Columbia River CROSSING

Current Bridge Criteria and Constraints

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Update to Project Sponsors Council
December 10, 2010

Oregon Department of Transportation

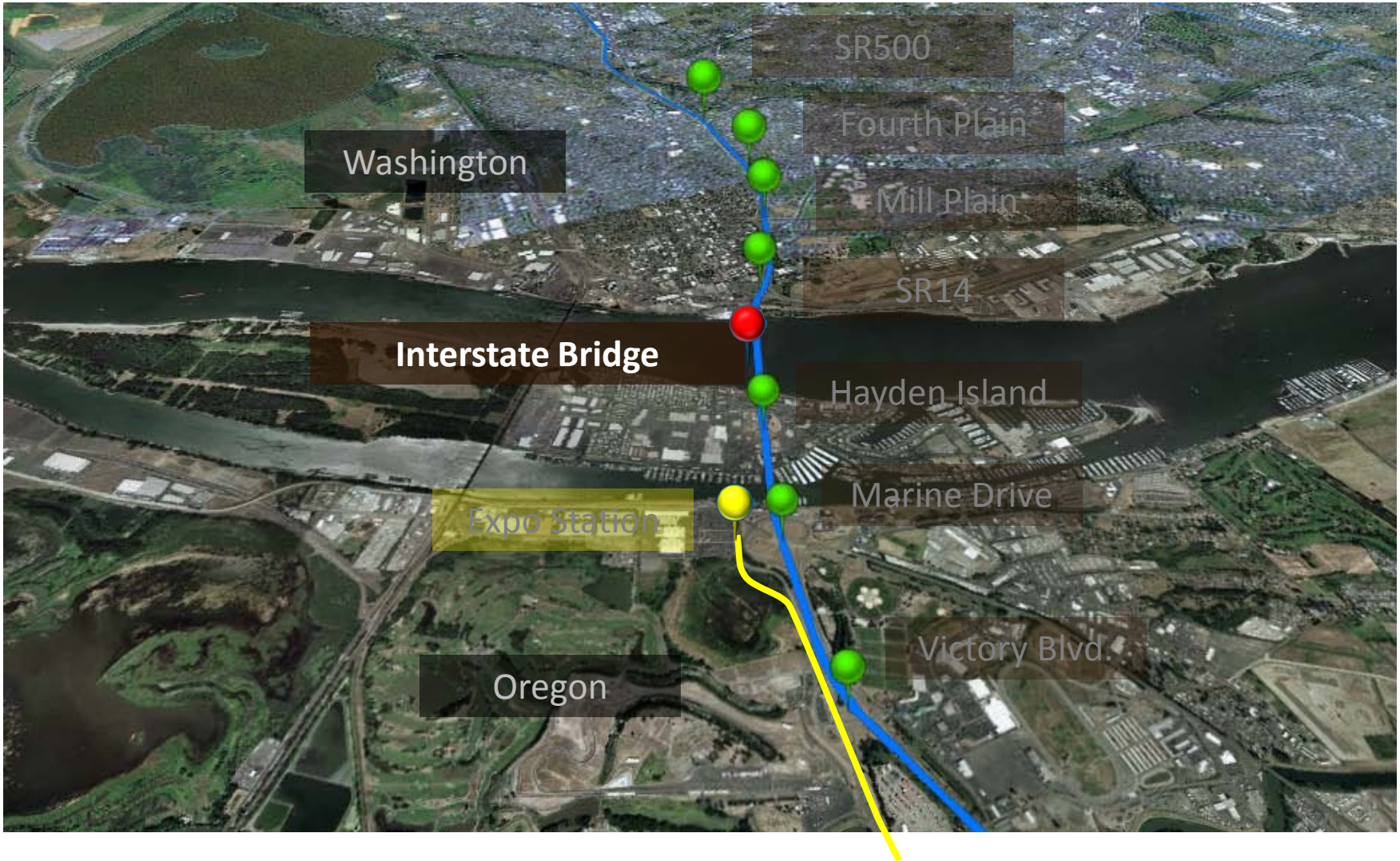
Washington State Department of Transportation

Federal Transit Administration • Federal Highway Administration
City of Vancouver • City of Portland • SW Washington Regional Transportation Council • Metro • C-TRAN • TriMet

Presentation topics

- River crossing constraints
- 2008 Bridge type screening process
- Bridge type study
- River crossing type timeline

CRC project area



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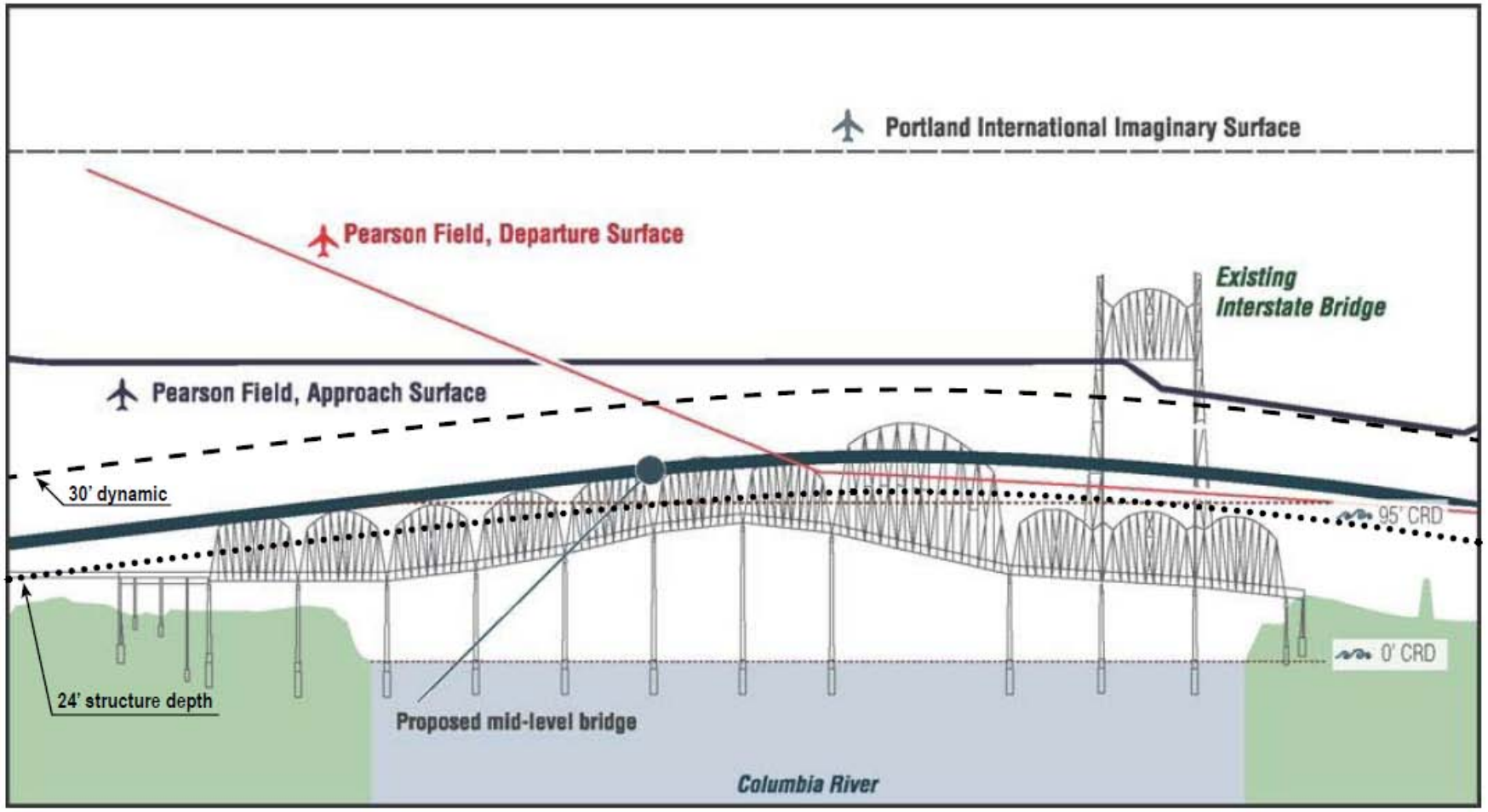
River crossing constraints

- Aviation
- River navigation
- Cultural and historic resources
- Environmental

Aviation


Vancouver
N
500
5
Pearson Field
BNSF
14
205
Columbia River
Proposed
Bridge
Portland
International
Airport
Portland

Navigation and aviation constraints



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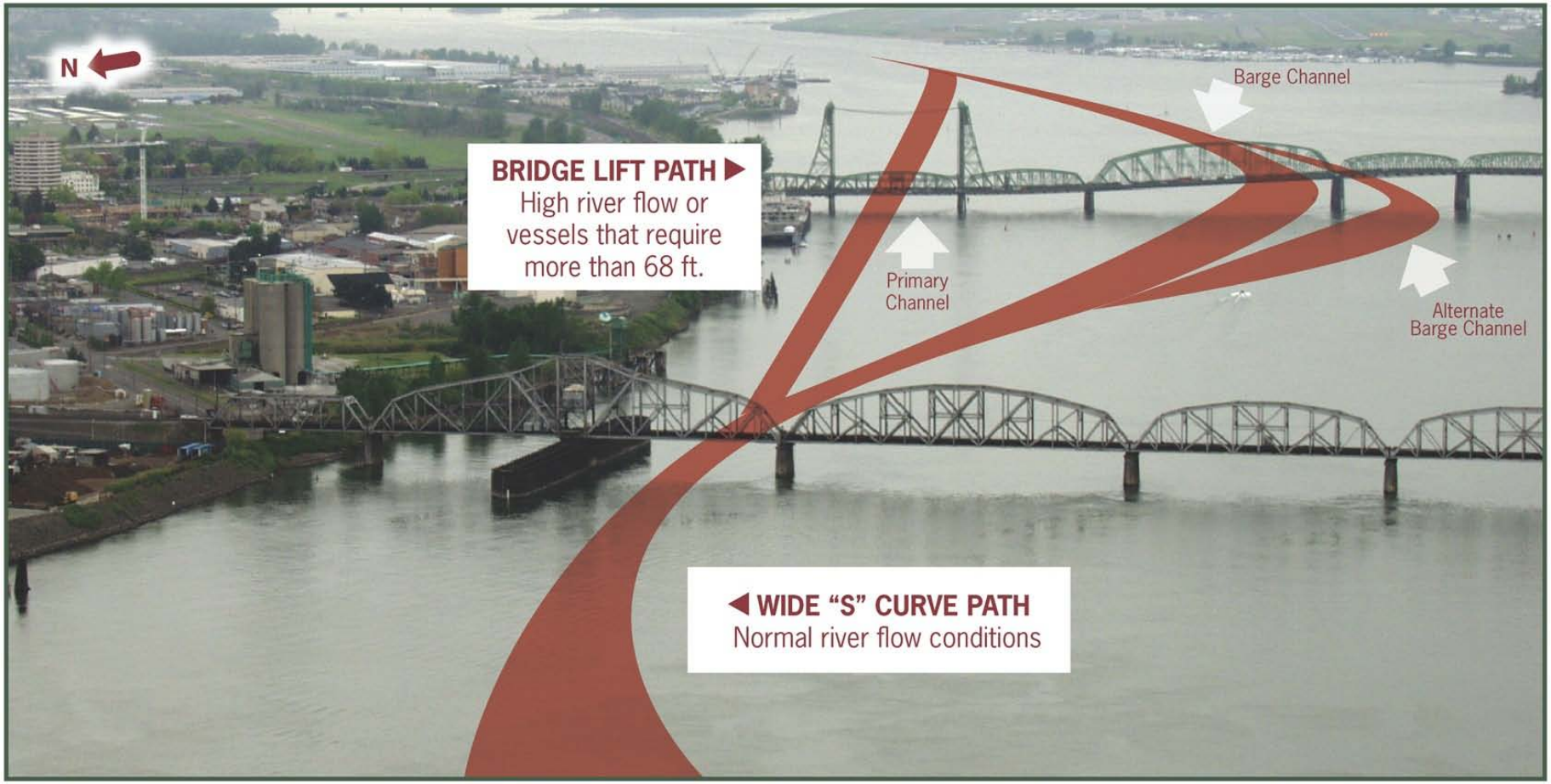
Existing navigation channels



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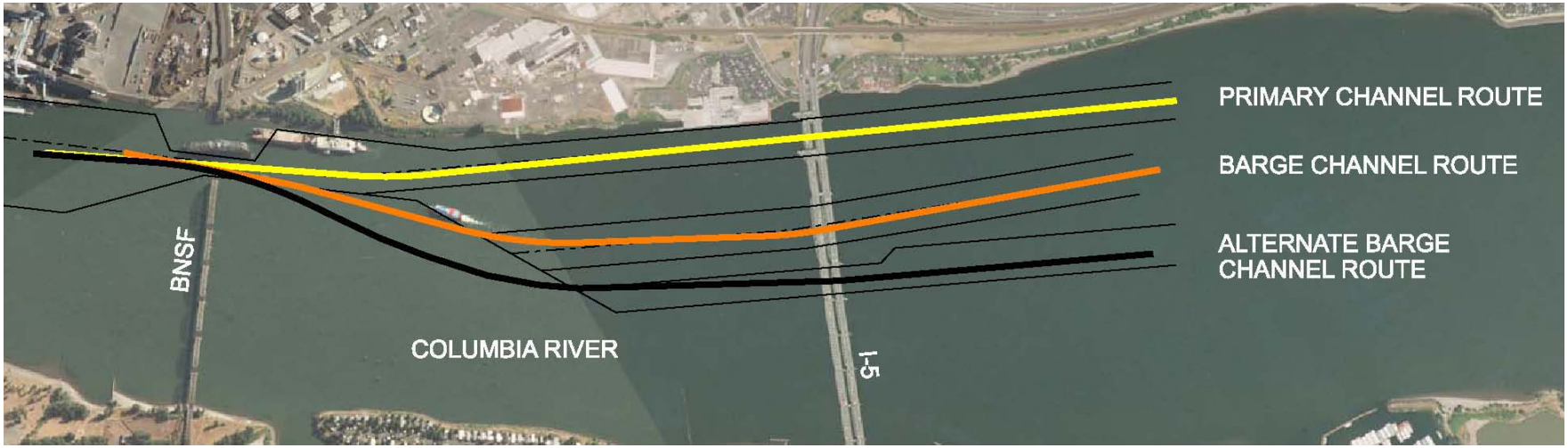
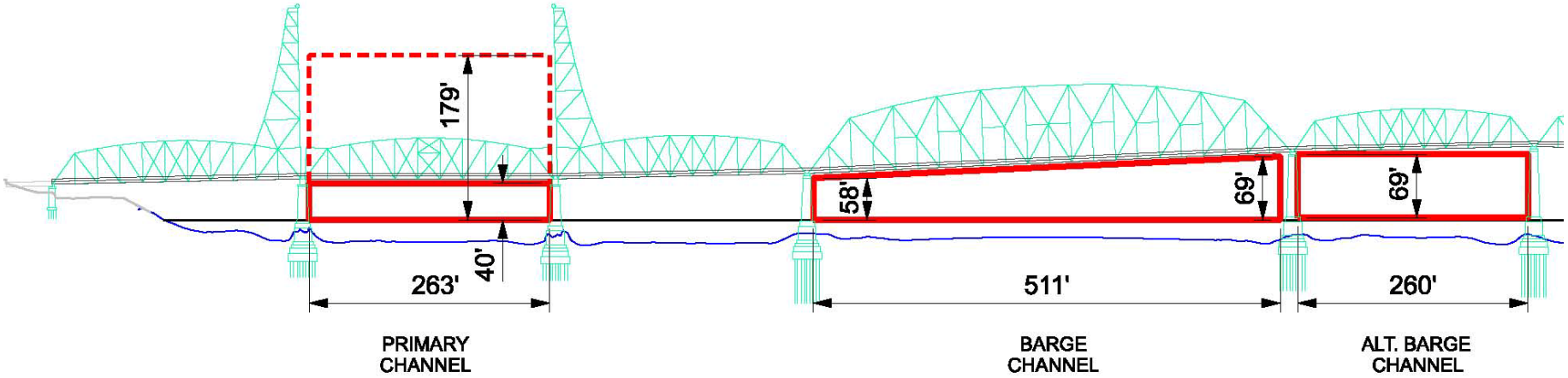
Existing navigation channels





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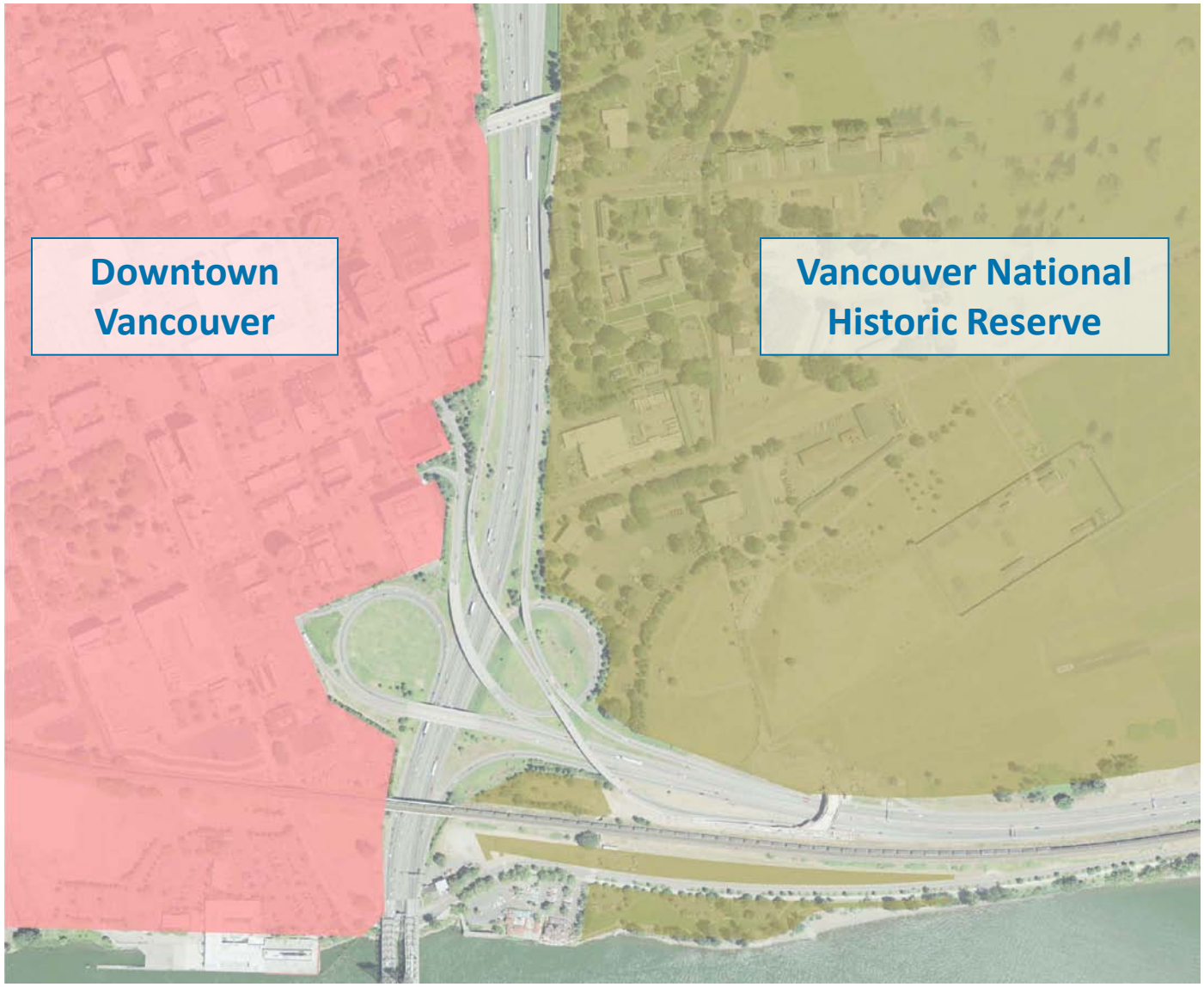
Physical constraints

Cultural and historical constraints



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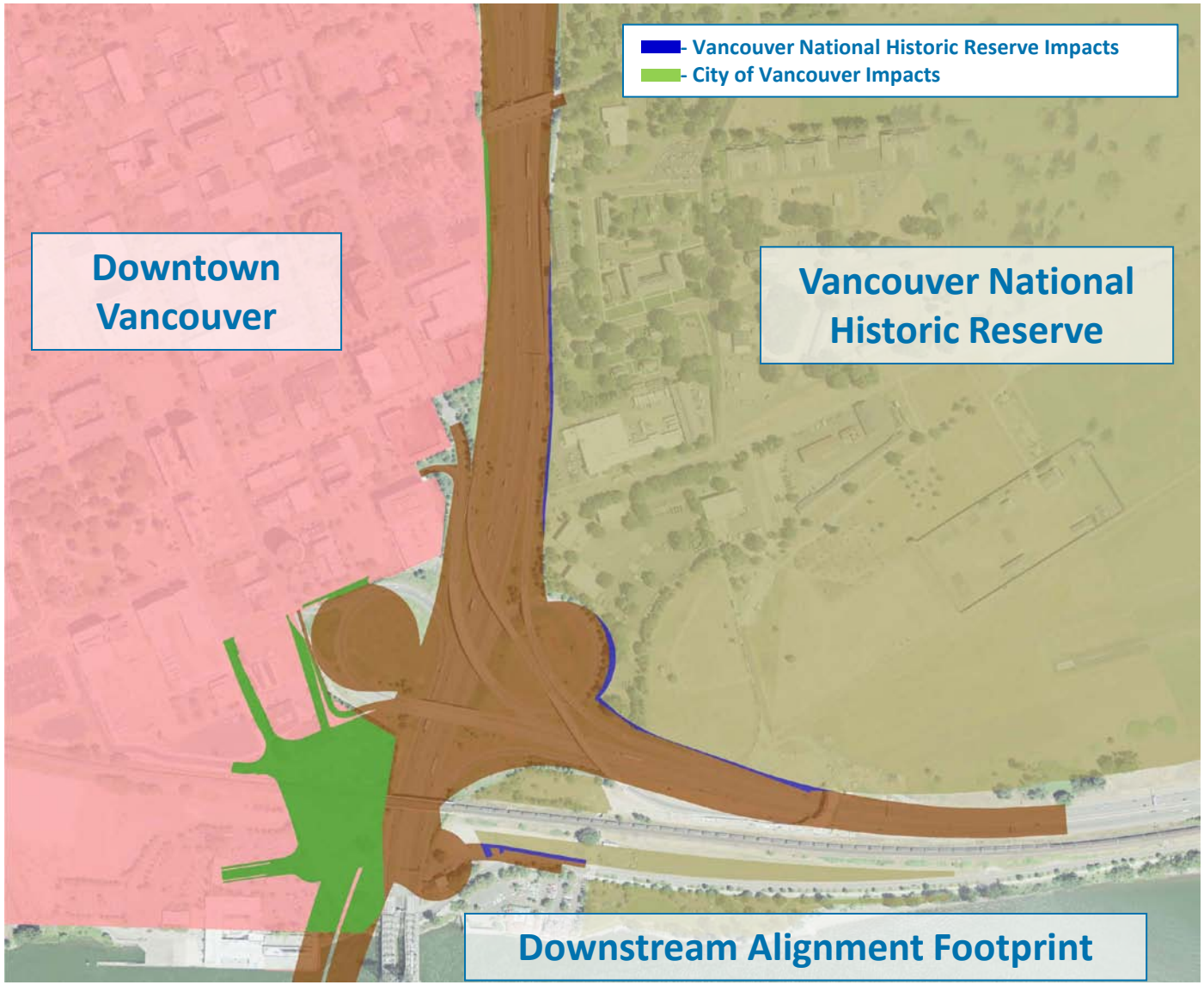
Cultural and historical constraints



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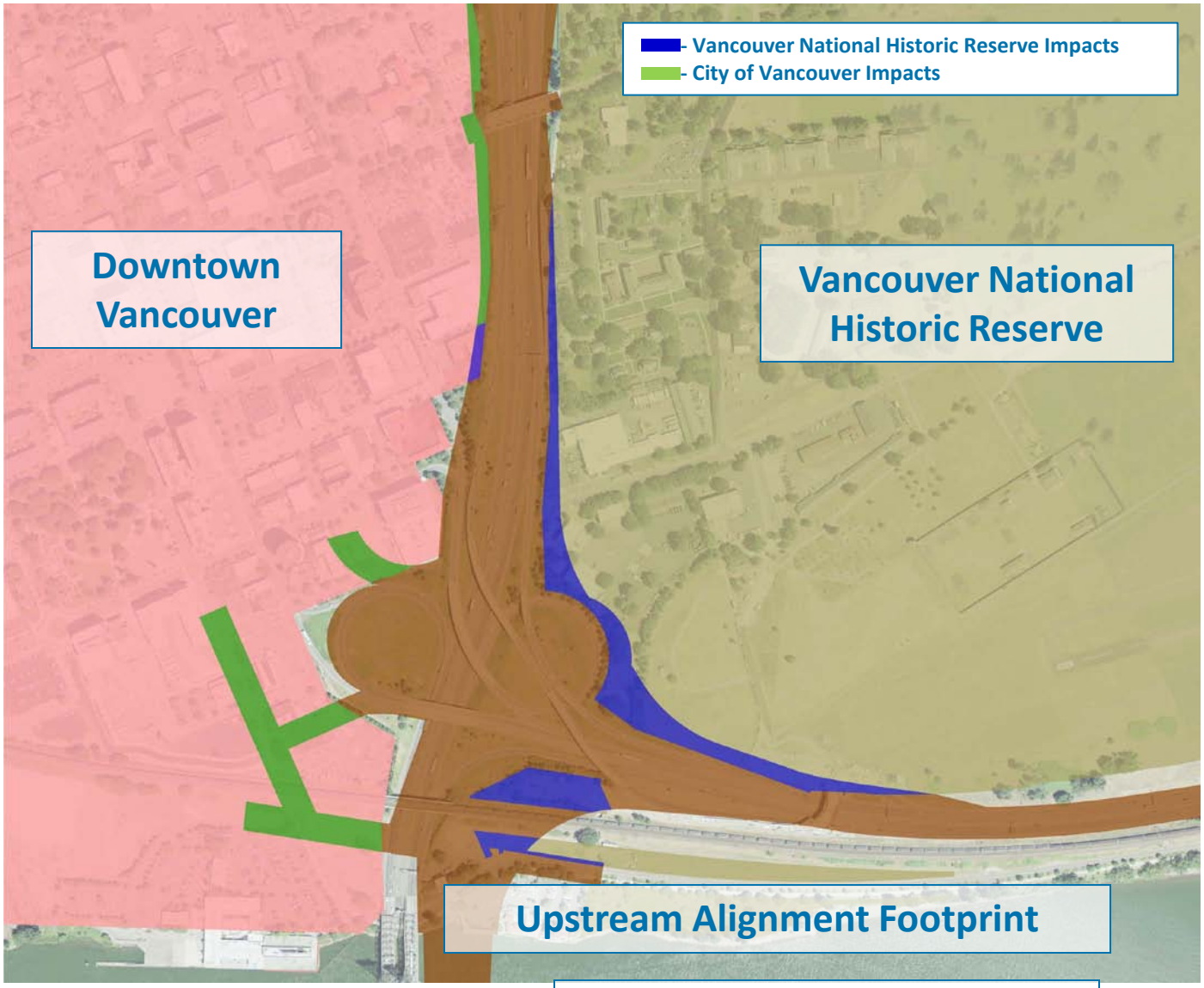
Cultural and historical constraints



5+ acres additional 4F impacts compared to downstream alignment

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Environmental constraints

Columbia River

- 16 ESA-listed fish species
- 1 ESA-listed marine mammal

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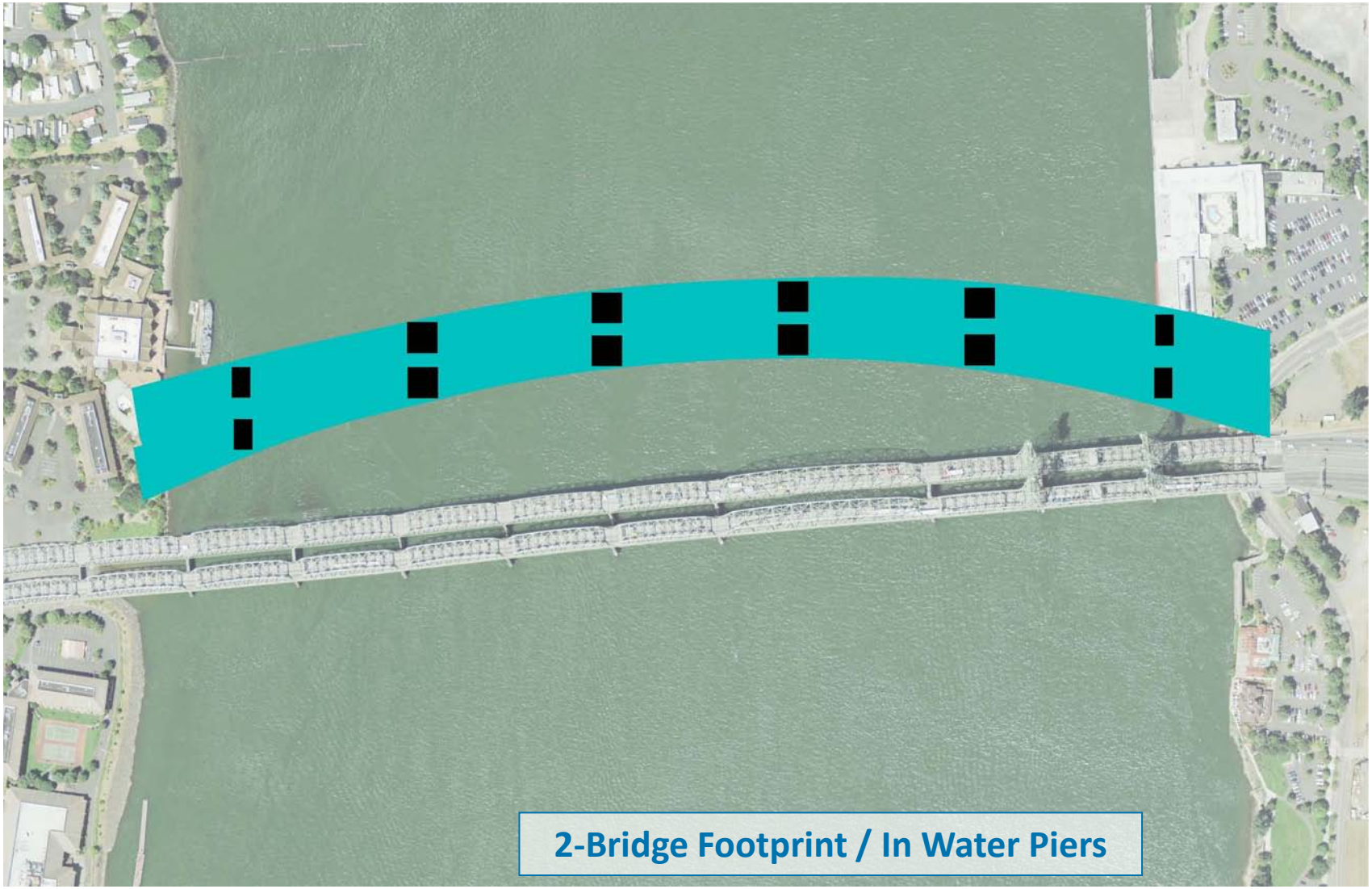
Environmental constraints



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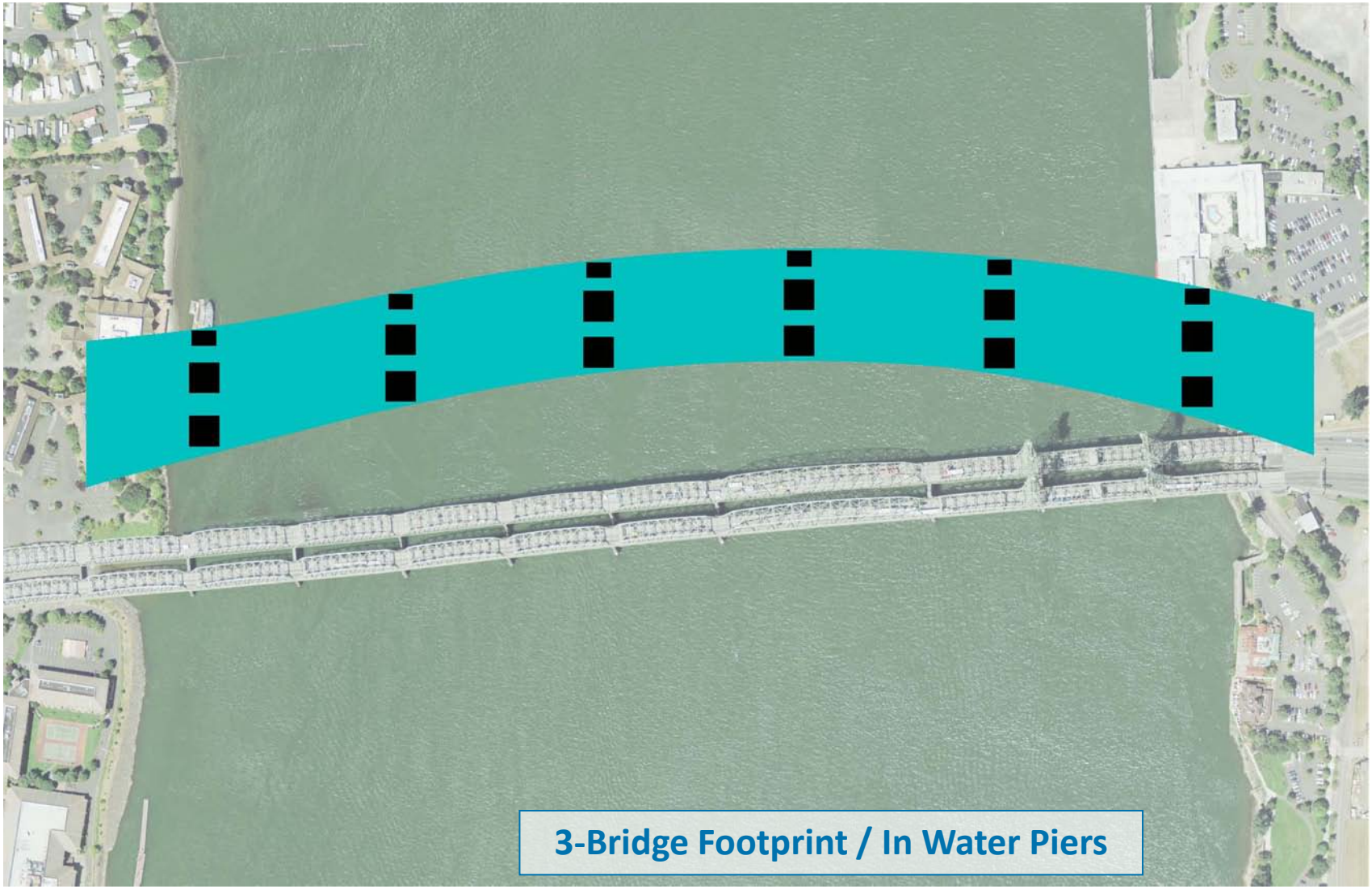
Environmental constraints



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Bridge type screening process

- **Determine bridge types that should be screened / analyzed**
- **Tier 1 Screening**
  - Determined which bridge types have the technical merit to warrant further consideration. Bridge types either passed or failed the performance requirements (project constraints and technical suitability)
- **Tier 2 Screening**
  - Bridge types that passed tier 1 were measured and analyzed against 6 performance attributes and 2 cost attributes.

Type screening workshop – Oct. 2008

- Jugesh Kapur (WSDOT)
- Tim Moore (WSDOT)
- Bruce Johnson (ODOT)
- Craig Shike (ODOT)
- Shoukry Elnahal (FWHA)
- Barry Brecto (FHWA)
- John Buchheit (FTA PMOC)
- Rod Miller (FTA PMOC)
- Steve Thoman (Independent Consultant)
- John Clark (Independent Consultant)
- Rob Turton (CRC, HDR)
- Matt Deml (CRC, HDR)

Bridge type screening workshop

Genre	Three-Bridge	Two-Bridge
Cable Supported	• Cable Stayed • Extradosed • Suspension	• Cable Stayed • Extradosed • Suspension • Extradosed Suspended
Arch	• Deck Arch • Through Arch	• Deck Arch • Through Arch
Truss	• Deck Truss • Through Truss	• Deck Truss • Through Truss
Girder	• Concrete I-Girder • Concrete Segmental Girder • Steel Box Girder • Steel I-Girder • Haunched Concrete Box with I-Girder Drop-In Spans	• Concrete Segmental Girder • Open Web Box Girder • Steel Box Girder • Suspended Frame

Table 5-2. Tier 1 screening results

Alternatives	Navigational Clearance	Aviation Clearance	Technical Suitability	Comments
Cable Stayed (Three-Bridge)	yes	no	yes	Violates all aviation surfaces. Considered suitable, but may be technically challenging due to the curved alignment.
Cable Stayed (Stacked)	yes	no	yes	Violates all aviation surfaces. Considered suitable, but may be technically challenging due to the curved alignment..
Suspension (Three-Bridge)	yes	no	no	Towers would violate PDX Obstacle Clearance Surfaces and Pearson Field Part 77 Imaginary Surfaces. Not technically suitable to build a suspension bridge on a curve.
Suspension (Stacked)	yes	no	no	Towers would violate PDX Obstacle Clearance Surfaces and Pearson Field Part 77 Imaginary Surfaces. Not technically suitable to build a suspension bridge on a curve.
Extradosed (Three-Bridge)	yes	yes	yes	Towers would be very close to the Pearson Field Part 77 Imaginary Surfaces.
Extradosed (Stacked)	yes	no	no	Requires either raising the profile which would violate the Pearson Field Part 77 Imaginary Surfaces or lowering the profile which would violate the navigation opening. Increased loads from the stacked configuration exacerbate the already significant transverse framing requirements due to deck width.
Through Arch (Three-Bridge)	yes	no	no	Violates the Pearson Field Part 77 Imaginary Surfaces. Curved alignment and poor soil conditions are problematic from a design and construction standpoint.
Through Arch (Stacked)	yes	no	no	Violates the Pearson Field Part 77 Imaginary Surfaces. Curved alignment and poor soil conditions are problematic from a design and construction standpoint.
Deck Arch (Three-Bridge)	yes	yes	no	A flatter arch or longer spans could be employed to accommodate the navigation opening. Curved alignment and poor soil conditions are problematic from a design and construction standpoint.

Table 5-2. Tier 1 screening results

Alternatives	Navigational Clearance	Aviation Clearance	Technical Suitability	Comments
Deck Arch (Stacked)	yes	yes	no	Requires raising the profile of the bridge in order to meet navigational clearances. Curved alignment and poor soil conditions are problematic from a design and construction standpoint.
Through Truss (Three-Bridge)	yes	no	yes	Violates the Pearson Field Part 77 Imaginary Surfaces.
Through Truss (Stacked)	yes	no	yes	Violates the Pearson Field Part 77 Imaginary Surfaces.
Deck Truss (Three-Bridge)	yes	yes	yes	Requires raising the profile of the bridge in order to meet navigation opening.
Deck Truss (Stacked)	yes	yes	yes	Requires raising the profile of the bridge in order to meet navigation opening.
Open Web Box Girder (Stacked)	yes	yes	yes	
Concrete Segmental Girder (Three-Bridge)	yes	yes	yes	
Concrete Segmental Girder (Stacked)	yes	yes	yes	
Concrete I-Girder (Three-Bridge)	no	yes	yes	Could consider for approach spans in conjunction with other bridge types.
Steel Box Girder (Three-Bridge)	yes	yes	yes	
Steel Box Girder (Stacked)	yes	yes	no	Non-redundant, fracture critical, fatigue prone bridge type. Highly susceptible to fire.
Steel I-Girder (Three-Bridge)	yes	yes	yes	
Suspended Frame	yes	yes	yes	Concerns about seismic performance of the suspended frame/system.

Table 5-2. Tier 1 screening results

Alternatives	Navigational Clearance	Aviation Clearance	Technical Suitability	Comments
Extradosed (Suspended)	yes	no	no	Requires either raising the profile which would violate the Pearson Field Part 77 Imaginary Surfaces or lowering the profile which would violate the navigation opening. Increased loads from the stacked configuration exacerbate the already significant transverse framing requirements due to deck width. Concerns about seismic performance of the suspended frame/system. Poses special technical challenges with transverse structural system and tower heights.
Haunched Concrete Box Girder with Concrete I-Girder Drop-In Spans (Three-Bridge)	yes	yes	yes	Concerns with the curved alignment and I-girders.

Bridge types analyzed in Tier 2

Genre	Three-Bridge	Two-Bridge
Cable Supported	• Cable Stayed • **Extradosed** • Suspension	• Cable Stayed • Extradosed • Suspension • Extradosed Suspended
Arch	• Deck Arch • Through Arch	• Deck Arch • Through Arch
Truss	• **Deck Truss** • Through Truss	• **Deck Truss** • Through Truss
Girder	• Concrete I-Girder • **Concrete Segmental Girder** • **Steel Box Girder** • **Steel I-Girder** • **Haunched Concrete Box with I-Girder Drop-In Spans**	• **Concrete Segmental Girder** • **Open Web Box Girder** • Steel Box Girder • **Suspended Frame**

Table 6-1. Performance attributes for Tier 2 screening

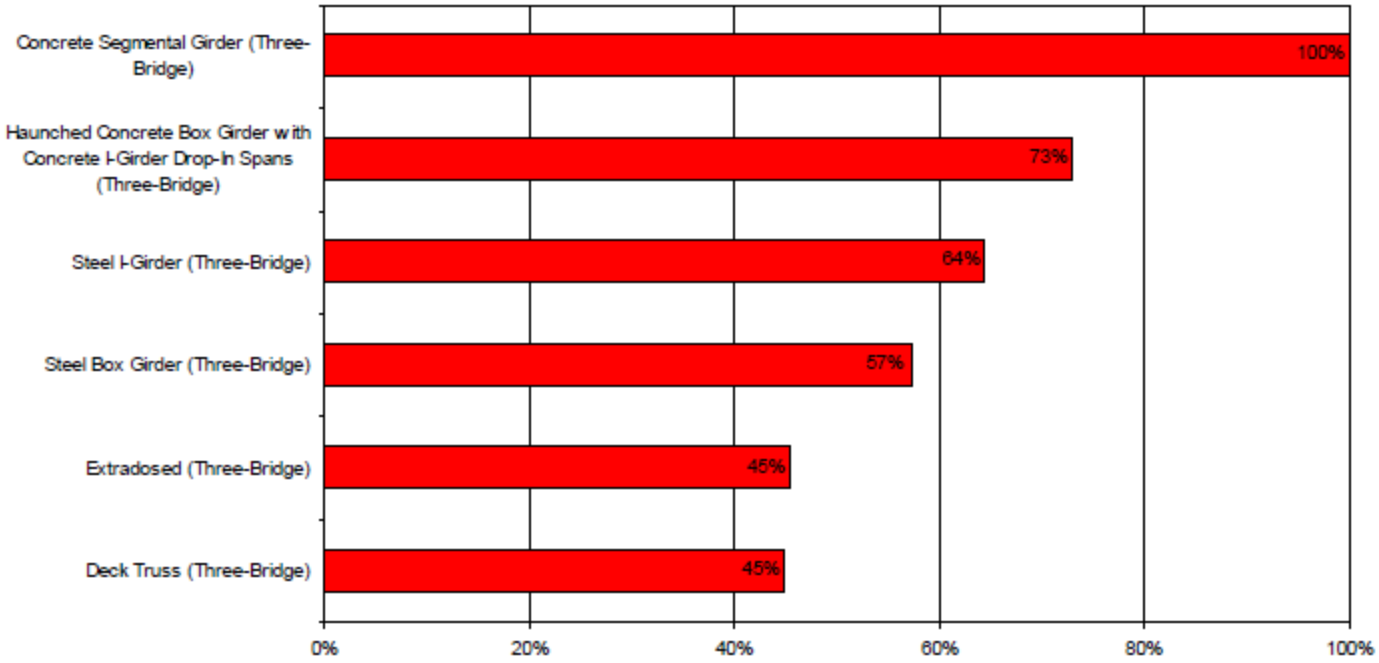
Performance Attribute	Definition
In-Water Work Impacts	An overall assessment of the impacts relative to the degree and duration of in-water work as it applies to marine traffic and environmental impacts.
Structural Complexity	An overall assessment of the technical complexity of the structural details as it relates to both design and construction:
Aesthetic Opportunity	An assessment of the opportunities for articulating the bridge in an aesthetically pleasing manner. Considers both the ease and diversity of potential aesthetic features.
Maintainability	The long-term maintenance and operations costs. This attribute also includes the ease of maintenance and inspection of the bridge.
Project Schedule	The total time to construct the bridge as measured from today.
Operational Reliability	An assessment of risk related to maintaining operations.

Table 6-2. Cost attributes for Tier 2 screening

Cost Attribute	Definition
Design Cost	The total cost to design the bridge.
Construction Cost	The total capital cost of construction, inclusive of risk.

Tier 2 results – 3 bridge configuration

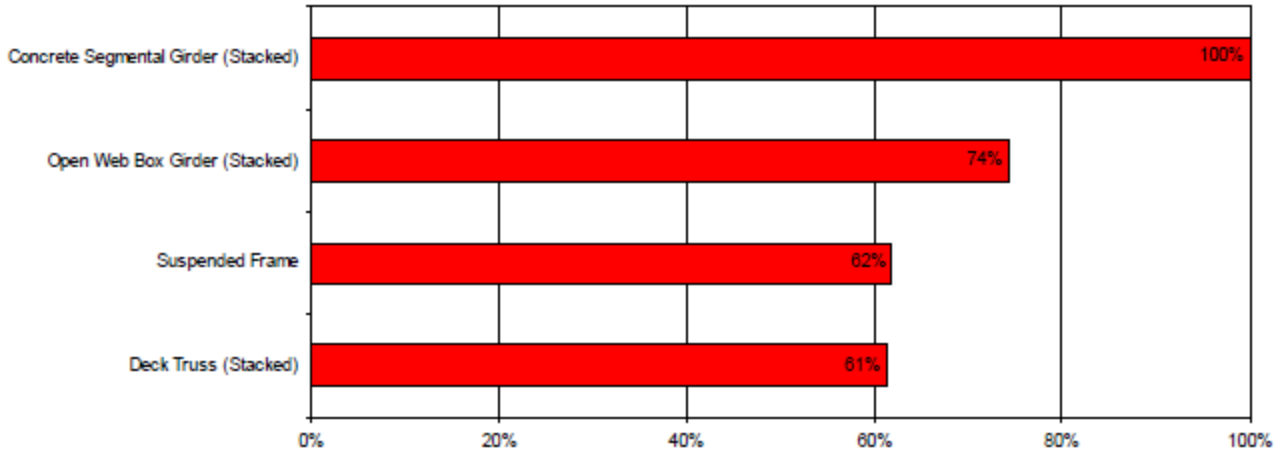
Figure 6-6. Tier 2 Screening Results for the Three-Bridge Configuration



- **Bridge type performance and cost attribute screenings for three-bridge configurations resulted in a "value index" for each bridge type. A higher percentage indicates greater relative value.**

Tier 2 results – 2 bridge configuration

Figure 6-7. Tier 2 Screening Results for the Two-Bridge Configuration



- **Bridge type performance and cost attribute screenings for two-bridge configurations resulted in a "value index" for each bridge type. A higher percentage indicates greater relative value.**

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Bridge type study

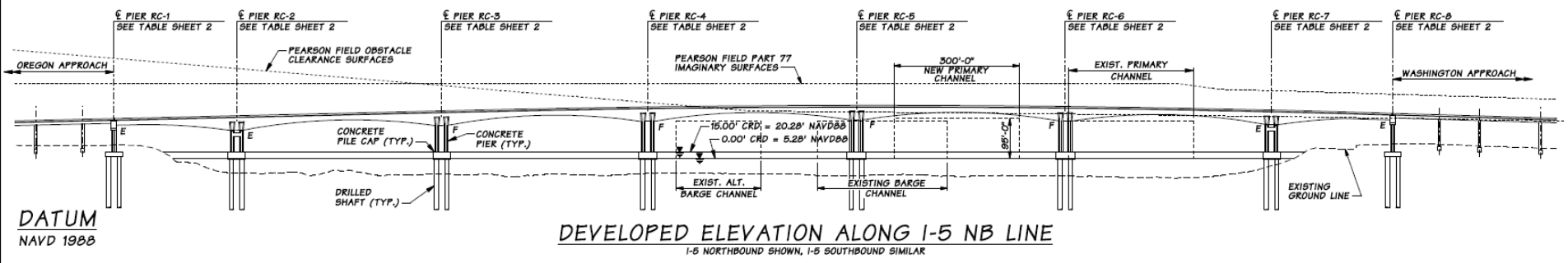
Genre	Three-Bridge	Two-Bridge
Cable Supported	• Cable Stayed • **Extradosed** • Suspension	• Cable Stayed • Extradosed • Suspension • Extradosed Suspended
Arch	• Deck Arch • Through Arch	• Deck Arch • Through Arch
Truss	• **Deck Truss** • Through Truss	• **Deck Truss** • Through Truss
Girder	• Concrete I-Girder • **Concrete Segmental Girder** • **Steel Box Girder** • **Steel I-Girder** • **Haunched Concrete Box with I-Girder Drop-In Spans**	• **Concrete Segmental Girder** • **Open Web Box Girder** • Steel Box Girder • **Suspended Frame**

Bridge type study

- **Preliminary design for all 10 bridge types**
  - Conceptual engineering
  - Conceptual plans, elevations and sections
  - Conceptual quantities
- **Preliminary cost estimates**
  - Contractor bid style
- **Recommended bridge type for 2-bridge and 3-bridge scenarios**

Bridge type study

- **3-Bridge Recommendation**
  - Concrete Segmental Box Girder



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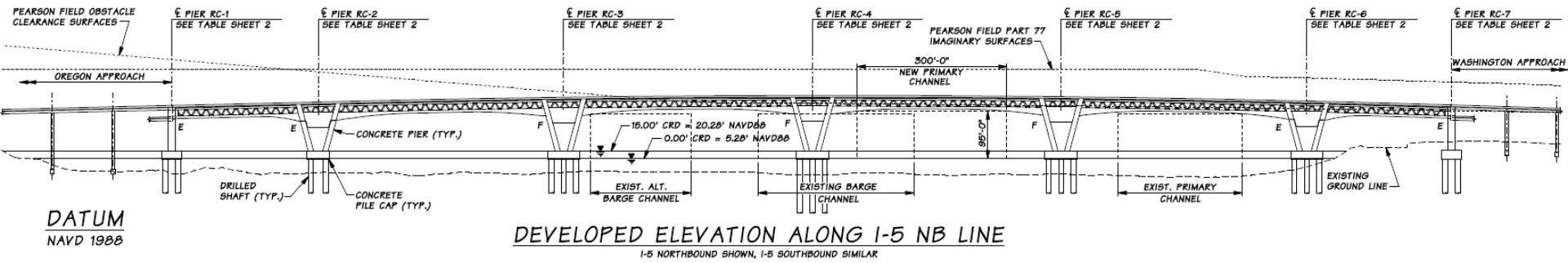
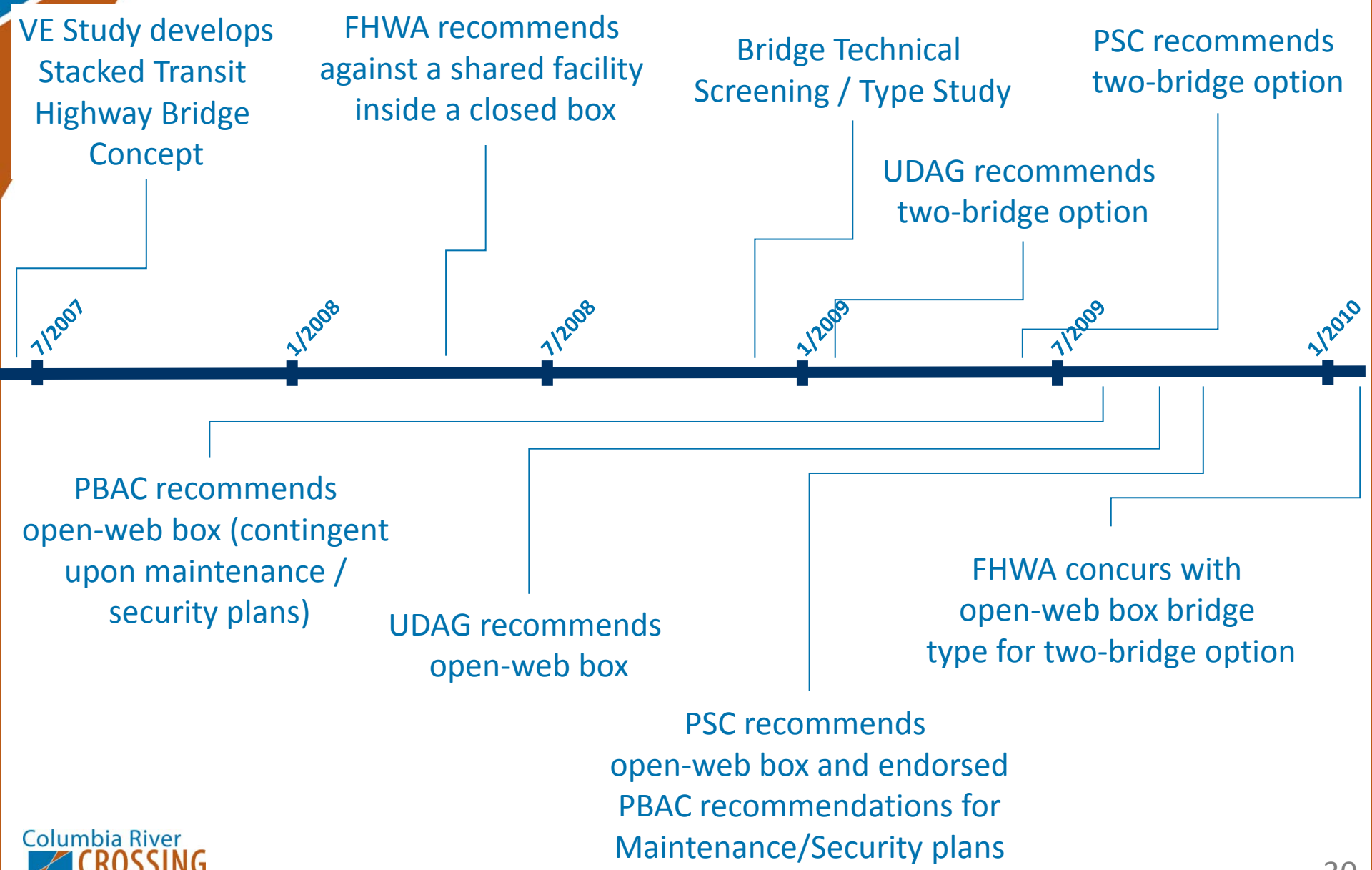
Bridge type study

- **2-Bridge Recommendation**
  - Open Web Box Girder



River crossing type timeline



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Oregon	**503-256-2726**
Toll-Free	**866-396-2726**

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