Portland - Milwaukie Light Rail

Willamette River Bridge

Willamette River Bridge Advisory Committee

08.11.09
Willamette River Transit Bridge

Vertical Clearance

Tower Design Refinements

Pathway Routing at Tower
Vertical Clearance
Additional analysis on vertical clearance to occur during Preliminary Engineering
Vertical Clearance Presentations

- 5/4/09: FTA and US Coast Guard
- 5/7/09: River Users and Landside Stakeholders
- 5/13/09: Lower Columbia Region Harbor Safety Committee

Assembled and analyzed data

Interviewed river users who might be impacted
Climate Change Research Findings

- **1.9’ – 3.5’** increase due to flow by 2099
- Increases occur mainly during winter months
- Does not consider possible flow management mitigation - dams
Vertical Clearance Update

Allowance added for

Safety and potential climate change impacts

3’ and 3.5’ were used

Analysis done with and without allowance to determine implications
Vertical Clearance Update

Willamette River Transit Bridge

Analyzed River Data

Analyzed a wide range of vertical clearance alternatives (17)

- 65.00'
- 72.00'
- 75.00'
- 76.00'
- 77.00'
- 77.36'
- 78.00'
- 78.36'
- 79.00'
- 80.00'
- 81.00'
- 82.00'
- 83.00'
- 84.00'
- 85.00'
- 90.00'
- 120.00'

Example
Vertical Clearance Update

Portland Spirit’s Vessels

Columbia Gorge
(Air Draft: 58’)
(Copied from: http://www.portlandspirit.com/sternwheeler.php)

Portland Spirit
(Air Draft: 44’)
(Copied from: http://www.portlandspirit.com/spirtech.php)
Vertical Clearance Update

Willamette River Transit Bridge

Results Analyzed

Graphed percent passage in December

Graphed the change in % between clearances for December

Determine point of diminishing return

<table>
<thead>
<tr>
<th>Bridge Clearance</th>
<th>Percent Passage</th>
<th>Change in % Between Clearances for Dec</th>
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<tbody>
<tr>
<td></td>
<td>Months</td>
<td>Jan</td>
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<tr>
<td>59.00</td>
<td>120.00</td>
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Vertical Clearance Update

Vertical Clearance Alternatives Analysis
Portland Spirit's Columbia Gorge: 58' Air Draft

Graphed percent passage in December
Vertical Clearance Update

Willamette River Transit Bridge

Vertical Clearance Alternatives Analysis
Portland Spirit’s Columbia Gorge: 58’ Air Draft

Graphed percent passage in December

Graphed the change in % between clearances for December
Vertical Clearance Update
Willamette River Transit Bridge
Without Allowances for Safety or Climate Change

Vertical Clearance Alternatives Analysis
Portland Spirit's Columbia Gorge: 58' Air Draft

Beyond 77.36’ there is
No Change
In % Passing
100%
Vertical Clearance Update
Willamette River Transit Bridge

With Three Foot Allowance for Safety – Climate Change

Vertical Clearance Alternatives Analysis
With Three Foot Allowance for Climate Change and Safety
Portland Spirit’s Columbia Gorge: 58’ Air Draft

Beyond 77.36’ there is Nominal Change
In % Passing
98.9% vs 100%
Dec: 10 days out of last 30 years
All year: 55 days out of 10,663

Change in % Passing Between Clearance Alternatives for December
Percent Passing from December

- Change in % Passing Between Clearance Alternatives
- Nominal Change
- Beyond 77.36’ there is
- 98.9% vs 100%
- Dec: 10 days out of last 30 years
- All year: 55 days out of 10,663

Graph showing vertical clearances and change in percentage passing between clearance alternatives.
Vertical Clearance Update

Willamette River Transit Bridge

With 3.5’ Allowance for Safety – Climate Change

Beyond 77.36’ there is Nominal Change
In % Passing
98.6% vs 100%

Dec: 13 days out of last 30 years
All year: 68 days out of 10,663
Additional vertical clearance provides diminishing benefit to existing commercial river users at about 77.36'
Analysis of Landside Implications

Willamette River Transit Bridge

Provide for stations at grade
Analysis of Landside Implications

Provide for stations at grade

- Supports landside development
- Increases public access to transit system
- Improves station safety and security
  - Crime prevention through environmental design (CEPTED)
Analysis of Landside Implications
South Waterfront North District

Provide for stations at grade
**Analysis of Landside Implications**

*Willamette River Transit Bridge*

---

**Portland - Milwaukie Light Rail Project**

- The Portland Central Business District will contain **over 200,000 jobs** in 2030:
  - Downtown - 150,000
  - Central Eastside - 45,000
  - South Waterfront - 15,000

- Connects PSU, OHSU, and OMSI in the Science and Technology Quarter:
  - Oregon’s largest university, PSU will have an enrollment over 35,000 students.
  - Named one of the nation’s top ten science museums, OMSI attracts over 900,000 visitors annually.
  - As the state’s only health and research university, OHSU is Portland’s largest employer, with an annual budget of $1.4 billion and more than 12,400 employees.

- New bridge guideway will serve 3 bus routes to SE Portland.

- South Waterfront will contain **over 10,000 residents** in 2030.

- New Markets: The project will provide service to **8,800 more households and 34,000 more employees** than the #33 Bus.
Analysis of Landside Implications

Willamette River Transit Bridge

Provide for stations at grade
Analysis of Landside Implications

**Portland - Milwaukie Light Rail Project**

- The Portland Central Business District will contain over 200,000 jobs* in 2030:
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  - Central Eastside - 45,000
  - South Waterfront - 15,000

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  - Oregon’s largest university, PSU will have an enrollment over 35,000 students.*
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- New bridge guideway will serve 3 bus routes to SE Portland.

- South Waterfront will contain over 10,000 residents* in 2030.

- New Markets: The project will provide service to 8,800 more households and 34,000 more employees* than the #33 Bus.
Analysis of Landside Implications

Analyzed a wide range of vertical clearance alternatives (10)

- 65.00’
- 72.00’
- 75.00’
- 77.36’
- 78.36’
- 80.00’
- 85.00’
- 85.00’ with ADA compliant ramps and landings
- 90.00’
- 120.00’
Analysis of Landside Implications

Willamette River Transit Bridge

Plans Developed
## Analysis of Landside Implications

### Willamette River Transit Bridge

### Implications Tabulated

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>SEDES Alt. A 65 feet</th>
<th>SEDES Alt. B 72 feet</th>
<th>Alt. 1 77.36 feet</th>
<th>Alt. 2 77.36 feet</th>
<th>Alt. 3 77.36 feet</th>
<th>Alt. 4 80 feet</th>
<th>Alt. 5 86 feet</th>
<th>Alt. 6 85 feet</th>
<th>Pre-SEDES Alt. 90 feet</th>
<th>Pre-SEDES Alt. 120 feet</th>
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<tr>
<td>River User Impacts (List is not comprehensive)</td>
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<td>Columbia Gorge 5</td>
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<td>87.6%</td>
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<td>99.7%</td>
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<td>Number of days over last 20 years in December WITHOUT passage</td>
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<td></td>
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<td>Sternwheeler Steamer Portland 4</td>
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<td>ADA Compliance</td>
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<td>4.75% skewed roadway</td>
<td>4.75% skewed roadway</td>
<td>4.75% skewed roadway</td>
<td>4.75% skewed roadway</td>
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<tr>
<td>ADA Compliance</td>
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<td>4.30% skewed roadway</td>
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<td>Right distance at crest vertical curve on bridge</td>
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<td>Moody Ave Station</td>
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<td></td>
<td></td>
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<td></td>
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<td>0.6%</td>
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<td>Slightly more</td>
<td>More</td>
<td>Pre change</td>
<td>Next</td>
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<td>0'</td>
<td>0'</td>
<td>0'</td>
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<td>Fill at Moody Ave. driveway</td>
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<td>Additional fill at future Station</td>
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<tr>
<td>Future greenway clearance at west abutment</td>
<td>12'</td>
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<td>13'</td>
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<td>Fill at Water Ave (Current ROW)</td>
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<td>Eastern Embankment Impacts</td>
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<td></td>
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<tr>
<td>Greenway clearance at east abutment (10' min)</td>
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<td>10'</td>
<td>10'</td>
<td>10'</td>
<td>10'</td>
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<td>4</td>
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<td>Minor</td>
<td>Major</td>
<td>Minor</td>
<td>Major</td>
<td>Major</td>
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</table>

*Note: SEDES = Strategic Environmental Design for Sustainability. LRT = Light Rail Transit. ROW = Right-of-Way.*
Analysis of Landside Implications

Relative Landside Implications for Bridge Clearance Alternatives

Costs used as a Proxy to graphically illustrate the composite landside implications analyzed.
Relative Landside Implications for Bridge Clearance Alternatives

Beyond 77.36’
Landside Impacts Change from
Nominal to Significant
Vertical Clearance Update

Draft Findings

Additional vertical clearance provides diminishing benefit to existing commercial river users at about 77.36’

Moderate to significant landside impacts for incremental increases in bridge vertical clearance occurs at about 77.36’
Analysis of Landside Implications

Willamette River Transit Bridge

Analyzed a wide range of vertical clearance alternatives

- 65.00’
- 72.00’
- 75.00’
- 77.36’
- 78.36’
- 80.00’
- 85.00’
- 90.00’
- 120.00’

Portland Spirit request

Analyze vertical clearance using ADA ramps and landings
Analysis of Landside Implications

77.36’ Vertical Clearance
Analysis of Landside Implications

Willamette River Transit Bridge

77.36’ Vertical Clearance

Add ADA Ramps and Landings
Analysis of Landside Implications

85.00’ with ADA compliant ramps and landings

Changes running slope

4.75% to 5.85%

23% Increase in slope

7.64’ Additional clearance

77.36’
Analysis of Landside Implications

Willamette River Transit Bridge

5.85% running slope
Exceeds LRT maximum design standards
Analysis of Landside Implications

Willamette River Transit Bridge

5.85% running slope
Exceeds LRT maximum design standards
Reduced service reliability during inclement weather
Analysis of Landside Implications

Willamette River Transit Bridge

5.85% running slope
Exceeds LRT maximum design standards
Reduced service reliability during inclement weather
Reduced service level – single track operations for bridge inspection and maintenance
Analysis of Landside Implications

Willamette River Transit Bridge

5.85% running slope
Exceeds LRT maximum design standards
Reduced service reliability during inclement weather
Reduced service level – single track operations for bridge inspection and maintenance
Reduced average speed
Analysis of Landside Implications

Willamette River Transit Bridge

5.85% running slope
Exceeds LRT maximum design standards
Reduced service reliability during inclement weather
Reduced service level – single track operations for bridge inspection and maintenance
Reduced average speed
Increased vehicle maintenance
Analysis of Landside Implications

Willamette River Transit Bridge

5.85% running slope
Exceeds LRT maximum design standards

Reduced service reliability during inclement weather

Reduced service level – single track operations for bridge inspection and maintenance

Reduced average speed

Increased vehicle maintenance

Draft Cost Estimate $17.2M
Vertical Clearance Update

Continuing Research on Future River Navigational Needs

- Marine Highway Act of 2007
  - Access to Willamette Falls Locks require passage under four bridges with lower vertical clearances than 77.36’
    - Sellwood Bridge ..................... 72’
    - Southern Pacific Railroad Bridge ........ 74’
    - I-205 Bridge .......................... 76’
    - Oregon City Bridge .................... 74’
Vertical Clearance Update

Continuing Research on Future River Navigational Needs

- Marine Highway Act of 2007
- Land Use changes
  - City of Portland’s Industrial Districts Atlas of 2004
Continuing Research on Future River Navigational Needs

- Marine Highway Act of 2007
- Land Use changes
- US Coast Guard rule changes

- Are there trends, codes, or regulation changes that may affect future vessel height?
  - Meeting set with USCG later this month to review
  - Scheduling meeting with Marine Architect to review
Vertical Clearance Update

Continuing Research on Future River Navigational Needs

- Marine Highway Act of 2007
- Land Use changes
- US Coast Guard rule changes
- Implications if changes are made to regions dam system
- Future dredging of navigational routes
Future Dredging of Navigational Routes

- Current research indicates that Army Corps of Engineers only has plans to dredge the area north of the Broadway Bridge to support the Working Harbor

Copied from Working Harbor Reinvestment Strategy Report December 2006
Vertical Clearance Update

Next Steps

Continue research on implications of future river navigation

Staff recommendation to Steering Committee scheduled for October

Discussion - Questions?
Vertical Clearance

Tower Design Refinements
Next Steps

Refinement of significant elements

- Tower – pier – walkway
- Railing
- Lighting and OCS integration
- Greenway
- Programming bicycle and pedestrian path
# 2009 Preliminary Engineering Bridge Design Timeline

<table>
<thead>
<tr>
<th>Bridge Design Meetings</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
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<td>Citizens Advisory Committee</td>
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<td>Open House</td>
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**Design of Bridge Elements**

- July: Towers, Piers, Walkways
- August: Greenway, Connections, Portals
- September: Overhead Catenary System, Lights, Cables
- October: Railings
- November: Design of design for all elements

**25% design on Dec. 2**

[trimet.org/pm](http://trimet.org/pm)
## 2009 Preliminary Engineering Bridge Design Timeline

<table>
<thead>
<tr>
<th></th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
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<tr>
<td><strong>Design of Bridge Elements</strong></td>
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<tr>
<td>- Towers</td>
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<td>- Walkways</td>
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### Bridge Design Meetings

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Working Group Recommendation

Willamette River Transit Bridge

SCHEME A
Inclined Tower

SCHEME B
V – Tower with Strut

SCHEME C
Split V – Tower with Strut

SCHEME D
H – Tower

SCHEME E
Steel – Tower
Tower Articulation Options
Edge Articulation - Developed
Edge Articulation - Illustrated
Form Articulation - Concept
Form Articulation - Developed
Form Articulation - Illustrated
Rounded - Concept
Rounded - Developed
Rounded – Illustrated
Rounded – Illustrated
## Tower Articulation Comparison

**Willamette River Transit Bridge**

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Steel tower cost was explored – $20.9 M premium
Willamette River Transit Bridge

Vertical Clearance

Tower Design Refinements

Pathway Routing at Tower
Pathway Routing at Towers
Pathway tight at Tower
Pathway tight at Tower
Pathway extended from Tower
Pathway split at Tower
Pathway **split** at Tower
Pathway tight at Tower
Pathway tight at Tower
Pathway **extended** from Tower
Pathway split at Tower
Pathway split at Tower
### 8/7/09 Working Group Meeting

**Willamette River Transit Bridge**

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**Scoring:**
- 3 = Best
- 2 = Good
- 1 = Low

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**Analyzed each mode**

**Pedestrian – Bicycle – Service Vehicles**
Analyzed each mode for each alternative

Base case: pathway tight to tower

Joint path extended from tower

Separated (split) pathway extended from tower
8/7/09 Working Group Meeting

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Scoring: 3 = Best  2 = Good  1 = Low

Reviewed characteristics that vary between alternatives

- Security
- Out of direction travel
- Maintenance
## 8/7/09 Working Group Meeting

**Willamette River Transit Bridge**

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### Reviewed characteristics that vary between alternatives

- Being on the bridge: Experiencing the bridge
- Being on the bridge: Experiencing the river
- Being near the bridge
- Transparency
### 8/7/09 Working Group Meeting

**Willamette River Transit Bridge**

#### Reviewed characteristics that vary between alternatives

- **Mode conflict**
- **Stormwater and shading**
- **Accidents – emergency response**

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- 3 = Best
- 2 = Good
- 1 = Low
Working Group Recommendation

Willamette River Transit Bridge

Alternative: Base                         Joint Path                    Separate Path
Working Group Recommendation

**Willamette River Transit Bridge**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Base</th>
<th>Joint Path</th>
<th>Separate Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total score</td>
<td>71</td>
<td>53</td>
<td>38</td>
</tr>
</tbody>
</table>

78 Maximum Points Available
## Working Group Recommendation

**Willamette River Transit Bridge**

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<td>Percent of total</td>
<td>91%</td>
<td>68%</td>
<td>49%</td>
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</tbody>
</table>
Working Group Recommendation

Willamette River Transit Bridge

Base case has the most technical merit

Alternative:          Base                         Joint Path                    Separate Path
Total score:              71                                      53                                        38
Percent of total:    91%                                   68%                                     49%

Base case has the most technical merit
### Working Group Recommendation

**Willamette River Transit Bridge**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Cost Premium</th>
<th>Total Score</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>$0</td>
<td>71</td>
<td>91%</td>
</tr>
<tr>
<td>Joint Path</td>
<td>$4.2 M</td>
<td>53</td>
<td>68%</td>
</tr>
<tr>
<td>Separate Path</td>
<td>$5.1 M</td>
<td>38</td>
<td>49%</td>
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</table>

Base case has the most technical merit
## Path Routing Discussion

**Willamette River Transit Bridge**

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<tr>
<th>Alternative:</th>
<th>Base</th>
<th>Joint Path</th>
<th>Separate Path</th>
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<tbody>
<tr>
<td>Cost Premium:</td>
<td>$0</td>
<td>$4.2 M</td>
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<td>49%</td>
</tr>
</tbody>
</table>

Base case has the most technical merit
### Tower Articulation Discussion

**Willamette River Transit Bridge**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Edge</th>
<th>Form</th>
<th>Rounded</th>
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</thead>
<tbody>
<tr>
<td>Cost Premium</td>
<td>$1.7 M</td>
<td>$1.7 M</td>
<td>$5.4 M</td>
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</table>

Steel tower cost was explored – $20.9 M premium
Questions?

Vertical Clearance

Tower Design Refinements

Pathway Routing at Tower
## 2009 Preliminary Engineering Bridge Design Timeline

### Design of Bridge Elements

<table>
<thead>
<tr>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>Towers</td>
<td>Greenway</td>
<td>Overhead Catenary System</td>
<td>Railings</td>
<td>Synthesis of design</td>
<td></td>
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<tr>
<td>Piers</td>
<td>Connections</td>
<td>Lights</td>
<td>Program Pathway</td>
<td>for all elements</td>
<td>25% design on Dec. 2</td>
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<tr>
<td>Walkways</td>
<td>Portals</td>
<td>Cables</td>
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### Bridge Design Meetings

<table>
<thead>
<tr>
<th>Willamette River Bridge Working Group</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>★</td>
<td>★</td>
<td>★</td>
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<table>
<thead>
<tr>
<th>Citizens Advisory Committee</th>
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<table>
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<tr>
<th>Willamette River Bridge Advisory Committee</th>
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<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>★</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Open House                               | ★      |           |         |          |          |
Thank you

For more information, visit: trimet.org/pm