TUNNEL CONCEPT ASSESSMENT

EXECUTIVE SUMMARY

The Interstate Bridge Replacement (IBR) program will replace the existing Interstate Bridge crossing the Columbia River. The IBR program considered a tunnel crossing as part of a comprehensive evaluation of different river crossing options.

Two types of tunnels are typically considered for crossing bodies of water: a bored tunnel and an immersed tube tunnel (ITT). A bored tunnel is constructed using a tunnel boring machine. Given the length, width, and soil conditions, a bored tunnel was dismissed during previous planning efforts. An ITT involves a series of prefabricated tunnel segments that are constructed in a casting basin or on dry docks, and then sunk onto a prepared soil substrate. Tunnel segments are then connected under water and the tunnel is dewatered.

The *Tunnel Concept Assessment* investigated two ITT alignments (upstream and downstream of the existing Interstate Bridge – see Figure 1) from multiple perspectives, including design, construction, operations, environmental, and cost considerations. The ITT would accommodate vehicular traffic, light rail transit (LRT), and a shared-use path (SUP) (see Figure 2).

Figure 1. Upstream and Downstream Tunnel Alignments

Figure 2. ITT Typical Section

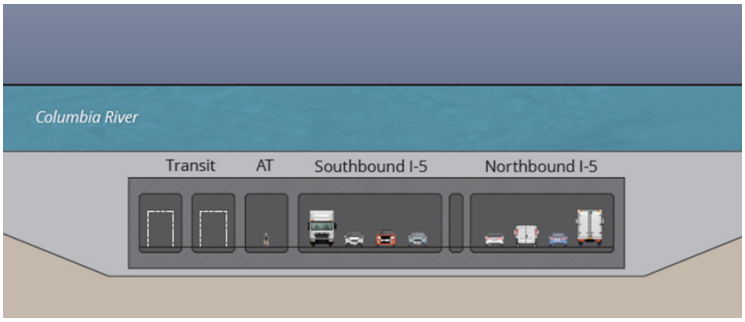

Table 1 includes a summary of the considerations associated with an ITT. While an ITT is shown to be technically feasible, numerous challenges demonstrate it is not a viable replacement solution for the IBR program that should receive further consideration.

These challenges include:

- Significant out-of-direction travel for drivers, freight, transit users, bicyclists and pedestrians.
- The inability to tie into the existing connections such as SR 14, Vancouver City Center, and Hayden Island.
- Safety concerns for bicyclists and pedestrians.
- Significant archeological, cultural, and environmental impacts.

Additionally, cost estimates for the ITT would be approximately two times higher than the cost estimates for a replacement bridge and approaches. This estimate does not include other highway, interchange, or high-capacity transit improvements that would be necessary.

For a comparison of all river crossing options and the IBR program's recommendation, please see the executive summary for the *River Crossing Option Comparison*.

Table 1. Summary of Immersed Tube Tunnel Considerations

Topic	Immersed Tube Tunnel
Active Transportation/ SUP	• **Safety concerns** due to enclosed shared use path for over 1 mile (e.g., no "eyes on the path," emergency egress, fire and life safety) • **Missed direct connectivity** from the shared use path on the river crossing to local trails on both sides of the river (e.g., Renaissance Trail, Marine Drive Trail) • Opportunities to **improve connectivity** between existing trails on the Washington shore and potential for more park space along the river due to removal of existing I-5 connections
Aviation	• **No penetration** into Pearson airspace
Columbia River Navigation	• **Unlimited** horizontal and vertical navigation clearances • **Compatible** with existing navigation channels • **Eliminates navigation hazards** at the bridge location (e.g., bridge piers, bridge deck) in/over the river

Topic	Immersed Tube Tunnel
Construction Considerations	• Requires **unconventional and complex** below-grade construction to accommodate interchange connections consisting of cut and cover tunnels with large temporary excavations. This would make **construction impractical** • Construction would require **negotiation and approval of a permit from BNSF** to construct over/under/through their right-of-way; it is unlikely that BNSF would accept interruptions of their operations, and therefore construction would likely require the program construct a temporary alternative route; **there is no readily available route**
Cost Considerations	• A conceptual construction cost estimate[1] of **$3.08 billion** for an ITT (from grade to grade) was developed based on previously completed projects and the collective expertise of the team

[1] The conceptual construction costs do not include an allowance for soft costs such as design, construction management, contingency, or life-cycle considerations. These costs are for a facility that would accommodate I-5, high-capacity transit, and the SUP. This estimate does not include other highway, interchange, or high-capacity transit improvements that would be necessary. See the Tunnel Concept Assessment.

Topic	Immersed Tube Tunnel
Environmental Considerations	• **Eliminates over-water shading** impacts to fish and marine habitat. While a bored tunnel would go under the river, thus reducing/avoiding impacts to the river, **an ITT would require dredging the river bottom** – see below for impacts specific to an ITT • **Potential impacts and benefits to riverfront properties**/land above the tunnel; construction noise, vibration, and congestion impacts to businesses, impacts to neighborhoods and parks/recreation due to tunnel portals and local connections; utilities would require substantial relocations • **Impacts on local communities and neighborhoods** from construction of the cut and cover sections, tunnel portals, and local connections, including displacement of businesses and residences and neighborhood isolation • **Removes the bridge from the viewshed**, which benefits historic properties, parks and trails, and other resources • **In-water trenching and dredging** would disturb the river bottom across the entire width of the Columbia River, including the riverbanks (in-water excavation would require removal of approximately 4 million cubic yards of material) • Dredged material would need to be placed in an in-water or upland site and **may require special handling** if contaminated materials are found; disturbance of the river bottom and nearshore habitat would require mitigation • **In-water construction** would impact aquatic plants, fish and other amphibians, marine mammals, and birds (including ESA-listed species) • **Cultural resources** along the shoreline and underwater are a concern; with potential impacts to Fort Vancouver and Old Apple Tree Park; size and volume of excavation and vibration could **disturb or permanently impact resources** • **Disturbance and suspension of potentially contaminated materials in the river**; large excavation of contaminated soil on land may exceed capacity of existing disposal locations
Geotechnical Considerations	• **Ground improvement may be required** to improve the soils of the river bottom above, below, and around the ITT, which contributes **to high construction schedule and cost risks**
High-Capacity Transit	• An underground station could result in **high costs and construction risks** due to ground conditions near the river
Highway Traffic	• Due to missed connections (loss of **two** interchanges - Hayden Island and State Route 14), large volumes of traffic would be **rerouted through local streets** to access I-5

Topic	Immersed Tube Tunnel
Highway/Local Connections	• **Eliminates two** I-5 interchanges (Hayden Island and State Route 14), resulting in a loss of access to local streets and require modifications to the adjoining corridors
Operational Considerations	• Requires a **full-time staffed operations center** for monitoring the mechanical, electrical, security and traffic control systems • Requires **additional and different systems requirements** (fixed firefighting systems; mechanical ventilation systems [jet fans]; standpipe system; tunnel thermal protection systems; drainage systems; traffic monitoring systems; security systems)
Safety	• Requires **extensive fire and life safety systems** • Requires **additional and different safety requirements**[2] (fixed firefighting systems; mechanical ventilation systems [jet fans]; standpipe system; tunnel thermal protection systems; drainage systems; traffic monitoring systems; security systems) • Fire prevention and ventilation **difficult** at abrupt changes in geometry • Hazardous materials are **not typically permitted in tunnels** (would require approval at the state level) • **Safety concerns due to enclosed tunnel** with two points of access (e.g., potential delays in emergency response, road blockage due to a collision)
Structural Considerations	• Requires **more rigorous design efforts** and specialty contractors

[2] These requirements are also listed under "Operational Considerations." The listed requirements pertain to both operations and safety.