibility of "opening" corridors or route segments to heavier freight loads specifically;
- and "event-driven" (non-deterioration based) needs, e.g. seismic events;

All these factors must be accommodated in the performance assessment of the State Bridge Program. Although a series of Health Index snapshots would tell us something about the whether or not the structural condition of Oregon bridges was improving over time, it would not be a good measure of the worthiness of our infrastructure investments in general. After all, Health Index was developed as a tool to evaluate maintenance and rehabilitation programs, not to select bridges for replacement.

HEALTH INDEX USES

The Health Index can be used to quickly obtain an estimate of a bridge's overall structural condition and to compare the overall condition of two or more bridges. It is also very versatile. A single Health Index may be calculated for a network of bridges by treating all the elements of all the bridges in the network as if the network were a single structure. Also, a Health Index may be calculated for a subset of elements on a bridge, for example, the superstructure, or even single element such as a deck.

Some states have found, or are considering the possible use of the Health Index for the following:

- Development and testing of new maintenance techniques
- Treatment selection policies
- Project priority setting and programming
- Budgeting
- Funding allocation
- Long Range Planning
- Monitoring program effectiveness

For example, Kansas (KDOT) has a long standing philosophy of fixing bridges with the most severe deficiencies first. KDOT has found that incorporating the Health Index into their "bridge priority formula" helps select bridges with structural deficiencies ahead of those with geometric or deck problems, which better reflect KDOT's policies and philosophy. California (CALTRANS) uses the Health Index to allocated funding for bridge repair and rehabilitation between 12 regional district offices. Each district makes its own decisions regarding the application of the funding. The Health Index is also used to evaluate the performance of each district's management strategies and decisions to preserve the system.

Although useful to consider, neither of these examples renders insights immediately applicable to Oregon's bridge management strategies. This is especially true of Oregon's freight mobility considerations of load capacity, vertical and horizontal clearances and route continuity.

Below is a table showing Health Index averages by region using the same data used to calculate the values in Table 5. For example, if this data were being used in making funding allocation decisions for maintenance, it would appear that all regions are performing fairly equally given current levels of funding, but perhaps consideration could be given to increasing the funding to Region 3, as the average health index lags that of the other regions slightly.

Average Health Index by Region			
	Ave. HI	HI wt. by Deck	Network HI
Region 1	89.7	88.5	88.7
Region 2	90.3	89.9	89.8
Region 3	88.5	87.6	87.8
Region 4	89.4	88.9	89.8
Region 5	88.9	87.4	88.6
Statewide	89.6	88.6	88.9

Table 6

Table 6 also illustrates another point, Health Index averages can be manipulated in a number of ways. The **Average HI** column presents the simple, arithmetic averages of the Health Indexes of each bridge in the region. However, a simple average has the possibility of being misleading. For example, averaging the Health indexes of five bridges, each fifty feet long and each with a low Health Index and one 1000 foot long bridge with a high Health Index would result in a low average, which might not adequately reflect the state of that system.

The **HI wt. by Deck** column represents one way to counteract this possible problem. In this column is an average of bridge Health Index values weighted by deck area. Deck area was chosen as a weighting factor as it is directly related to the size of a bridge. Therefore, the Health Index of a larger bridge will have more impact on the average than that of a small bridge.

The **Network HI** column represents another way to reflect bridge size in Health Index averages. This is technically not an average, it is the health index of a network. In other words, the numbers presented in this column represent the Health Index calculated using ALL the elements of ALL the bridges in the region as if they were part of a single bridge, as discussed above. As larger bridges have larger quantities of elements, the effect is for a network Health Index to perform like a weighted average Health Index.

There appears to be very little difference in the simple average, weighted average and network Health Index for this data, which implies bridge size does not seem to be distorting the simple average. This is not particularly surprising, based on the fact that over half of the bridges have Health indexes of 90% or greater according to Table 5.

CAUTIONS ON USE OF HEALTH INDEX

One thing that must be kept in mind is that Health Index was developed solely as a measure of structural condition. It will not take into account a bridge's functional performance, such as a bridge's capacity in relation to traffic demand (e.g. width, clearance).

Much of the literature discussing Health Index implies that TEV represents a "new" value of a bridge and CEV represents the current value of the bridge. However, one must be wary of this interpretation. Although current and total element values are given in dollars, the Health Index is based on weighted average condition state, not asset value. Assigning a dollar value to elements based on economic consequences of failure is done in calculating the Health Index to allow a consistent way to weight dissimilar elements. The dollar amounts do not reflect an actual asset value. An automobile could be used as an analogy. While a fan belt is far cheaper than a power window motor, the economic consequences of the fan belt's failing while 50 miles from the nearest garage is as great or greater than that of the power window motor, depending on the towing bill and other factors. A total cost for the car calculated on economic consequences of the failure of its parts would be analogous to the Health Index's TEV. This cost would be far higher than the purchase price of the car when new. A total cost based on the economic consequences of failure of a car's parts reduced by the condition that they are currently in would be analogous to the Health Index's CEV. This cost would not reflect the resale value of the car.

Calculation of the Health Index can be done using two different methods, the first uses element failure costs and the second uses replacement costs and multipliers. As far as the first method is concerned, it is very difficult to determine element failure costs. Although there are procedures to estimate the minimum element failure costs that will allow PONTIS' modeling functions to operate properly, these costs would not represent the true cost of failure and therefore would not be appropriate for calculating a Health Index. Any effort beyond calculating this minimum would involve many assumptions and estimations. As far as the second method, replacement costs are not as difficult to determine, but they are still based on estimates, and the associated multipliers are assumptions, not calculated. Therefore, regardless of the method chosen, some of the information needed to calculate Health Index will never be known precisely.

There is no current way smart flags can be taken into account when calculating Health Index. As smart flags can be viewed as bridge defects, the fact that Health Index calculations can't incorporate smart flags has been seen as a weakness. There is a research proposal with TRB to develop a procedure that would allow smart flags to be incorporated into Health Index Calculations.

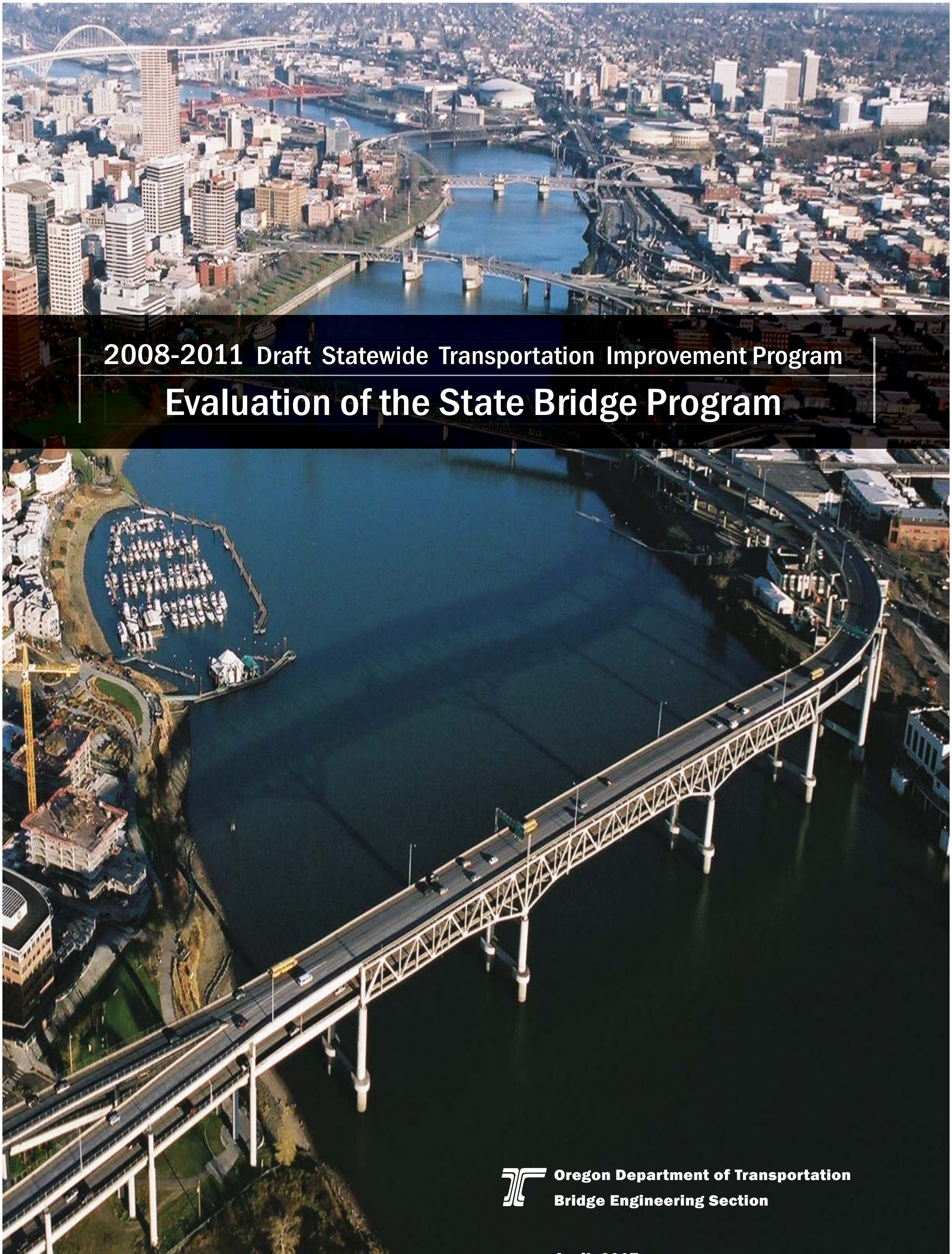
The Health Index is a one number simplification and summary of much diverse data. Like any other similar measure, while it can provide a useful overall picture, much detail is lost.

CAN ODOT CALCULATE ACCURATE HEALTH INDEXES?

Currently, ODOT Bridge Section has all the data needed to calculate Health Indexes in the PONTIS database using the element replacement cost method. We now have cost models that include element replacement costs developed for PONTIS, and ODOT Bridge Section Technical experts have determined that the default values for element weighting factors already incorporated into PONTIS are acceptable for calculating Health Indexes. The values in tables 5 and 6 were calculated using this method. Therefore, ODOT is now capable of calculating Health Indexes with some confidence.

CONCLUSION

The Health Index is a single number that is used to reflect the structural condition of an individual bridge, or a set of bridges. There are two ways to calculate the Health Index, both of which involve assumptions. When used as a performance measure, the Health Index can be used to show how the structural condition of Oregon's bridges is changing over time, and will reflect the result of Oregon's bridge management strategies. However, the Health Index by itself is not an accurate measure to evaluate programming decisions. Programming decisions may involve policy considerations, such as freight mobility and route importance, as two examples, that are not included in the Health Index. Therefore, while the Health Index may be useful as an adjunct to other considerations when evaluating programming decisions, it should never be the sole, or even the primary, consideration.



2008-2011 Draft Statewide Transportation Improvement Program

Evaluation of the State Bridge Program

Oregon Department of Transportation
Bridge Engineering Section

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