Vision

Deliver a bridge that embodies the Portland aesthetic is functional and affordable

- Aesthetic – the right bridge for the context
- Function – the right bridge for the use, site and environment
- Cost – the right bridge for the budget
- Viable solutions must balance all three
Design Parameters and Constraints

Willamette River Transit Bridge

Proposed Bridge Alignment from LPA

1720’-0”
Design Parameters and Constraints

Additional analysis on vertical clearance to occur during Preliminary Engineering
LPA included a range of spans
300’ to 780’ clear
Engineer Team
Architectural Team
Stakeholder Committee

Information Gathering
Establish Bridge Design Framework

Develop Range of Potential Bridge Types (Many)

Screen

Engineer, Architecture and Urban Design Development of Initial Viable Alternatives (Some)

Screen

Verify Viable of Alternatives (Few)

Begin Full Public Conversation
“Some” Bridge Types

Willamette River Transit Bridge

Wave Frame

Tied Arch

Through Arch

Cable Stayed - 4

Cable Stayed - 2
<table>
<thead>
<tr>
<th>Bridge Type</th>
<th>Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wave Frame</td>
<td>120'</td>
</tr>
<tr>
<td>Tied Arch</td>
<td>223'</td>
</tr>
<tr>
<td>Through Arch</td>
<td>180'</td>
</tr>
<tr>
<td>Cable Stayed - 4</td>
<td>250'</td>
</tr>
<tr>
<td>Cable Stayed - 2</td>
<td>270'</td>
</tr>
</tbody>
</table>
Tied Arch

Examples

Willamette River Transit Bridge
Willamette River Transit Bridge

Through Arch

Steel shown as white  –  Concrete shown as gray
Wave Frame

Willamette River Transit Bridge

Steel shown as white  –  Concrete shown as gray
Cable Stayed – 2 Pier

Steel shown as white – Concrete shown as gray
Cable Stayed – 4 Pier

Steel shown as white – Concrete shown as gray
Cost

- Initial cost
- Life cycle cost - maintenance
Risk

- Cost escalation risk (superstructure)
- Foundations and geotechnical
- Design risk
- Bid risk
- Schedule risk
- In-water construction risk
- Permitting risk (navigational – environmental)
Fundamental Performance

- Number, location and size of piers
- Seismic performance
- Modal optimization of section
- User comfort – deflection and vibration
Architectural

- Looking at the bridge  (proportion and scale)
- Being near the bridge  (experience on greenway, walkways and river)
- Being on the bridge   (experience crossing the river)
Urban Context

- Portland core values, traditions and symbolism
- Compatibility with existing context, fabric and adjacent bridges
- Reflection of current technology and innovation
Greenway

- Depth of span over greenway (vertical clearance)
- Width of span over greenway
- Length of span at greenway (column to abutment)
- Greenway trail user experience
Environmental – Sustainability

- Environmental impacts during construction
- Resource use – availability of local materials
- In-water piers in or near known contaminated media cap
Evaluation Criteria

Supplemental Criteria

Bridge Operations

- Line of sight between modes
- OCS integration - complexity
- Emergency response on bridge
- Extent of inspections
- Access for inspections
Miscellaneous

- Utility duct bank integration
- Pier proximity to existing subsurface utilities
- Accommodates asymmetrical loading
- Accommodation of curved greenway spans
Opportunities

- Ability to treat stormwater on bridge
- Addition of wildlife habitat on/under bridge
- Additional fish habitat near bridge
- Habitat enhancement at staging site
- Incorporate alternative energy
Each alternative has opportunities and challenges
Challenges

- In-water pier proximity to existing subsurface utilities

12” Gas main

Fiber optic line
Challenges

• In-water pier proximity to proposed contaminated media cap
Tied and Through Arches

Challenges

- Environmental Permitting Risk
  - Piers in shallow water
Tied and Through Arches

Challenges

• Navigational Permitting Risk
  ➢ Horizontal and vertical clearances

Willamette River Transit Bridge

Thicker Deck
Tied and Through Arches

Willamette River Transit Bridge

Challenges

• Navigational Permitting Risk
  ➢ Maneuvering
Tied and Through Arches

Challenges

• Greater depth of structural section over the Greenway trail
Wave Frame

Challenges

- One of a kind – prototype
- Higher risk profile
2 and 4 Pier Cable Stayed

Challenges

- Architectural and Urban Context
Discussion

Willamette River Transit Bridge
Recent Work

- Evaluate structural performance of options
- Define construction sequence
- Create computer models
- Analyze for service loads
- Analyze for seismic loads
Recent Work

Willamette River Transit Bridge

- Determine member sizes and quantities
- National Constructors Group
  - Cost bases
  - Cost certainty
  - Constructability review
  - Contractor’s risk assessment
- J. Paul Silvestri, National Constructors Group
J. Paul Silvestri

- Graduate of Stanford
- 39 years building major heavy civil
J. Paul Silvestri

Willamette River Transit Bridge

- Graduate of Stanford
- 39 years building major heavy civil
- Founded National Constructors Group in 1991
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Willamette River Transit Bridge

J. Paul Silvestri

- Representative projects:
  - Woodrow Wilson Bridge, WA DC
  - Maumee Bridge, Toledo, OH
  - Dames Point Bridge, Jacksonville, FL
  - San Francisco to Oakland Bay Bridge, east span replacement, CA
  - I70, New Mississippi Bridge, St. Louis, MI
  - Alameda Corridor, Los Angeles, CA
  - I405, Seattle, WA
  - Gerald Desmond Bridge, Long Beach, CA
<table>
<thead>
<tr>
<th>Risks</th>
<th>Willamette River Transit Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Foundations</td>
<td>Tied Arch</td>
</tr>
<tr>
<td>• Material – Substructure</td>
<td>Through Arch</td>
</tr>
<tr>
<td>• Material - Superstructure</td>
<td>Wave Frame</td>
</tr>
<tr>
<td>• Fabrication - Erection</td>
<td>2 Pier Cable Stayed</td>
</tr>
<tr>
<td>• Schedule</td>
<td>4 Pier Cable Stayed</td>
</tr>
<tr>
<td>• Design</td>
<td></td>
</tr>
</tbody>
</table>
• **Foundations**
  – Conceptual method developed minimizes risk
    – Unforeseen conditions
    – Environmental (noise and vibration)
    – In-water construction window
  – Conceptual method the same for all types
Risks

- **Material - Substructure**
  - Concrete
  - Readily available
  - Lower cost and schedule risk
  - Same for all substructures
Risks

- **Material - Superstructure**
  - Standard steel
  - Available from multiple sources
  - Moderate cost and schedule risk
  - Two have standard steel superstructures
Risks

- Material - Superstructure
  - High performance steel
  - Available from only one source
  - Volatile pricing
  - Special run - availability limited
  - Material sizes at upper limit of availability
  - Higher cost and schedule risk
  - One has HP steel superstructure
Risks

• Material – Superstructure
  – Concrete
  – Readily available
  – Lower cost and schedule risk
  – Two have concrete for the superstructure
Risks

- **Fabrication - Erection**
  - Standard steel at superstructure
  - Option A: On-site at staging yard
  - Option B: Near bank on temp work platform
  - Option C: In place on temp work platform
  - Moderate schedule and cost risk
  - Two have standard steel superstructures
Risks

Willamette River Transit Bridge

- Fabrication - Erection
  - High performance steel at superstructure
  - Option A: In place on temporary work platform
    - Restrict navigation to 150’ 3 - 4 month
    - Helps manage construction risks
    - Lowers labor cost
    - Reduces schedule
Risks

- **Fabrication - Erection**
  - High performance steel at superstructure
  - Option B: Balanced cantilever method
    - Higher construction risk
    - Jones Act – Increase labor cost 10%
Willamette River Transit Bridge

Risks

- Fabrication - Erection
  - High performance steel at superstructure
  - Complex – highly technical welding
  - Higher cost and schedule risk
  - One has HP steel superstructure
Risks

- **Fabrication - Erection**
  - Concrete at superstructure
  - Balanced cantilevered method
Risks

Willamette River Transit Bridge

• Fabrication - Erection
  – Concrete at superstructure
  – Balanced cantilevered method
  – Limit in-water work
  – Lower schedule and costs risk
  – Two have concrete superstructures
Risks

• Schedule
  – **Moderate construction durations**
  – Tied and Through Arch
Risks

• **Schedule**
  
  – *Longest construction duration*
  
  – *Wave Frame*
Risks

• Schedule
  – Shortest construction durations
  – Two and Four Pier Cable Stayed
Risks

• Design – Tied and Through Arch
  – Conventional design
  – Complex steel to concrete connections
  – Moderate cost and schedule risk
**Risks**

Willamette River Transit Bridge

- **Design – Wave Frame**
  - Prototype design
  - Complex steel to concrete connections
  - Non redundant structure
  - Higher cost and schedule risk
Willamette River Transit Bridge

Risks

- Design – Four Pier Cable Stayed
  - Conventional design
  - Complex construction of cantilevered walkway
  - Moderate cost and schedule risk
Risks

- Design – Two Pier Cable Stayed
  - Conventional design
  - Lowest cost and schedule risk

Willamette River Transit Bridge
# Risks

<table>
<thead>
<tr>
<th>Center-to-center Span Width</th>
<th>Wave frame</th>
<th>Tied Arch</th>
<th>Thru Arch</th>
<th>4 Pier Cable Stayed</th>
<th>2 Pier Cable Stayed</th>
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<tbody>
<tr>
<td>680</td>
<td>680</td>
<td>680</td>
<td>795</td>
<td>860</td>
<td></td>
</tr>
</tbody>
</table>

## Major Risk Categories

- Foundations
- Material - Substructure
- Material - Superstructure
- Fabrication - Erection
- Schedule
- Design

## Legend

- Higher Risk
- Moderate Risk
- Lower Risk
Risks

- Foundations
- Material – Substructure
- Material – Superstructure
- Fabrication - Erection
- Schedule
- Design

Questions?

Willamette River Transit Bridge

Tied Arch
Through Arch
Wave Frame
2 Pier Cable Stayed
4 Pier Cable Stayed
Willamette River Transit Bridge

Working Group

Recommendations

- Continue evaluation of cost and risks
- Present information at December 11th meeting
Next Steps

- **WRBAC formal adoption of recommendation of viable types**
  (December 11, 2008)

- **WRBAC recommendation to PMLR Steering Committee**
  (January meeting, TBD)

- **Additional design and process to select final bridge type**
  (January to March 2009)
Thank you