Structural: HNTB

Willamette River Transit Bridge

With Greg DeMond as Bridge Architect

Both as Primes

Willamette River Bridges

North to South Locations

Source: The Portland Bridge Book
Willamette River Bridges

North to South Locations

New Willamette River Bridge

Movable Bridges – 5 total
Fixed Bridges – 5 total

Willamette River Bridges

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"

Additional analysis on vertical clearance to occur during Preliminary Engineering
Design Parameters and Constraints

Willamette River Transit Bridge

LPA included a range of spans
300’ to 780’ clear

Review of Navigational Clearances
Horizontal Navigational Width

Proposed Bridge Alignment

Willamette River Transit Bridge
Horizontal Navigational Width

Proposed Bridge Alignment
**Horizontal Navigational Width**

Willamette River Transit Bridge

680’ Span = 600’ clear
Investigations

- Independent Experts
  - Robert Sanders, Admiralty Attorney
  - Captain Steven Brown
- Tug and barge simulation
- Ross Island field trip
- US Coast Guard – Bridge Administrator Austin Pratt discussions
- Willamette River Harbor Safety Committee meeting

Independent Expert - Robert Sanders

- Graduate US Merchant Marine Academy
- Officer on ocean going vessels
- Attorney with Wood Tatum
  - Involved in all ocean going vessel casualties investigations involving Willamette River Bridges – 1970 to present
Horizontal Navigational Width

Willamette River Transit Bridge

Independent Expert - Captain Steven Brown

- Recently retired Columbia River Pilot
- Numerous years of experience on both Columbia and Willamette Rivers
- Extensive experience in with tug/barges in Willamette River between Ross Island and Marquam bridges
Ross Island Sand and Gravel

- **Existing**
  - Ross Isle tug (59’) plus two 195’ barges = 449’ long and 40’ to 80’ wide – 4,500 tons
  - Dauby tug (84’) plus two barges (250’ + 244’) = 574 long by 80’ wide – 8,000 tons

- **Future**
  - Future Columbia River tows could be 675’ long and 80’ wide
  - Ocean going tugs/barge could be 550’ long and 100’ wide 15,000 tons

Tug and Barge Simulation

- Tug/barge path developed by TriMet
  - Based on video from Dauby tug
  - Includes input from boat operators

- Reviewed by Captain Steven Brown
- Newlands and Company 3d model
Horizontal Navigational Width

Ross Island Field Trip – 10.8.08

Observations

• Span length of +/- 680’ appears “reasonable”

• Provides 600’ clear
The Narrowing Process

Willamette River Transit Bridge

Information Gathering
Establish Bridge Design Framework

Develop Range of Potential Bridge Types (Many)

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

Verify Viable of Alternatives (Few)
Begin Full Public Conversation
Process Diagram

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

Willamette River Transit Bridge

The “Universe” of Bridge Alternatives

- Trusses and Arches
- Cable Supported
- Movable
“Universe” of Bridges
Willamette River Transit Bridge

Type: Girders

- Steel I-Girder
- Double Deck Option
- Steel Box
- Concrete
- Segmental Box
- Wave Frame Girder
- Sail Blade Girder

Type: Trusses and Arches

- Through Truss
- Tied Arch
- Continuous Through Arch
- Long Span Arch
“Universe” of Bridges

Willamette River Transit Bridge

Type: Cable Supported

- Cable Stayed Extradosed
- Cable Stayed Asymmetrical
- Cable Stayed
- Cable Stayed Hybrid Suspension
- Suspension

Type: Movable

- Movable Swingspan - Turnspans
- Movable Swingspan - Turnspans
- Movable Vertical Lift Low Level
- Movable Vertical Lift
### Evaluation Criteria

**Engineering**

**Willamette River Transit Bridge**

**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)
Evaluation Criteria
Willamette River Transit Bridge

**Engineering**

**Fundamental Performance**

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

---

**Architecture – Urban Design**

**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)
Evaluation Criteria
Willamette River Transit Bridge
Architecture – Urban Design

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

Evaluation Criteria
Willamette River Transit Bridge
Supplemental Criteria

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
**Evaluation Criteria**  
**Willamette River Transit Bridge**

**Supplemental Criteria**

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

**Bridge Operations**
- Line of sight between modes
- OCS integration - complexity
- Emergency response on bridge
- Extent of inspections
- Access for inspections
Evaluation Criteria

Willamette River Transit Bridge

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
Screening Criteria

“Universe” to “Many”

1. Engineering Criteria
2. Conforms to Baseline Criteria
3. Budget Tolerance

“Many” Bridges Alternatives
“Many” to “Some” Bridge Alternatives

Concrete Segmental (470’ clear)
Wave Frame (600’ clear)
Tied Arch (670’ clear)
Through Arch (600’ clear)
Extradosed (520’ clear)
Cable Stayed (760’ clear)
“Some” Bridge Alternatives

Willamette River Transit Bridge

Concrete Segmental
(470’ clear)

Wave Frame
(600’ clear)

Tied Arch
(670’ clear)

Through Arch
(600’ clear)

Extradosed
(520’ clear)

Cable Stayed
(800’ clear)

“Some” Bridge Types

Willamette River Transit Bridge

Wave Frame

Tied Arch

Through Arch

Cable Stayed - 4

Cable Stayed - 2
“Some” Bridge Types

Wave Frame
Tied Arch
Through Arch
Cable Stayed - 4
Cable Stayed - 2
120’-0”
223’-0”
180’-0”
250’-0”
270’-0”

Steel shown as white – Concrete shown as gray
Wave Frame

Willamette River Transit Bridge
Wave Frame  
Architectural illumination not currently in budget

Tied Arch  
Examples
Through Arch

Willamette River Transit Bridge

Steel shown as white – Concrete shown as gray
Through Arch
Willamette River Transit Bridge

Through Arch
Willamette River Transit Bridge
Architectural illumination not currently in budget
Cable Stayed – 4 Pier

Willamette River Transit Bridge
Cable Stayed – 4 Pier

Architectural illumination not currently in budget
Willamette River Transit Bridge

Cable Stayed – 2 Pier

Steel shown as white – Concrete shown as gray
Cable Stayed – 2 Pier  
Willamette River Transit Bridge
Cable Stayed – 2 Pier

Willamette River Transit Bridge
Willamette River Transit Bridge

Cable Stayed – 2 Pier

Architectural illumination not currently in budget
View Comparison
Willamette River Transit Bridge
West Bank – Future Greenway Trail

View Comparison
Willamette River Transit Bridge
East Bank – Greenway Trail
View Comparison
Willamette River Transit Bridge
East Bank – Greenway Trail

View Comparison
Willamette River Transit Bridge
On the Bridge
View Comparison
Willamette River Transit Bridge
On the Bridge

View Comparison
Willamette River Transit Bridge
On the River
View Comparison

Willamette River Transit Bridge

On the River

Architectural illumination not currently in budget
### Willamette River Transit Bridge

#### Current Status

**Draft Ranking from 10/28/08 Working Group**

<table>
<thead>
<tr>
<th>Center-to-center Span Width</th>
<th>Wave</th>
<th>Tied</th>
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<th>Cable Stayed</th>
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**Legend**

- High Score
- Moderate Score
- Low Score

**Each alternative has opportunities and challenges**

#### Tied Arch

**Willamette River Transit Bridge**
Through Arch

Willamette River Transit Bridge

Finding - Arches

Challenges

- Environmental Permitting Risk
  - Piers in shallow water
- Navigational Permitting Risk
  - Horizontal and vertical clearances, maneuvering
- Greater depth of structural section over the Greenway trail
- In-water pier proximity to existing subsurface utilities
- In-water pier proximity to proposed contaminated media cap
Wave Frame

Finding – Wave Frame

Challenges

- Fracture critical members
- Very non-redundant structure
- Life cycle cost
- Design risk
- Fabrication risk
- Sole source for engineering services
Finding – Cable Stayed

Challenges

- Architectural and Urban Context

Next Steps

- Evaluate structural performance of options
- Define construction sequence
- Create computer models
- Analyze for service loads
- Analyze for seismic loads
Cost and Constructability

- Determine member sizes and quantities
- National Constructors Group
  - Cost bases
  - Cost certainty
  - Constructability review
  - Contractor’s risk assessment
- Review at Nov. 12th Working Group Meeting

Current Status

Working Group’s Draft Findings
- Tied and Through Arches
- Wave Frame
- Cables Stayed
Next Steps

- Preliminary recommendation of viable types (1-4 anticipated) to WRBAC (November 13, 2008)
- 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