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Memorandum

To: Calvin Chow, Seattle City Council Central Staff

From: Jane Li & Jimmy Chen, RHC Engineering

Date: November 6, 2020

Re: West Seattle Bridge Cost Benefit Analysis

Dear Calvin,

RHC Engineering reviewed the cost benefit analysis (CBA) developed by the Seattle Department of Transportation (SDOT) for traffic recovery from the West Seattle Bridge emergency closure since March 2020. The CBA identified five alternatives for restoring traffic, and assessed the performance and cost for each alternative. Alternatives 2 (repair) and 4 (superstructure replacement) stand out with overall high scores in the CBA assessment. Below is a summary of our technical comments on the CBA, and the rapid construction idea, which was recently presented at the Community Task Force Meeting held on October 21, 2020.

In general, RHC Engineering believes that additional engineering analysis could be undertaken to better capture the existing bridge behavior and quantify the risks and benefits related to Alternative 2. The CBA attempts to compare all alternatives using a consistent approach to risk and contingencies, this approach may mischaracterize the costs and benefits of Alternative 2. Unlike Alternative 4 that relies on a planning level concept, there is significant existing information, including original construction drawings, bridge inspection and health monitoring data, load rating and seismic evaluation, and the stabilization work, to support a refined engineering analysis for Alternative 2.

Further analysis has the potential to address risk factors associated with repair, which could affect the cost and performance assessment of Alternative 2, when compared to Alternative 4. As an example of this clarification of risk, SDOT has progressively found that the bridge is technically repairable, and the bridge foundation is solid under a design earthquake event.

We also note that the CBA comparison has some inconsistencies in the assessment of total lifecycle and what future project elements should be compared for the next 75 years of the corridor function. For instance, the replacement schedule for Alternative 2, after 40 years, will be a planned event instead of an emergency event, and managing traffic during the replacement is possible instead of closure. At minimum the closure would be during construction only, not during the planning and engineering phases that could take years. In addition to the faster traffic recovery now, the public will still get a newer bridge in the long run after 75 years.

Alternative 4 seems to have more uncertainties, with a completely new engineering design, permit and regulations compliance, demolition and new construction period. This could result in the public facing a more prolonged traffic closure than under a repair scenario.

Based on the above considerations, we would have expected that the performance score for Alternative 2 to be more comparable with or even higher than that for Alternative 4, in terms of constructability, seismic safety, traffic closure, and risks. Additionally, the costs for Alternative 2 associated with risk contingency, maintenance and inspection could be lower. Some examples include:

- The bridge maintenance scores for Alternatives 2 and 4 would be similar since they are both concrete bridges (*Figure 18*).
- The complexity of construction for Alternative 2 would be similar or less than Alternative 4 (*Figure 19*), with the existing bridge supporting construction similar to stabilization work.
- Forward compatibility, for reserving the existing lane configuration and accommodating future light rail, is possible for Alternative 2 and should be assigned “yes” in Figure 23.
- From a 75-year life-cycle point of view, the future replaced Alternative 2 will have a better seismic performance than Alternative 4 (*Figure 38*).
- The life cycle value index of Alternative 2, for zero cost contingencies in Figure 53, could be higher than Alternative 4. The repair option would be a continuation of the stabilization work, and would provide sufficient safety redundancy.

In summary, comparisons of the different alternatives should be based on the same starting point, in addition to the same ending point. For a long span post tension box girder bridge, sufficient engineering analysis on the material stress level is necessary to predict the bridge behavior.

With regards to the rapid construction approach recently presented at the Community Task Force Meeting, RHC believes that the option should be evaluated on a similar level as the other replacement alternatives. In the evaluation, we recommend that the following concerns be addressed:

- The existing pier columns may need to be cut short in order to fit the arch superstructure, which will then increase the seismic load demands to the entire main span structure and foundations.
- The span-to-width ratio, which seems very different from the example bridge, should be considered for the tied arch bridge for forward compatibility.
- A tied arch is a fractural critical structure. If the arch fails, the bridge will collapse.
- Inspection and painting of the tied arch system could increase maintenance challenge and cost.