

MEMORANDUM

Date:	August 20, 2021
To:	Chris Regan, Environmental Manager, IBR program
From:	Emma Johnson, Environmental Coordinator, IBR program Angela Findley, Environmental Lead, IBR program
Subject:	Screening and Evaluation of a Tunnel River Crossing

1. INTRODUCTION

This memorandum summarizes the evaluation of a tunnel as a potential option to address the transportation problems in the Interstate Bridge corridor. Two tunnel construction technique options were evaluated as part of the alternatives screening process during the Columbia River Crossing (CRC) Environmental Impact Statement (EIS) phase and were ultimately dismissed from more detailed study in the EIS. Recently, the concept of an immersed tube tunnel (ITT) has been advocated by members of the public as a possible solution that should be considered by the Interstate Bridge Replacement (IBR) program. The IBR program investigated the ITT design/construction option because it was not studied during previous planning efforts. The IBR program prepared a detailed fact-based, data-driven whitepaper providing assessment of the technical considerations of designing, constructing, and operating an ITT.

The purpose of this memorandum is to summarize the evaluations of the bored tunnel and ITT concepts and explain why they do not warrant further analysis under the IBR program.

2. TUNNEL ALTERNATIVES PREVIOUSLY CONSIDERED BUT ELIMINATED

Throughout the CRC's development, the project team worked in tandem with the CRC Task Force, which was a 39-member group composed of leaders representing a broad cross section of Washington and Oregon communities.¹ The Task Force group met regularly to advise the CRC project team and provide guidance and recommendations at key decision points.

During the initial two-step screening process (Step A and Step B, detailed below), the CRC Task Force and project team reviewed various types of options for river crossing(s) and transit in order to narrow the range of alternatives. These options were known as river crossing components and transit components. The

¹ Public agencies, businesses, civic organizations, neighborhoods, and freight, commuter, and environmental groups were represented on the Task Force.

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components were later combined into multi-modal alternatives that represented a reasonable range of combinations for further evaluation.

The river crossing components included a replacement tunnel (in which a new tunnel would be constructed, and the existing Interstate Bridge would be removed) and a supplemental tunnel (in which a new tunnel would be constructed to supplement the existing bridge). The description of the two tunnel river crossing components, as reported in the CRC screening documents, are provided below.

Description of the Replacement Tunnel component

The replacement tunnel river crossing (known as RC-20) would construct a multi-lane tunnel with the removal of the existing I-5 bridge. The multi-modal tunnel would carry vehicular, transit, and active transportation trips. The tunnel would connect above ground to interchanges north of State Route (SR) 14 and south of Hayden Island (near Marine Drive).

Description of the Supplemental Tunnel component

The supplemental tunnel (RC-13) would construct a multi-lane, 5,700-foot tunnel, and would leave the existing Interstate Bridge in place. It was estimated that the supplemental tunnel could accommodate approximately 45 percent of the future vehicular traffic, with the remaining 55 percent using the existing bridge (CRC 2006a).

The CRC screening analysis identified several factors that limit the possible alignment and design of a supplemental tunnel (CRC Engineering Team 2006). In order to (1) maintain the existing bridge, (2) match existing vertical grades of the land on each side of the river, and (3) meet freeway design standards, the tunnel would have to be configured as follows:

- On the Oregon side, the tunnel would surface and tie back into existing I-5 on the south end of Hayden Island.
- In Washington, the tunnel would connect north of SR 14 (just south of Mill Plain Boulevard).
- No connections would be available from the tunnel to the interchanges at Marine Drive (ramps from Marine Drive are too close to the south tunnel entrance), Hayden Island, SR 14, Mill Plain Boulevard, and 4th Plain Boulevard. Connections to these interchanges would be provided via existing I-5.
- Portions of I-5 where the tunnel resurfaces would require major reconstruction to tie back into the existing alignment.

The results of the screening process for the two tunnel components are described below.

Step A Screening Process

The initial screening effort in April 2006 evaluated 37 river crossing and transit components using a pass/fail test designed to eliminate ideas well outside the scope of the project and/or that clearly could not address the relevant elements of the project's Purpose and Need statement (CRC 2006b). The components were evaluated by asking six pass/fail questions:

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“Does the component...”

1. Increase vehicular capacity or decrease vehicular demand?
2. Improve transit performance?
3. Improve freight mobility?
4. Improve safety and decrease vulnerability to incidents?
5. Improve bicycle and pedestrian mobility?
6. Reduce seismic risk of the I-5 Columbia River Crossing?

River crossing and transit components that passed were recommended to advance for further consideration and screening, while components that failed were recommended to be dropped from further consideration. As shown in Table 1, the Replacement Tunnel failed the Step A screening whereas the Supplemental Tunnel passed. The individual evaluations of the two tunnel options are described in the following sections.

Table 1 – Step A Component Screening Results

Component	Q1 Traffic	Q2 Transit	Q3 Freight	Q4 Safety	Q5 Bike/Ped	Q6 Seismic	Overall Score
Replacement Tunnel (RC-20)	F	F	F	P	F	P	F
Supplemental Tunnel (RC-13)	P	P	P	P	P	U	P

P = Pass F = Fail U = Unknown

Step A Results - Replacement Tunnel

The replacement tunnel failed four out of six of the pass/fail questions and had an overall failing score. The Step A Screening Process concluded that the replacement tunnel (RC-20) should not advance to further/detailed study for the following reasons.

- **Traffic:** The increased vehicular capacity would be located underground and would require an elaborate frontage road network to serve SR 14, Vancouver City Center, and Hayden Island resulting in substantial out of direction travel for drivers. A tunnel would surface south and north of much of the project area, thereby not serving most of the access needs of traffic using this section of I-5.
- **Transit:** The tunnel alignment results in significant out-of-direction travel for transit to serve I-5 transit markets. It would require an elaborate frontage road system to link I-5 activity centers.
- **Freight:** The tunnel alignment results in significant out-of-direction travel for freight to serve I-5 freight activity centers. It would require an elaborate frontage road system to link I-5 activity centers.
- **Bike/Pedestrian:** The tunnel alignment creates significant out-of-direction travel for bike/pedestrian users to reach I-5 activity centers. In addition, it is not desirable to serve bicyclists and pedestrians.

Step A Results - Supplemental Tunnel

The supplemental tunnel passed five out of six of the pass/fail questions and had an overall passing score and was recommended to advance for further study. The “unknown” score under Question 6 (seismic) for the supplemental tunnel was due to uncertainty as to whether the existing bridge could be retrofitted to meet current seismic design standards. This was later studied and determined to be infeasible, as detailed further below.

Step B Screening Process

Components that passed the Step A screening process advanced to the Step B screening process. The supplemental tunnel river crossing was one of nine river crossing components recommended to advance following the Step A Screening. The purpose of the Step B screening was to identify the most promising and potentially effective components, which would then be advanced into alternatives packaging and modeling. During Step B, components were scored on the project values listed below, which were developed and formalized by the CRC Task Force in October 2005:

- Community livability and human resources
- Mobility, reliability, accessibility, congestion reduction, and efficiency
- Safety
- Regional economy, freight mobility
- Stewardship of natural resources
- Distribution of benefits and impacts

The Step B Screening concluded that there were relatively few dramatic differences between the remaining components, and that these differences were not large enough to warrant completely eliminating any additional river crossing or transit components from further consideration (CRC 2006c).

Additional Component Screening

As noted in the Step B report the project identified several differences between above-ground river crossing components and the tunnel option. While all components passed Step B, additional analysis was being completed at the same time to further screen several components. Further evaluations and additional information revealed important problems with several components, including streetcar transit, low-level bridges, and the supplemental tunnel river crossing (Ficco and Osborn 2006). The supplemental tunnel was recommended to not advance to further/detailed study for the following reasons (CRC Engineering Team 2006):

- **Traffic:** Because the existing I-5 bridge would still be needed to carry non-tunnel traffic (approximately 55 percent), continued safety issues would remain related to the existing bridge lift spans, alignments, vertical profiles, and shoulder widths. In the areas where the tunnel surfaces and the realigned I-5 alignments tie back in, significant traffic turbulence would be anticipated.
- **Freight:** Most of the existing interchanges would not have access to the supplemental tunnel which would benefit through freight trips but restrict access to the new capacity provided by the tunnel. As

bridge openings would continue and be limited to off-peak hours, this would disproportionately impact freight movements, which tend to occur outside the peak periods.

- **Safety:** Without a complete reconstruction of the existing I-5 bridge to accommodate the 55 percent of traffic needing to use it, significant and continued safety concerns would remain. These would include seismic vulnerability, inadequate and unsafe shoulder and bike/pedestrian path widths, substandard vertical and horizontal alignments, and the remaining lift span still in place. If the reconstruction would be envisioned to correct these deficiencies, then it would be impractical to also build a parallel tunnel for cost reasons.
- **Cost:** A supplemental tunnel would be likely to cost significantly more than any bridge component and could be in the range of twice that of a major bridge crossing. In addition, there would also be significant costs associated with rebuilding significant parts of I-5 in the portal areas so that the tunnel could resurface, and annual operations and maintenance costs for a tunnel of this length (5,700 feet) would exceed \$2 million (as estimated in 2006), which would be significantly more than for a major bridge crossing.
- **Environmental Impacts:** Other river crossing options would avoid some of the more severe environmental impacts associated with the supplemental tunnel construction. Development of tunnel designs revealed unique and potentially severe impacts to aquatic habitat, archaeological and other historic resources, in addition to commercial property impacts adjacent to the portal areas on Hayden Island and downtown Vancouver.

Seismic Retrofitting the Existing Bridge

As noted in Table 1, the supplemental tunnel received a score of “unknown” under Question 6 of the Step A Screening due to uncertainty over whether the existing bridge spans could be seismically upgraded. Subsequent evaluations have since determined that seismic retrofits would be prohibitively expensive and would incur additional impacts to the environment (due to the need for expansion in the Columbia River). In addition, seismic retrofits may not be sufficient to reliably ensure that the bridge could handle a 500-year earthquake (with little to no damage) or a 2,500-year earthquake (with no collapse). Therefore, any alternative that involves the seismic retrofitting of the existing bridge does not meet the program’s Purpose and Need statement.

3. RECENT ASSESSMENT OF AN IMMERSSED TUBE TUNNEL

In response to recent comments from individuals urging consideration of an immersed tube tunnel (ITT) as a potential design/construction solution, the IBR program assembled a group of engineers with international experience in tunnel design and construction to provide a comprehensive conceptual review of the suitability of an ITT (IBR program 2021a, 2021b). The group evaluated what it would take to accomplish an ITT and provided a summary of the considerations that would have to be weighed with such a design solution.

Two alignments, one upstream and one downstream of the existing Interstate Bridge, were investigated from multiple perspectives, including design, construction, operations, environmental, and cost considerations. The study’s intention was to determine the feasibility of an ITT as a bridge replacement alternative within the

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limitations of the program area. The report was a good faith effort to evaluate an ITT option in the best possible light given the constraints and requirements of the program.

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 existing connections such as SR 14, Vancouver City Center, and Hayden Island; safety concerns for bicyclists and pedestrians; and significant archaeological, cultural, and environmental impacts. The minimum tunnel depth needed to accommodate shipping needs in the Columbia River combined with grade and safety considerations would create a situation where the “entrances/exits” of a tunnel would have to bypass much of downtown Vancouver and parts of North Portland – resulting in real transportation and equity challenges for the residents and businesses in the project area. Additionally, cost estimates for the ITT would be approximately two times higher than 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.

4. CONCLUSION

As described in this memorandum, the supplemental and replacement tunnels were found to not meet the Purpose and Need statement. The recent technical assessment of an ITT demonstrated that it is also not a viable replacement option for the IBR program. Therefore, the tunnel options do not warrant further consideration under the IBR program and no further analysis will be conducted.

5. REFERENCES

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