Notable results

- Ninety-two percent of state and local bridges measured by deck area are in fair or better condition; 8% are structurally deficient.
- Of the 3,286 bridges WSDOT manages, 137 have weight restrictions.

- Measured by deck area, 9.3% of bridges on the National Highway System in Washington are structurally deficient.
- WSDOT closed 44 fracture critical bridges in fiscal year 2014.

Bridge conditions remain steady from previous year

Ninety-two percent of the state-owned bridges by deck area were in fair or better structural condition as of June 2014, the same as in June 2013. In terms of the number of bridges, 98 percent of state-owned bridges were in fair or better condition as of June 2014.

The percentage in fair or better condition is greater in terms of the number of bridges compared to the percentage of deck area because several large bridges — the State Route 699 Alaskan Way Viaduct and the SR 520 floating bridge — are classified as structurally deficient.

WSDOT’s percent of bridges by deck area in good condition declines between 2009 and 2014.

Number of bridges and percent of bridges by deck area by condition category: Deck area in millions of square feet.

<table>
<thead>
<tr>
<th>Structural Condition</th>
<th>2009</th>
<th>2014</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good/Very Good</td>
<td>2,828</td>
<td>2,855</td>
<td>↓</td>
</tr>
<tr>
<td>Percent of bridges</td>
<td>89.3%</td>
<td>88.9%</td>
<td></td>
</tr>
<tr>
<td>Bridge deck area</td>
<td>37.9</td>
<td>37.3</td>
<td>↑</td>
</tr>
<tr>
<td>Percent of deck area</td>
<td>82.4%</td>
<td>80.1%</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>300</td>
<td>290</td>
<td>↑</td>
</tr>
<tr>
<td>Percent of bridges</td>
<td>8.2%</td>
<td>8.8%</td>
<td>↓</td>
</tr>
<tr>
<td>Bridge deck area</td>
<td>5.3</td>
<td>5.5</td>
<td>↓</td>
</tr>
<tr>
<td>Percent of deck area</td>
<td>11.5%</td>
<td>11.7%</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>141</td>
<td>141</td>
<td>↑</td>
</tr>
<tr>
<td>Percent of bridges</td>
<td>2.5%</td>
<td>4.3%</td>
<td>↓</td>
</tr>
<tr>
<td>Bridge deck area</td>
<td>2.8</td>
<td>3.8</td>
<td>↑</td>
</tr>
<tr>
<td>Percent of deck area</td>
<td>6.1%</td>
<td>8.2%</td>
<td></td>
</tr>
</tbody>
</table>

Combined, these two bridges (which are currently being replaced) account for 2 percent of the state-owned bridge deck area in Washington. When construction is completed on these projects in 2017, the percentage of bridge deck area in fair or better condition is expected to improve to 94 percent. In total, there are 24 bridges that account for 1.3 million square feet (2.7 percent of WSDOT-managed bridge deck area) that are in poor condition but are under contract for repair. Once these 24 bridge repairs or replacements have been completed and inspected, they will no longer be considered in poor condition.

Measuring bridge conditions by deck area provides a more comprehensive measure than by number of bridges.
Bridge and Structures

The Bridge and Structures Office provides the full range of structural engineering services required to provide safe, economical and reliable structures for Washington’s transportation system, which includes nearly 3,100 existing vehicular bridges and typically 18 new bridges per year.

WSDOT is known for its bridge design and bridge inspection technical expertise. Our professional staff is motivated and trained to design the optimum solutions for the highly complex and challenging projects we deliver and to preserve our large and valuable inventory of existing bridges and structures.

Bridge Asset Management

- Numbers, Ratings, Seismic Retrofit, and Inspection
- Structurally Deficient Bridges
- SD Bridge List (pdf, 225kb)
- SD Bridge Map (pdf, 3.06mb)
- Concrete Bridges in Washington State (pdf, 667kb)
- Bridge Annual Report -Gray Notebook Article 2014
- Past Bridge Gray Notebook Articles - Index
- Bridge Preservation Needs List
- Asphalt Bridge Overlays

Bridge Inspection

- Bridge List
- Bridge Inspection Manual
- Bridge Load Restrictions
- Bridge Vertical Clearance Trip Planner
- Post Earthquake Inspection Video (wmv, 338mb)
Washington State Bridge Inspection Manual

M 36-64.05
March 2015

Bridge Preservation Office/Local Programs

Bridge Design Manual (LRFD)

M 23-50.13
February 2014

Engineering and Regional Operations
Bridge and Structures Office
WSDOT Bridge Asset Management

WSDOT HQ
Olympia

Maintenance / Preservation
3,127 Vehicular Structures (53M sq. ft.)  *(Average Age = 45 yrs)*

75+ yrs old – 310 bridges (1.6 million sq ft)
50+ yrs old - 1,339 bridges (10.7 million sq ft)
WSDOT Bridges – Material Types

- Concrete: 74% (2,713 brgs)
- Steel: 25% (322 brgs)
- Timber: 1% (92 brgs)

% based on bridge deck area

7 out of 10 WSDOT bridges built in the past 10 years are precast prestressed/post-tensioned concrete
Bridge Management Plan

What information is needed?

- Basic Inventory Data (NBI)
- Inspection Data
  - NBI
  - Element Level
- Element History
- Element Service Life
  - Deterioration Rate
- Risks
  - Seismic
  - Scour
  - Overheight / Overloads
Bridge Condition Rating – MAP 21

- Deck
- Superstructure
- Substructure

Bridge Condition Ratings:
- 8: Good
- 7: Fair
- 6: Fair
- 5: Fair
- 4: Poor
- 3: Poor
WSDOT Bridges - NHS

2,148 Bridges
44M SF

33.2% Good
57.9% Fair
8.9% Poor

1,023 % Good
1,032 % Fair
93 % Poor

137 All
Border Bridges
Scour Repairs
Bridge Repairs (incl. Movable Brgs)
Bridge Painting
Bridge Deck Rehab and Overlay
Bridge Replacement / Rehab
Seismic Retrofits
State Highway Funding Plan

10 Year Needs

6 Year Plan

2 Year Bien Plan
## WSDOT Bridge Preservation Program

### 10 year Needs vs 6 year Plan

<table>
<thead>
<tr>
<th>Category</th>
<th># Brgs</th>
<th>10yr Needs $</th>
<th>6yr (# brgs)</th>
<th>6yr Plan $</th>
<th>Gap $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Border Bridges</td>
<td>5</td>
<td>$71M</td>
<td>5</td>
<td>$71M</td>
<td>$0</td>
</tr>
<tr>
<td>Scour Repair</td>
<td>13</td>
<td>$16M</td>
<td>7</td>
<td>$11M</td>
<td>$5</td>
</tr>
<tr>
<td>Bridge Repairs</td>
<td>134</td>
<td>$118M</td>
<td>22</td>
<td>$49M</td>
<td>$69</td>
</tr>
<tr>
<td>Movable Bridges</td>
<td>12</td>
<td>$26M</td>
<td>8</td>
<td>$17M</td>
<td>$9</td>
</tr>
<tr>
<td>Steel Painting</td>
<td>144</td>
<td>$694M</td>
<td>31</td>
<td>$143M</td>
<td>$551</td>
</tr>
<tr>
<td>Deck Rehab</td>
<td>70</td>
<td>$125M</td>
<td>13</td>
<td>$21M</td>
<td>$104</td>
</tr>
<tr>
<td>Repl / Rehab</td>
<td>26</td>
<td>$182M</td>
<td>9</td>
<td>$65M</td>
<td>$117</td>
</tr>
<tr>
<td>Seismic Retrofit</td>
<td>???*</td>
<td>???*</td>
<td>0</td>
<td>$0</td>
<td>??</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>404</td>
<td><strong>$1,232M</strong></td>
<td>95</td>
<td><strong>$377M</strong></td>
<td><strong>$855</strong></td>
</tr>
</tbody>
</table>

*10 year Seismic Needs excluded*
Border Bridges
Scour Repairs
Bridge Repairs (incl. Movable Brgs)
Bridge Painting
Bridge Deck Rehab and Overlay
Bridge Replacement / Rehab
Seismic Retrofits
Border Bridges

US101 Astoria (ODOT) - 21,473 ft. 1966
SR433 Lewis and Clark (WSDOT) - 5,478 ft. 1930
Interstate 5 (ODOT) - 3,538 ft.

NB - 1917
SB - 1958
Border Bridges

- I-205 Glenn Jackson - ODOT
  - 10,580 ft.
  - 1982

- US197 Dalles - ODOT
  - 3,339 ft.
  - 1953

- US97 Biggs Rapids - WSDOT
  - 2,567 ft.
  - 1962
Border Bridges

Interstate 82 Umatilla - SB
3,433 ft. 1988

Interstate 82 Umatilla - NB
3,308 ft. 1955
Border Bridges
Scour Repairs
Bridge Repairs (incl. Movable Brgs)
Bridge Painting
Bridge Deck Rehab and Overlay
Bridge Replacement / Rehab
Seismic Retrofits
Since 1923 – WSDOT Owned Bridges:

- 70 Documented Bridge Failures
- 43 due to Floods/Scour
Bridge Scour Repair

- WSDOT has 1,583 bridges over water
- 262 bridges categorized as being “scour critical”.
- Dec. 1979 - US101 Russel Barker bridge failure - (Bogachiel River)
- Dec. 1999 - last WSDOT Bridge scour failure (Scour of a bridge pier).
- Over the past 10 years $12M has been invested to address 17 bridges.
- Seven bridges to be addressed over the next 6 years for $11M.
WSDOT Bridge Asset Management

- Border Bridges
- Scour Repairs
- Bridge Repairs (incl. Movable Brgs)
- Bridge Painting
- Bridge Deck Rehab and Overlay
- Bridge Replacement / Rehab
- Seismic Retrofits
Bridge Repairs
Bridge Repairs – Floating Bridges

- SR104 Hood Canal
- SR520 Evergreen Pt.
- I-90 Homer Hadley
- I-90 Lacey V Murrow
Bridge Repairs – Floating Bridges
Bridge Repairs – Floating Bridges

Sample anchor cables (similar to those used on Hood Canal Bridge)

East-Half
1 ¾ in Diameter

West-Half
3.0 in Diameter
Cond State 1: 
Like New – No Defects

Cond State 2: 
Surface Corrosion / Galvanizing starting to deteriorate.

Cond State 3: 
Corrosion with section loss / Single wire breaks

Cond State 4: 
Multiple wire breaks / affects capacity

Anchor Cable Service Life 25-30 years
Bridge Repairs – Floating Bridges

West Half – built in 1982

East Half – built in 2009

SR 104 Hood Canal Bridge
Bridge Repairs – Floating Bridges

SR104 Hood Canal Bridge - Anchor Cable Conditions

West Half – 24 cables (1982)
East Half – 20 cables

Anchor Cable Service Life 33 years

21 cables to be replaced in 2015
Manson Construction - $7.3M
21 cables to be replaced in 2015
Orion Marine - $3.4M
BMS Expansion Joints
Bridge Repairs – Modular Expansion Joints

60 WSDOT bridges  
4,977 Lineal Feet
Bridge Repairs – Modular Expansion Joints

I-90 East Channel bridges
1981 - WB
1988 - EB

I-90 East Channel bridges
Bridge Repairs – Modular Expansion Joints

I-90 East Channel bridge - WB

Modular Expansion Joints – installed 1981
Bridge Repairs – Modular Expansion Joints
Bridge Repairs – Modular Expansion Joints

I-90 East Channel bridge - WB

Modular Expansion Joints – installed 2014
(old Joints service life – 34 years)

Total Project cost - $1.6M
WSDOT has 13 Movable bridges statewide and shares ownership of 3 others.

10 year needs
12 bridges
$26M

6 year plan
8 bridges
$17M

SR99 – Duwamish River (1st Ave South)
Border Bridges
Scour Repairs
Bridge Repairs (incl. Movable Brgs)
Bridge Painting
Bridge Deck Rehab and Overlay
Bridge Replacement / Rehab
Seismic Retrofits
Steel Structures Painting Council

“All coating systems will fail eventually.”

The question is “When?”
The bridge was repainted in 2014. All the previous paints were removed and the steel was prepared per SSPC SP-10 specifications. A new Zinc and Moisture cured urethane paint system was applied.
Steel Bridge Painting

Paint Cond State 1:
The paint system is sound and functioning as intended.

Paint Cond State 2:
The paint system may be chalking, peeling, curling, or showing distress with no exposure of metal.

Paint Cond State 3:
The paint system is no longer effective. The metal substrate is exposed.
Steel Bridge Painting
# Steel Bridge Painting

## Steel Bridge Paint Form

<table>
<thead>
<tr>
<th>Bridge Number:</th>
<th>12 / 328N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Name:</td>
<td>NACHES R NELSON</td>
</tr>
<tr>
<td>Milepost:</td>
<td>198.66</td>
</tr>
<tr>
<td>Region:</td>
<td>South Central</td>
</tr>
<tr>
<td>Year Built:</td>
<td>1958</td>
</tr>
<tr>
<td>Bridge Type:</td>
<td>ST</td>
</tr>
<tr>
<td>Steel Span Length:</td>
<td>304 ft.</td>
</tr>
<tr>
<td>Width (curb-curb):</td>
<td>28 ft.</td>
</tr>
<tr>
<td>Steel Tonnage:</td>
<td>316</td>
</tr>
<tr>
<td>Paint Age:</td>
<td>27</td>
</tr>
<tr>
<td>Paint Color:</td>
<td>Light Brown</td>
</tr>
<tr>
<td>Steel Surf. Area:</td>
<td>47,400 sqft</td>
</tr>
<tr>
<td>BMS Cond State 2:</td>
<td>3,934 sqft</td>
</tr>
<tr>
<td>Next Paint Year:</td>
<td>2018</td>
</tr>
<tr>
<td>Priority Rank:</td>
<td>10</td>
</tr>
<tr>
<td>OK/Due/Past Due:</td>
<td>Past Due</td>
</tr>
<tr>
<td>CPMS Ad date:</td>
<td></td>
</tr>
<tr>
<td>Paint Pin Number:</td>
<td></td>
</tr>
<tr>
<td>Future $/SF:</td>
<td>$50</td>
</tr>
<tr>
<td>Future Paint Cost:</td>
<td>$2,370,000</td>
</tr>
</tbody>
</table>

### Painting Cycle

- 1988: 10
- 1978: 7
- 1971: 13
- 1958: 27

**Cycle**: 39.03

**Painting Cycle**: 5.6%
Steel Bridge Painting

- **Paint Condition “OK”**
  - Repainting not planned
  - < 2% Paint CS3

- **Paint Condition “Due”**
  - Repainting Needed
  - 2% - 5% Paint CS3

- **Paint Condition “Past Due”**
  - Repainting Needed
  - Repairs may be required
  - > 5% Paint CS3
Steel Bridge Painting

WSDOT needs $694 million for 10-year steel bridge painting plan
Fiscal years (FY) 2013 through 2023; Planned projects and spending for 2013-2015 biennium; Dollars in millions

<table>
<thead>
<tr>
<th>Painting needs</th>
<th>Number of bridges</th>
<th>Cost to repaint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently due or past due¹</td>
<td>110</td>
<td>$467.0</td>
</tr>
<tr>
<td>11 projects planned for 2013-2015 biennium²</td>
<td>8.5³</td>
<td>$54.8</td>
</tr>
<tr>
<td>Remaining backlog</td>
<td>101.5</td>
<td>$412.2</td>
</tr>
<tr>
<td>Due within the next 10 years</td>
<td>43</td>
<td>$282.0</td>
</tr>
<tr>
<td><strong>10-year total need</strong></td>
<td><strong>144.5</strong></td>
<td><strong>$694.2³</strong></td>
</tr>
</tbody>
</table>
Steel Bridge Painting

10 year needs
144 bridges
$694M

Currently Past Due / Due
110 bridges
$467M

6 year plan
31 bridges
$143M

Current Projects
9 Bridges - $68 million
Steel Bridge Painting

2013 Paint Contract
Total Cost = $6.9M

I-5 Nisqually River Bridges
Previously painted - 1988
Paint Service life – 25yrs
<table>
<thead>
<tr>
<th>Years</th>
<th>Cycle</th>
<th>Painting Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>1978</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>1970</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>1963</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>1951</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

**Steel Bridge Painting**

Year Built – 1940  
Year Last Painted – 1988

<table>
<thead>
<tr>
<th>Action</th>
<th>Year</th>
<th>Cost $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned Paint Year –</td>
<td>2014</td>
<td>$1.0 M</td>
</tr>
<tr>
<td><em>Do Nothing SD Year –</em></td>
<td>2020</td>
<td></td>
</tr>
<tr>
<td>Do Nothing Rehab Year -</td>
<td>2025</td>
<td>$3.0 M</td>
</tr>
<tr>
<td>Do Nothing Replace Year –</td>
<td>2035</td>
<td>$6.0 M</td>
</tr>
</tbody>
</table>
# Steel Bridge Painting

<table>
<thead>
<tr>
<th>Action</th>
<th>Year</th>
<th>Cost $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned Paint Year –</td>
<td>2014</td>
<td>$1.0 M</td>
</tr>
<tr>
<td><em>Do Nothing SD Year –</em></td>
<td>2050</td>
<td>$3.0 M</td>
</tr>
<tr>
<td>Do Nothing Rehab Year -</td>
<td>2055</td>
<td>$3.0 M</td>
</tr>
<tr>
<td>Do Nothing Replace Year –</td>
<td>2065</td>
<td>$6.0 M</td>
</tr>
</tbody>
</table>

- **Year Built**: 1940
- **Year Last Painted**: 2014
- **2014 Paint Contract Total Cost**: $1.0M
WSDOT Steel Bridge Preservation Options

- **Paint on Time**
  - Plan 1 - $1.1 Billion
  - Period 1: 2015-24
  - Period 2: 2025-34
  - Period 3: 2035-44

- **Rehab & Paint**
  - Plan 2 - $3.2 Billion
  - Period 1: 2015-24
  - Period 2: 2025-34
  - Period 3: 2035-44

- **Replace Bridges**
  - Plan 3 - $4.8 Billion
  - Period 1: 2015-24
  - Period 2: 2025-34
  - Period 3: 2035-44

30 years
WSDOT Steel Bridge Preservation Options

2023 – Projected Steel Bridge Inventory Condition (with $141M funding for painting)

- SD 71: 38%
- Past Due 94: 29%
- Due 59: 18%
- OK 64: 15%

Washington State Department of Transportation
Border Bridges
Scour Repairs
Bridge Repairs (incl. Movable Brgs)
Bridge Painting
Bridge Deck Rehab and Overlay
Bridge Replacement / Rehab
Seismic Retrofits
Bridge Deck Rehab and Overlay

Concrete Bridge Deck

Deck issues over Bridge Life

- Rebar Corrosion
- Rebar Cover
- Poor Concrete
- Rutting
Bridge Deck Rehab and Overlay
Bridge Deck Rehab and Overlay

Maintain – Patching and spalls < 2% of total deck area
Preserve - (Deck Rehab and Overlay) > 2% of total Deck area
Replace Deck - Patching and spalls > 10-15% of total deck area
WSDOT Concrete Bridge Decks

(2,962 Bridges with Concrete Decks)

- Bare Conc (21.8%)
- Bare Conc-ECR (22.2%)
- Conc Overlays (31.6%)
- Asphalt (21.3%)
- Polyester (2%)
- Polymer (0.8%)

(2nd Gen)
Modified Concrete Overlays

Bridges with a Modified Concrete Overlay

Total No. = 580
Deck area = 14.1 mil SF

- 30+ yrs
  - 144br - $185M

- 25–30 yrs
  - 165br - $182M

- 20 – 25 yrs
  - 142br - $139M

- 10 year needs – 70 brgs ($125M)

451br - $506M

Latex
Microsilica
Low Slump
Fly-Ash
Bridge Deck Replacements

14 bridges (588,536 sq ft)
[1.3% of total Statewide Deck Area]
WSDOT Structurally Deficient Bridges

- SD based on Br Deck Conditions

SD due to Deck 76 brgs ($92M)

10 year needs 70 bridges $125M

6 year plan: 13 brgs ($21M)
Border Bridges
Scour Repairs
Bridge Repairs (incl. Movable Brgs)
Bridge Painting
Bridge Deck Rehab and Overlay
Bridge Replacement / Rehab
Seismic Retrofits
Bridge Rehabilitation / Replacement

2005 TPA Funded

24 Bridges
$304 million

(average age old bridge - 74 yrs)
Bridge Rehabilitation / Replacement

10 year needs
26 bridges
$182M

6 year plan
7 bridges
$43M

SR142 Klickitat River
Bridge Rehabilitation / Replacement

Year Built – 1954

SR142 Klickitat River
Bridge Rehabilitation / Replacement

Year Built – 1954

2011

SR142 Klickitat River
SR142 Klickitat River

Bridge Rehabilitation / Replacement

Bailey Bridge installed in June 2012
Bridge Rehabilitation / Replacement

Bailey Bridge installed in June 2012
(Replacement planned 2017)

Year Built – 1954

SR142 Klickitat River
New Bridges - Performance Deck Concrete
Border Bridges
Scour Repairs
Bridge Repairs (incl. Movable Brgs)
Bridge Painting
Bridge Deck Rehab and Overlay
Bridge Replacement / Rehab
Seismic Retrofits
Objectives:

• Minimize risk of bridge collapse
• Keep Interstate / essential bridges open
• Accept moderate damage

Program Status:

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Bridges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrofit Complete</td>
<td>301</td>
</tr>
<tr>
<td>Partially Retrofitted</td>
<td>120</td>
</tr>
<tr>
<td>In-Progress</td>
<td>17</td>
</tr>
<tr>
<td>Retrofit Needed</td>
<td>462</td>
</tr>
<tr>
<td>Totals</td>
<td>900</td>
</tr>
</tbody>
</table>
Comparison of selected Earthquakes

<table>
<thead>
<tr>
<th></th>
<th>NISQUALLY</th>
<th>KOBE</th>
<th>NORTHRIDGE</th>
<th>LOMA PRIETA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>6.8</td>
<td>6.9</td>
<td>6.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Peak Acceleration (a)</td>
<td>0.25</td>
<td>0.80</td>
<td>1.00</td>
<td>0.60</td>
</tr>
<tr>
<td>Depth of Rupture (km)</td>
<td>52.0</td>
<td>14.3</td>
<td>18.0</td>
<td>19.0</td>
</tr>
<tr>
<td>Duration (sec.)</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Bridge Damage ($ x Millions)</td>
<td>$5</td>
<td>$6,700</td>
<td>$300</td>
<td>$1,500</td>
</tr>
</tbody>
</table>
Multiple Column Retrofit
“Pay me now, or pay me more - lots more - later”
Questions?