

# Earthquake Ready Burnside Bridge Feasibility Study Report

Portland, OR  
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# Earthquake Ready Burnside Bridge Feasibility Study Report

## EARTHQUAKE READY BURNSIDE BRIDGE FEASIBILITY STUDY REPORT

*Prepared for*

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**Department of Community Services**  
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*The information presented here, and the public and agency input received, may be adopted or incorporated by reference into a future environmental review process to meet the requirements of the National Environmental Policy Act.*

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## ACRONYMS

ADA	Americans with Disabilities Act
CSZ	Cascadia Subduction Zone
EB	Eastbound
EQRB	Earthquake Ready Burnside Bridge
NEPA	National Environmental Policy Act
ODOT	Oregon Department of Transportation
PG	Policy Group
Project	Earthquake Ready Burnside Bridge Project
SASG	Senior Agency Staff Group
SRG	Stakeholder Representative Group
WB	Westbound



# Earthquake Ready Burnside Bridge

## Feasibility Study Report

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## 1. EXECUTIVE SUMMARY

In 2015, Multnomah County’s Willamette River Bridges Capital Improvement Plan prioritized a Burnside Street river crossing that can withstand a major earthquake. To address this need, Multnomah County is conducting the Earthquake Ready Burnside Bridge (EQRB) project to provide the community with a reliable Willamette River crossing on the Burnside regional lifeline route.

**Figure 1** below shows the schedule and phases necessary to complete this project.

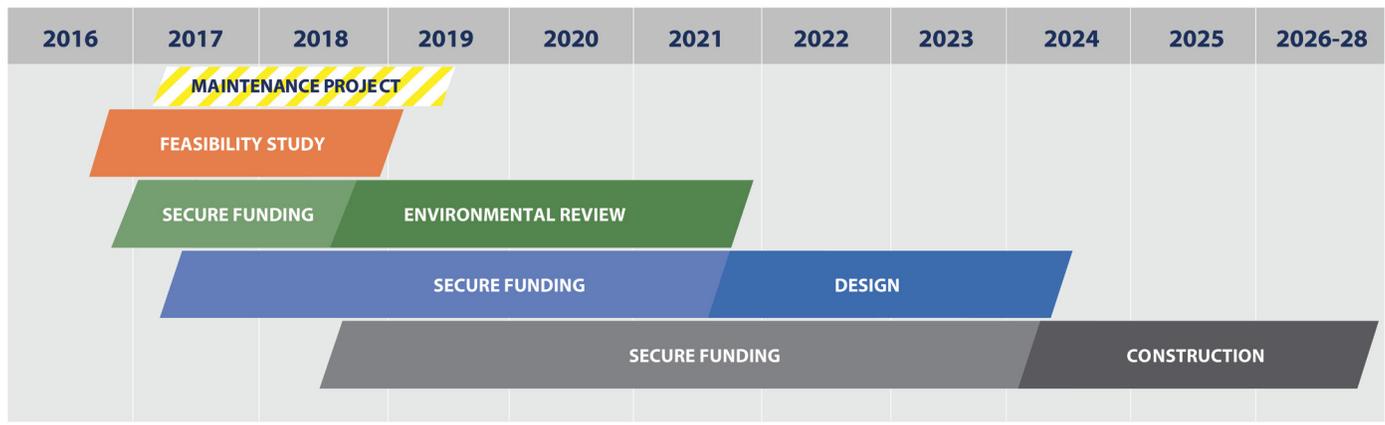


Figure 1: Project Schedule

The Feasibility Study phase began in fall 2016 and was completed in winter 2018. As part of the study, the Draft Feasibility Study Report was available to the public and project stakeholders during the month of September 2018 for review and comment at in-person and on-line open houses and on the project website. The Feasibility Study was completed in November 2018 after public and agency comments were received and the draft purpose and need and range of alternatives were adopted by the Multnomah County Board of Commissioners (**Appendix F**) for further study in the Environmental Review phase of the project.

### Project Background

Oregon is located in the Cascadia Subduction Zone (CSZ), making it subject to some of the world’s most powerful, recurring earthquakes. That is why Multnomah County is conducting the Earthquake Ready Burnside Bridge (EQRB) Project to provide the community with a reliable Willamette River crossing on the Burnside regional lifeline route after a major earthquake. During the Feasibility Study phase, the project team analyzed more than 100 Willamette River crossing options that resulted in four options being recommended for further evaluation in the Environmental Review phase. This report documents the alternatives development, screening process, screening results, and community and agency engagement process of the Feasibility Study phase.

The Feasibility Study included four major phases, as shown on **Figure 2**.



Figure 2: Project Milestones

## 1.1. PROJECT INITIATION AND DEVELOPMENT

During this phase, the project team worked with community and agency stakeholders to develop the project objectives and problem statement, as well as build project awareness through early engagement, which included shaping project key messages and identifying stakeholder interests.

## 1.2. PRELIMINARY ALTERNATIVES DEVELOPMENT

The following four steps were used to develop the alternatives list:

### Step 1: Define the Alternative Groupings

The project team developed a comprehensive set of bundled alternatives, called alternative groupings, as follows:

1. **Preservation Alternatives** – this alternative grouping would implement standard preservation and maintenance to the existing bridge but would not involve seismic retrofit work.
2. **Seismic Retrofit Alternatives** – this alternative grouping would retrofit the existing bridge to make it seismically resilient.
3. **Replacement Alternatives** – this alternative grouping would replace the existing bridge with a new bridge or tunnel.
4. **Enhanced Seismic Retrofit Alternatives** – this alternative grouping would replace some sections of the existing bridge and retrofit all others.
5. **Enhance Another Bridge Alternatives** – this alternative grouping would replace and/or designate a different bridge (other than the Burnside Bridge), where traffic would be rerouted after a major earthquake.

### Step 2: Identify Potential Crossing Alternatives

For each alternative grouping, the project team developed a list of potential crossing alternatives. For example, the “Replacement Alternatives” grouping consisted of “low movable bridge,” “high fixed bridge,” and “tunnel” options, while the “Enhanced Seismic Retrofit Alternatives” grouping considered various proportions of bridge retrofit versus replacement. For each potential crossing alternative, the following question was asked to establish a crossing profile:

- What is the alternative’s clearance height over or under the Willamette River?

### Step 3: Refine and Expand the Crossing Alternatives List

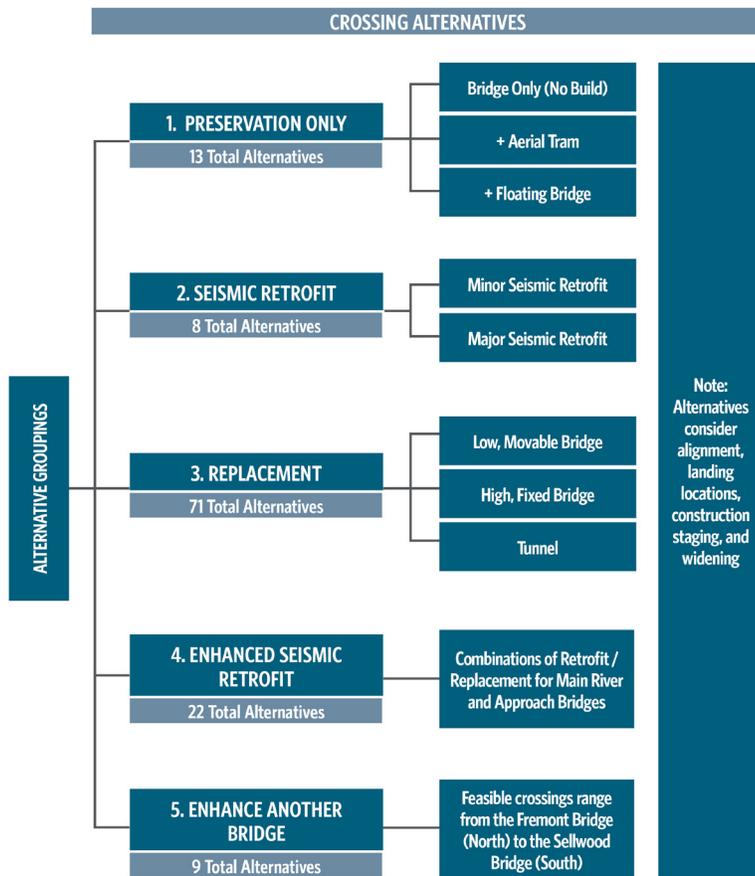
For each crossing alternative, the following questions were considered that led to an expanded suite of design options. These questions were as follows:

- Where does the bridge cross the Willamette River?
- How many bridges should there be?
- How should the roadway alignment be set?
- What overall bridge widths should be considered?

### Step 4: Consider the Construction Method

For each crossing alternative, multiple construction methods were considered. These can generally be summarized as those that maintained traffic on site during construction versus those that detour traffic to another adjacent bridge during construction.

**Figure 3**, on the following page illustrates the alternative groupings and subsequent crossing alternatives considered during the Feasibility Study phase.



**Alternative groupings:** Five major crossing types.

**Crossing alternatives:** Specific river crossing alternatives within each grouping.

Figure 3: Alternative Groups and Crossing Alternatives

### 1.3. ALTERNATIVES SCREENING PROCESS

The alternatives screening process was conducted in three steps. Each step involved developing screening criteria and then applying them to the alternatives to eliminate unreasonable alternatives. Screening criteria were developed based on the project’s problem statement, stakeholder interests, and technical considerations. This included input from stakeholder interviews and project committees, which are comprised of representatives from multiple local, state, and federal agencies, neighborhoods, business and citizen groups, special interest groups and social service providers, and on-line events.

The ratings were informed through analysis based on aerial photos, plans and policies, existing data, maps, stakeholder input, and ArcGIS. The results were presented to the project committees for feedback and were shared publicly through on-line events and in-person open houses.

## 1.4. SCREENING RESULTS

The three-step screening process, including analysis and stakeholder input, led to the recommendation to advance the following bridge alternatives for further study in the Environmental Review phase.

### Enhanced Seismic Retrofit

This alternative involves an upgrade of the existing bridge to meet current seismic standards. Because a retrofit over the I-5 corridor and railroad tracks is not feasible because of long-term closures of those facilities during construction, that portion of the bridge would be replaced.



### Replacement: Fixed Bridge

This alternative involves a new fixed bridge with a maximum clearance of 97 feet, at approximately the same location as the current bridge. The new bridge would not open but is tall enough to allow ships to pass without halting traffic. The west landing touches down about three blocks further west than the current bridge, near NW 5th Avenue.





# Earthquake Ready Burnside Bridge

## Feasibility Study Report

### Replacement: Movable Bridge

This alternative involves a new movable bridge at approximately the same height and location as the current bridge.



### Replacement: Movable Bridge – NE Connection

This alternative involves a new movable bridge at approximately the same height as the current bridge. The east landing splits and connects to NE Couch Street. Westbound (WB) traffic enters from NE Couch Street.



## 1.5. COST ESTIMATES

**Figure 4** contains the preliminary cost estimates for each of the four recommended alternatives. The dark blue columns represent the project cost if traffic were detoured to another site during construction, and the light grey columns represent the project cost if the alternative maintained traffic at the site during construction.

### Total Preliminary Project Costs (\$M)

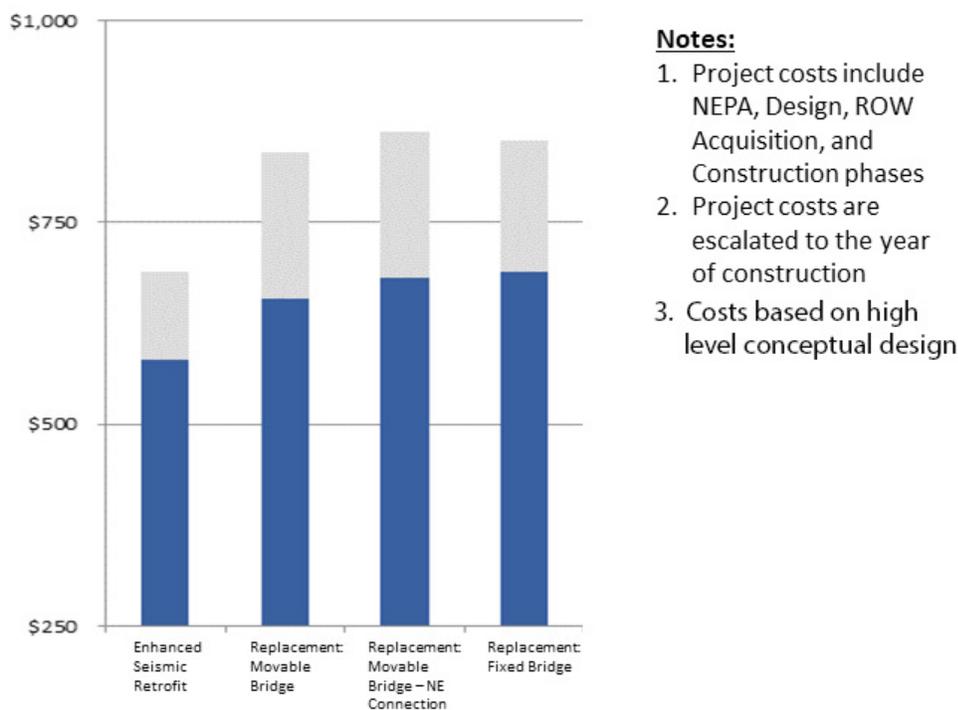


Figure 4: Preliminary Capital Costs

## 1.6. NEXT STEPS

The next phase of the project is the environmental review process. During this phase, the County will work with the public, regulatory agencies, special interest groups and other project stakeholders to further refine the recommended options and evaluate how they affect the environment and the community. This process will result in selecting a preferred option to advance into subsequent phases.

## 2. PROJECT APPROACH

Multnomah County is conducting the Earthquake Ready Burnside Bridge (EQRB) Project to provide the community with a reliable Willamette River crossing on the Burnside regional lifeline route after a major earthquake.

Figure 5 below shows the schedule and phases necessary to complete this project.



Figure 5: Project Schedule

The Feasibility Study phase began in fall 2016 and was completed in winter 2018. During the Feasibility Study phase, the project team analyzed more than 100 Willamette River crossing options that resulted in four options being recommended for further evaluation in the Environmental Review phase. This report documents the alternatives development, screening process, screening results, and community and agency engagement process of the Feasibility Study phase.

### 2.1. BACKGROUND

Oregon is located in the Cascadia Subduction Zone (CSZ), making it subject to some of the world’s most powerful, recurring earthquakes. Studies show the most recent CSZ earthquake occurred just over 300 years ago, and there is a significant risk that the next major earthquake will occur within the lifetimes of the majority of Oregon residents.<sup>1</sup> The best available science warns that, given current conditions, the next major CSZ event is expected to result in thousands of deaths, widespread damage to the region’s critical infrastructure, and long-term adverse social and economic impacts.<sup>2</sup>

<sup>1</sup> United States Geological Survey Professional Paper 1661-F: Earthquake Hazards of the Pacific Northwest Coastal and Marine Regions, Robert Kayen, Editor. Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone. 2012. Chris Goldfinger, et. al. [https://pubs.usgs.gov/pp/pp1661f/pp1661f\\_text.pdf](https://pubs.usgs.gov/pp/pp1661f/pp1661f_text.pdf)

<sup>2</sup> The Oregon Resilience Plan. Report to the 77th Legislative Assembly. 2013 [https://www.oregon.gov/oem/Documents/Oregon\\_Resilience\\_Plan\\_Final.pdf](https://www.oregon.gov/oem/Documents/Oregon_Resilience_Plan_Final.pdf)

The effects of the next CSZ earthquake can be reduced through preparation, including creating seismically-resilient transportation “lifeline routes,” which, particularly, provide access to critical facilities in urban areas. Such lifeline routes will facilitate post-earthquake emergency response, rescue, and evacuation, as well as enable post-disaster regional recovery and help prevent permanent population loss and long-term economic decline.

In 1996, a regional emergency management group, comprised of cities, counties, Metro, and the American Red Cross, designated the Burnside corridor as a “Primary East-West Emergency Transportation Route,”<sup>3</sup> a designation reflected today in regional plans.<sup>4</sup> Among the reasons it was selected as a lifeline route is that Burnside Street extends 17 miles from Washington County to Gresham and has very few overpasses vulnerable to collapse, a significant advantage for a lifeline transportation route following a major earthquake. The Burnside Bridge provides a key link in the Burnside corridor, connecting two sides of the region across the Willamette River. Although the Burnside Bridge carries approximately 40,000 vehicles and over 2,000 bikes and pedestrians per day, it is unable to live up to its designation as a lifeline route. Built in 1926, the Burnside Bridge is an aging structure requiring increasingly more frequent and significant repairs and maintenance. Like the other aging county and state bridges over the Willamette River, the Burnside Bridge is not expected to be immediately functional following the next CSZ earthquake.

The post-earthquake community costs when infrastructure fails are substantially more expensive compared to proactively investing in seismically-resilient infrastructure.<sup>5</sup> Even so, there aren’t enough investment funds to make every bridge earthquake resilient. The Oregon Highways Seismic Plus Report (Oregon Department of Transportation [ODOT] 2014) indicates the state owned Willamette River crossings are not the first priorities for the state system, in part because of the high cost to replace or retrofit multiple vulnerable structures. Creating a regionally continuous, seismically-resilient Willamette River crossing within the state highway system would require retrofitting or replacing at least one large state-owned bridge, as well as multiple overpasses and viaducts.<sup>6</sup> By comparison, the Burnside Bridge is the only structure that would need to be upgraded to create a seismically-resilient Willamette River crossing for the regional Burnside Street lifeline route.

The importance of having a seismically-resilient lifeline route across the Willamette River is why Multnomah County has proposed to make the Burnside Bridge earthquake ready.

## 2.2. PROJECT OBJECTIVES

The primary purpose of this project is to create a seismically-resilient Burnside Street lifeline crossing of the Willamette River that will remain fully operational and accessible for vehicles and other modes of

3 *Regional Emergency Transportation Routes, Portland Metropolitan Region. Metro Regional Emergency Transportation Routes Task Force. 1996* <https://multco.us/file/64350/download>

4 *Oregon Highways Seismic Plus Report* [https://www.oregon.gov/ODOT/HWY/BRIDGE/docs/2014\\_Seismic\\_Plus\\_Report.pdf](https://www.oregon.gov/ODOT/HWY/BRIDGE/docs/2014_Seismic_Plus_Report.pdf)

5 *National Highway Research Collaborative Program Report 777; Chang, 2000. Transportation Performance, Disaster Vulnerability, and Long-Term Effects of Earthquakes;* <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.25.381>

6 *Madhusudan & Ganapathy, 2011. Disaster resilience of transportation infrastructure and ports – An overview* <http://www.ipublishing.co.in/jggsvol-1no12010/voltwo/EJGGS3037.pdf>

transportation immediately following a major CSZ earthquake. This will support the region’s ability to provide rapid and reliable emergency response, rescue, and evacuation after a major earthquake, as well as enable post-disaster economic recovery. In addition to ensuring that the crossing is seismically resilient, the purpose is also to provide long-term, low-maintenance, and safe transportation for all users.

The EQRB Project intends to address the following needs:

- **A seismically-resilient river crossing and lifeline route** - There is a significant risk that the next major CSZ earthquake will occur soon. None of the Willamette River bridges in downtown Portland are expected to be functional immediately after a CSZ earthquake, either because of bridge damage, loss of approaches, or both.
- **Post-earthquake emergency response** - Without at least one seismically-resilient bridge and approaches, there will be no crossing available in downtown Portland for emergency response, rescue, or evacuation immediately following a CSZ earthquake.
- **Post-earthquake recovery** - The lack of seismically-resilient transportation can adversely affect a region’s population and economy for many years after a major earthquake.
- **Emergency transportation routes and seismic resiliency as stated in plan and policy directives** - Local plans and policies designate and rely on Burnside Street as a lifeline and emergency transportation and evacuation route.
- **Long-term, multimodal travel across the river** - The Burnside Bridge currently carries approximately 40,000 vehicles and over 2,000 bicyclists and pedestrians per day. It carries multiple bus routes and is planned to carry a future streetcar line.

A problem statement (**Appendix A**) was created to help convey the project need. It was written to provide a basis for the purpose and need statement (**Appendix A**) required in the Environmental Review phase of the project.

### 2.3. PUBLIC ENGAGEMENT

Informing and engaging the community and gaining its input is not only a Multnomah County value but is essential to the success of the EQRB Project. As part of the Feasibility Study, it was critical to obtain feedback and insight from local, regional, and state agencies, as well as the local community, to inform the study and process.

The project team implemented a broad stakeholder engagement process to inform the community about the project and solicit their input. Key elements of the



Figure 6: Public Engagement Matrix

stakeholder engagement plan included stakeholder committees, interviews, briefings and presentations, stakeholder workshops, booth tabling, online surveys and briefings, project videos and simulation, and a project website. The project team relied heavily on individual and small group interviews and briefings as the most responsive method for engaging key stakeholders. The project team established a website ([www.BurnsideBridge.org](http://www.BurnsideBridge.org)) to disseminate information to the public and used email and social media to publicize meetings and project news. The media also showed much interest in the project, providing wide spread information to their audiences every several months.

### 2.3.1. Desired Objectives

At the onset of the Feasibility Study, the project team developed a stakeholder engagement plan that outlined a strategic approach for stakeholder education and involvement. This plan provided the specific tools and timelines to address the following outreach goals:

- Communicate complete, timely, accurate, and understandable information to the public
- Educate and solicit input about the study process, considerations, and recommendations in a clear, responsive, and transparent way
- Build community relationships
- Provide meaningful, relevant public involvement opportunities and demonstrate how input has influenced the process
- Seek participation of all potentially affected and/or interested individuals, communities, and organizations
- Implement an equity and diversity outreach strategy intended to engage historically marginalized populations and bring their voices to the project

#### Equity and Diversity Outreach

- The equity and diversity outreach plan was woven into the overall public involvement process. Key activities included the following:
  - » Performed stakeholder interviews and briefings with organizations that serve historically marginalized Portland communities
  - » Engaged environmental justice-related organizations to participate on and represent their community's views on the Stakeholder Representative Group (SRG) committee
  - » Hosted a Social Services Workshop
- Multnomah County will rely on stakeholder input and lessons learned from the Feasibility Study phase of the project to inform the development of the equity and diversity outreach strategy for the project's Environmental Review phase.

## 2.3.2. Stakeholder Committees

The project included three committees with members reflecting a wide range of interests and perspectives. These committees provided critical feedback and insight to the project team throughout the Feasibility Study process. Committees met during key project milestones (**Figure 7**). The Senior Agency Staff Group (SASG) and the SRG met five times; the Policy Group (PG) met four times.

*(For the last meeting of the SRG, the group was re-chartered to expand and diversify membership. The reassembled group is called the Community Task Force and will continue to serve throughout the Environmental Review phase of the project.)*



Figure 7: Stakeholder Committees Timeline

Committee participants, along with the organizations they represent, are provided below.

### Senior Agency Staff Group

The SASG was assembled to review the Feasibility Study process and provide informed feedback on the Feasibility Study findings. SASG members consisted of senior-level agency and elected official staff that provided their agency perspectives and individual technical insights in advising the project team through the process of narrowing a comprehensive list of Willamette River crossing concepts to a short list of feasible options to be evaluated in the National Environmental Policy Act (NEPA) phase of the project. SASG members acted as liaisons between the project and their agency by sharing project information with relevant agency staff. Members represented the following agencies and elected officials:

SENIOR AGENCY STAFF GROUP	
City of Beaverton	Oregon State Representative Barbara Smith Warner
City of Gresham	Oregon State Senator Kathleen Taylor
City of Portland	Port of Portland
Clackamas County	Portland Streetcar
Federal Highway Administration (Oregon)	Prosper Portland
Metro	TriMet
Multnomah County	Washington County
ODOT (Region 1)	

### Stakeholder Representative Group

SRG members provided their organization’s perspective in advising the project team through the process of narrowing a comprehensive list of Willamette River crossing concepts to a short list of feasible options to be evaluated in the NEPA phase of the project. SRG members acted as liaisons between the project and their organizations by sharing project information with other staff in their organizations. Members of the SRG communicated the perspectives of the following community organizations, businesses, and interest groups:

STAKEHOLDER REPRESENTATIVE GROUP	
American Automobile Association Oregon	Oregon Trucking Association
Buckman Community Association	Portland Business Alliance
Burnside Skatepark	Portland Spirit
Central City Concern	Portland Saturday Market
Central Eastside Industrial Council	Sharon Wood Wortman (author of Bridge Stories)
Multnomah County Bike/Pedestrian Advisory Committee	The Street Trust (formerly Bicycle Transportation Alliance)
Neighborhood Emergency Teams	University of Oregon School of Architecture student
Old Town Community Association	Willamette Riverkeeper

### Policy Group

The PG was an executive-level agency and elected official partnership assembled to review Feasibility Study findings. PG members provided their agency’s or constituent’s perspectives in advising the project team through development of options and evaluation criteria. Members were invaluable in reviewing the Feasibility Study process and results to align with their jurisdiction’s mission, identifying linkages with regional plans, and developing long-term, productive partnerships that will endure throughout the entire planning, design and construction process. Members of the PG represented the following agencies and elected representatives:

POLICY GROUP	
City of Beaverton	Oregon State Senator Kathleen Taylor
City of Gresham	Prosper Portland (formerly Portland Development Commission)
City of Portland	TriMet
Clackamas County	U.S. Representative Earl Blumenauer’s office
Federal Highway Administration (Oregon)	U.S. Representative Suzanne Bonamici’s office
Metro	U.S. Senator Jeff Merkley’s office
Multnomah County	U.S. Senator Ron Wyden’s office
ODOT (Region 1)	Washington County
Oregon State Representative Barbara Smith Warner	

### 2.3.3. Engagement Activities

The project team tailored its approach with a variety of activities that allowed the public to engage in different ways. Opportunities ranged from receiving email updates to face-to-face project briefings to share valuable input. The project team sought to provide multiple avenues for engagement to allow a wide range of stakeholders to be involved. The engagement tools used and activities completed during the project are listed on the following pages.



#### Interviews: 14 initial stakeholder interviews

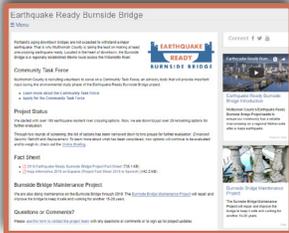
The project team kicked off outreach efforts with initial stakeholder interviews to help understand potential community issues and opportunities with the project. The interviews also provided feedback on effective ways to keep stakeholders engaged and informed, as well as input on initial project key messages. Project team members met with 14 community organizations and Multnomah County departments representing various interest areas including:

- American Automobile Association Oregon
- American Medical Response
- The Street Trust (formerly Bicycle Transportation Alliance)
- Central City Concern
- Central Eastside Industrial Council
- JOIN
- Louis Dreyfus Company
- Old Town Community Association
- Oregon Trucking Association
- Multnomah County Bicycle and Pedestrian Citizen Advisory Committee
- Multnomah County Health Department
- Multnomah County Office of Diversity and Equity
- Multnomah County Office of Emergency Management
- Multnomah County Office of Sustainability

#### Factsheets: Shared at over 49 activities and events

A factsheet with project information was developed for use in engagement activities. The project team provided updates to the fact sheet as the study progressed. Factsheets provided information about the study process and ways to share input, including project purpose, need, study process, and timeline, as well as ways to contact the project team or submit a comment.





### Website: 9,035 unique pages views

Multnomah County secured the web address [www.BurnsideBridge.org](http://www.BurnsideBridge.org) to make it easy for the public to find the project online. The project website was the public's one-stop shop for finding project information, including videos, past and upcoming committee meetings and materials, project factsheets, frequently asked questions, and opportunities to provide input and contact the team.



### Videos: 7 project videos, 4,560 views

At the beginning of the Feasibility Study, five videos were developed as a tool to broaden awareness and educate the public about the project. The five videos provided a general overview of the project and focused on topics such as emergency preparedness, CSZ earthquakes, and the Burnside lifeline route. The videos are available on the project website and were publicized through emails, social media, project meetings, and briefings. Two additional videos were developed to publicize the Draft Feasibility Study Report findings and share opportunities for input.



### Earthquake Simulation: 79,000 views, seen in 96 countries

The project team developed a video simulation of what could happen to the Burnside Bridge during a Magnitude 8+ CSZ earthquake. Like the other project videos, this simulation was shared on the project website and via email, social media, and project meetings and briefings. Additionally, this video was aired by numerous news sources, including KGW, KPTV, KATU, KPIC Roseburg, KVAL Eugene, and Reddit. The video drew large attention from not only local and regional communities but was viewed internationally in 96 different countries, as well. The 79,000 views do not include several thousands of views seen on news media websites and broadcasts.



### Online Survey #1: 170 responses

The project team made an online survey available between July 15 and August 21, 2017, to gather input on the public's priorities, concerns, and questions about the project. It was promoted online through Multnomah County's Facebook and Twitter pages, as well as by email to 340 stakeholders on the project's interested parties list. The survey presented a brief project summary, including the project overview video, followed by four open-ended questions and a set of questions pertaining to respondents' project communication preferences, use of the bridge, and demographics. The survey received 170 responses.



### **Briefings and Presentations: 42 briefings and presentations with key stakeholders**

Project team members proactively engaged key stakeholders by reaching out and offering project briefings and presentations to community and government organizations. By visiting the venues of existing organizations, the project team expanded the depth of its community outreach. Opportunities to request a project briefing were communicated on project information materials, including fact sheets and the website. The project team collected feedback from these events to inform the study. Through these efforts, the project team met with 35 community, agency, and educational organizations; some, multiple times (see list below). These organizations represent a wide range of interests and views.

- Kerns Neighborhood Association
- Buckman Community Association
- Multnomah County Bike and Pedestrian Committee
- Night Strike
- Voz
- Mercy Corps
- Burnside Skatepark
- Multnomah County Disability Services Advisory Council
- Portland Historic Landmarks Commission
- Central City Concern
- Portland Business Alliance
- Portland Rescue Mission
- Old Town Community Association
- Federal Highway Administration
- ODOT
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- Port of Portland
- Oregon Senator Jeff Merkley's Office
- Regional Disaster Preparedness Organization Steering Committee
- Portland Bureau of Transportation
- Oregon Representative Barbara Smith Warner
- City of Gresham
- Multnomah County Board of Commissioners
- Metro Joint Policy Advisory Committee on Transportation
- Metro Transportation Policy Alternatives Committee
- Multnomah County Health Department
- Portland Bureau of Development Services
- East Multnomah County Transportation Committee
- University of Portland
- Professional Engineers of Oregon
- Central Eastside Industrial Council
- Portland Design Commission
- Regional Public Information Officers
- American Society of Civil Engineers Oregon Chapter



### **Booth Tabling – American Red Cross/KGW Prepare Out Loud**

In September 2017, television station KGW launched its “Keeping You Safe” campaign to educate the public about emergency preparedness. As part of the September-long campaign, KGW teamed up with the American Red Cross to co-sponsor three Prepare Out Loud preparedness forums on September 26, 27, and 28, 2017. Given the project’s key objective of creating a resilient Burnside Bridge in the face of a major earthquake, the event provided an opportunity to spread awareness and encourage feedback. Staffed by project team members, booths were hosted at all three events and premiered a large-screen earthquake simulation video, a laptop so people could participate in the online survey and learn about how the CSZ earthquake would compare to other large scale earthquakes in Japan and Chile. Project factsheets, comment cards, and opportunity to sign up for project emails were available for booth participants. Twenty people registered to receive project emails.



### **Booth Tabling – Portland Saturday Market**

In an effort to spread project awareness, the project team hosted a booth on December 21, 2017 at the Portland Saturday Market. The booth provided fact sheets and comment cards, as well as an opportunity for the community to talk to project team members, ask questions, share feedback, and sign up for project emails.



### **Online Briefing and Survey #2: 1,800 views, 65 responses**

Multnomah County launched an online briefing in spring 2018 to provide the public with a project update and initial screening results of the Feasibility Study. The online briefing included a survey to gather input on what else Multnomah County should consider as options were further evaluated. The project team publicized the online briefing and survey through a media release and stakeholder email blast. It was also promoted on Multnomah County’s Facebook and Twitter accounts. The online briefing received about 1,800 views and 65 responses between March 12, 2018, and April 27, 2018.



### **Emergency Management Workshop: 10 participating agencies**

To obtain feedback from local and regional emergency management professionals, the project team coordinated and facilitated an emergency management workshop. Representatives from emergency service agencies and organizations were invited to share and discuss existing emergency management plans, learn how the EQRB Project relates to these planning efforts, and discuss opportunities for coordination and further engagement with these efforts. Representatives from 10 different agencies joined the discussion and provided meaningful input.



### **Social Services Workshop: 12 social service provider representatives**

Because of the Burnside Bridge's downtown location and proximity to numerous social service providers and accommodations, the project team engaged social service organizations to learn how the project might impact and support some of the community's most vulnerable populations. On July 31, 2018, the project team facilitated a workshop with 12 representatives of different local social service organizations. The group discussed potential issues and concerns related to the project and opportunities for engaging their organizations and the people they serve.



### **City Club Community Forum: 139 attendees, 132 online views**

On July 27, 2018, the project was featured as part of [City Club's Friday Forum](#) on "Earthquake Preparedness." Multnomah County's EQRB project manager was one of four panelists, and Multnomah County's commissioner and EQRB co-chair moderated the panel discussion. This event provided an opportunity to raise awareness about the importance of a resilient Burnside crossing in the case of a major earthquake. It also elevated the importance of regional planning efforts and agency coordination in helping the region be prepared. The event was attended by 139 people and was live-streamed on the City Club website. A video recording of the forum was made available online following the event and has been viewed 132 times to date. Post card flyers with information about the project, upcoming in-person and online open houses, and project team contact information were set at each place setting prior to the event.



### **Media: 14 media releases**

The project team utilized media releases, email blasts, and social media to broaden awareness about upcoming meetings, online surveys, briefings, open houses, and other opportunities for engagement. Ten media releases were distributed, which helped media coverage around specific activities and events. Stories about the project were picked up and shared through local news channels; over 19 instances were identified.



### **Stakeholder Database: Over 565 contacts**

The project team developed and maintained a stakeholder database throughout the project. This database was used to disseminate project information and event notices and share opportunities for public input and participation. During the Feasibility Study, the project team added more than 565 contacts.



### September 2018 Open Houses: 1,747 people visited the online open house

Multnomah County hosted two in-person open houses and one online open house to gather input from the public on the results of the Feasibility Study and kickoff the Environmental Review phase with the public. The two in-person open houses were held about two weeks apart – one near the west approach of the bridge, and the other near the east approach to attract a broader range of stakeholders. The online open house launched at the beginning of September and lasted through the month, a total of four weeks. 56 people combined attended the in-person open houses, while 1,747 people participated in the online open house. 166 comments were received during this period.

### 2.3.4. Stakeholder Feedback Overview

Feedback received throughout the EQRB Feasibility Study displayed fairly consistent themes across stakeholder groups. While some groups had more specific insight related to their interest areas, there were five distinct themes heard most frequently throughout the in-person and online engagement activities, as listed in Sections 2.4.2 and 2.4.3. Key themes included:

**Resiliency:** Make sure it can withstand a CSZ earthquake.

**Multimodal:** Make sure it addresses the community's interests and future goals for improving multimodal transportation facilities: bike, pedestrian, Americans with Disabilities Act (ADA), transit, and vehicle.

**Preparedness:** Help the community prepare to respond and recover after a major earthquake. Work in a coordinated effort with local and regional partners to improve efficiency in the effort to make the region more resilient.

**Urgency:** Can the project go faster? Many expressed interest in getting a resilient Burnside Bridge built as soon as possible.

**History:** Honor the past, build for the future. While many expressed support for a new bridge, the public still held interest in preserving historic aspects of the bridge.

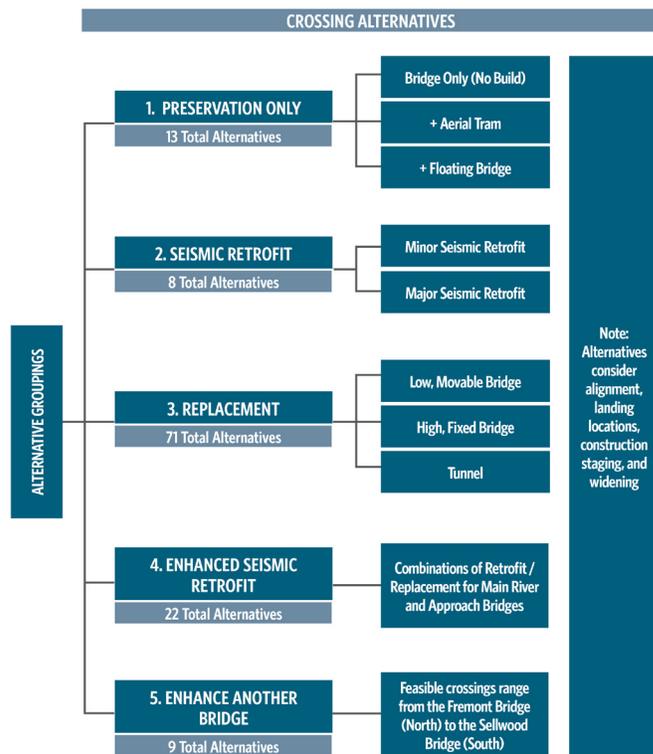
Community engagement supporting documents and feedback received throughout the project can be found in **Appendix B**.

## 3. ALTERNATIVES

### 3.1. GENERAL APPROACH

During the project’s Feasibility Study phase, 123 alternatives were assessed. This comprehensive list was established after considering a wide variety of river crossing types, horizontal roadway alignments, vertical bridge profile grades, bridge types, bridge widths, and construction variations.

**Figure 8** illustrates the list of river crossing alternatives considered during the Feasibility Study, and the complete list is provided in **Appendix C**.



**Alternative groupings:** Five major crossing types.

**Crossing alternatives:** Specific river crossing alternatives within each grouping.

Figure 8: Alternative Groups and Crossing Alternatives

Each of these alternative groupings and crossing alternatives are described in Section 3.3, Alternatives Development. It also describes the systematic procedure that was implemented to determine the wide range of alternatives considered. Following the development process, the alternatives list was provided to the various stakeholder committees for feedback, vetting, and eventual concurrence.

### 3.2. DESIGN CONSTRAINTS

To be considered feasible, each alternative must satisfy the following two foundational design criteria:

1. The alternative avoids prolonged, substantial interruption or degradation of the use or function of other major infrastructure, defined as:
  - TriMet MAX lines on either side of the Willamette River
  - City of Portland roadways (Naito Parkway, Martin Luther King Boulevard, and Grand Avenue)
  - City of Portland combined sewer overflow pipes on either side of the Willamette River
  - ODOT facilities (I-5 freeway mainlines and ramps to/from I-84)
  - Union Pacific Railroad mainline
  - U.S. Coast Guard navigational clearances
2. The alternative satisfies the “fully-operable” performance standard for the project’s seismic design criteria, as follows.
  - The alternative enables reliable and rapid emergency vehicle response following a major earthquake by avoiding crossing routes that possess two or more blockage locations (including seismically-vulnerable bridges or overhead bridges).
  - The alternative accommodates reliable and rapid emergency vehicle response by ensuring that at least 2,000 vehicles per hour can cross the Willamette River immediately following a Magnitude 8+ CSZ earthquake.

### 3.3. ALTERNATIVES DEVELOPMENT

In addition to satisfying the above criteria, the alternatives were conceptually designed with roadway alignments and vertical profiles that meet clearance requirements, pier locations that reasonably minimized impacts on the built environment, and reasonable bridge types and depth that meet industry accepted design parameters. Consideration was also given to utility and right-of-way impacts, environmental impacts, traffic and mobility impacts, and construction methodology during the development of each alternative. The following four steps were applied to develop the alternatives list:

**Step 1: Define the Alternative Groupings.** The project team, in conjunction with stakeholder committees, developed a comprehensive set of alternatives, called alternative groupings, that could result in an earthquake-ready crossing. The 123 alternatives considered are summarized as follows.

- **Preservation Alternatives (13 alternatives)**, would implement standard preservation and maintenance to the existing bridge but no seismic retrofit work. Some of these alternatives would also include an added, non-bridge crossing, such as an aerial tram, water taxis, or temporary floating bridge that could potentially allow at least some vehicles, people, and/or freight to cross the river after a major earthquake.

- **Seismic Retrofit Alternatives (8 alternatives)**, would retrofit the existing bridge to make it seismically resilient. The different alternatives in this group are defined by the option’s level of seismic resiliency and whether the structure was widened (**Appendix D**).
- **Replacement Alternatives (71 alternatives)**, would replace the existing bridge with a new bridge or tunnel. The replacement bridge alternatives include multiple geometric variations, including variations in both vertical and horizontal alignments and maintenance of traffic options (whether staging construction to keep traffic on the bridge or detouring traffic to an adjacent bridge) (**Appendix E**).
- **Enhanced Seismic Retrofit (22 alternatives)**, would replace some sections of the existing bridge and retrofit all else (**Appendix D**).
- **Enhance/Use Another Bridge (9 alternatives)**, would replace and/or designate a different bridge (other than the Burnside Bridge), where traffic would be rerouted after a major earthquake.

**Step 2: Identify Potential Crossing Alternatives.** For each alternative grouping, the project team developed a list of potential crossing alternatives. For example, the “Replacement Alternatives” grouping consisted of “low-movable bridge,” “high-fixed bridge,” and “tunnel” options, while the “Enhanced Seismic Retrofit Alternatives” grouping considered various proportions of bridge retrofit versus replacement. For each potential crossing alternative, the following question was asked to establish a bridge profile:

- **Question: What is the alternative’s clearance height above and below the Willamette River?**

For example, is the clearance unlimited (e.g., a drawbridge type movable bridge) or comparable to the nearby Tilikum Bridge, or is the clearance much higher (e.g., 120 feet) to allow for larger emergency response vessels after a major earthquake? To address these questions, the following vertical clearances were considered:

- » **Low – Movable Bridge Span:** For each of the horizontal alignment alternatives, a low profile is established to maintain the existing closed bascule span clearance, maintain the other transportation mode clearances, and tie in near the existing Burnside Street Bridge limits for existing alignment sections. Grades are limited to a maximum of 5 percent while meeting the other vertical clearance criteria for City of Portland streets, ODOT freeways, Union Pacific Railroad tracks, and TriMet/Streetcar facilities.

- » **High – Fixed Bridge, 97-Foot Clearance:** This profile provides a 97-foot or less clearance over the Willamette River navigation channel for a fixed bridge. This clearance was used because it provides reasonable impacts and costs for a bridge that touches down before reaching the existing transit facilities on either side of the Willamette River (i.e., TriMet MAX lines on NW 5th Avenue/NW 6th Avenue in downtown Portland and the Portland Streetcar on SE Martin Luther King Boulevard/SE Grand Avenue on the east side). Grades are limited to a maximum of 5 percent while meeting the other vertical clearance criteria for City of Portland streets, ODOT freeways, Union Pacific Railroad tracks, and TriMet/Streetcar facilities.
- » **High – Fixed Bridge, 120-Foot Clearance:** This profile provides a 120-foot vertical clearance over the Willamette River navigation channel for a fixed bridge. This clearance was used because it provides reasonable impacts and costs for a bridge that touches down beyond the existing transit facilities on either side of the Willamette River (i.e., TriMet MAX lines on NW 5th Avenue/NW 6th Avenue in downtown Portland and the Portland Streetcar on SE Martin Luther King Boulevard/SE Grand Avenue on the east side). Grades are limited to a maximum of 5 percent while meeting the other vertical clearance criteria for City of Portland streets, ODOT freeways, Union Pacific Railroad tracks, and TriMet/Streetcar facilities.
- » **Tunnel:** A tunnel depth was selected that maintained a reasonable clearance below the large City of Portland Bureau of Environmental Services combined sewer outfall pipes. Grades are limited to a maximum of 5 percent while meeting the other vertical clearance criteria to accommodate the Streetcar within the tunnel.

**Step 3: Refine and Expand the Crossing Alternatives List.** For each crossing alternative, a series of questions were considered that led to an expanded suite of options. These questions were as follows:

– **Question 1: Where does the bridge cross the Willamette River?**

For example, should the crossing be located on the existing Burnside Street alignment or shifted north or south? As part of this analysis, new bridge options entirely off the Burnside alignment (between the existing Morrison and Steel bridges) were considered but deemed unreasonable due to challenges with connecting to the existing street network and significant impacts to the built environment and cultural resources. **Figure 8** illustrates the low profile alternatives. Comparable 97- and 120-foot-high profile alignments were also used and are similar, but the tie-in locations are further out on one or both sides of the Willamette River.

Alignments considered are on the following page.

**Existing Alignment** – As the name implies, this alignment maintains the existing horizontal geometry of Burnside Street. The existing one-way couplet of NE Couch Street for WB traffic and Burnside Street for eastbound (EB) traffic is maintained.



**Northeast Wishbone (or NE Couch Connection)** – The west landing is full width on the existing Burnside Street alignment; the east landing splits into the existing one-way couplet of NE Couch Street (WB) and Burnside Street (EB).



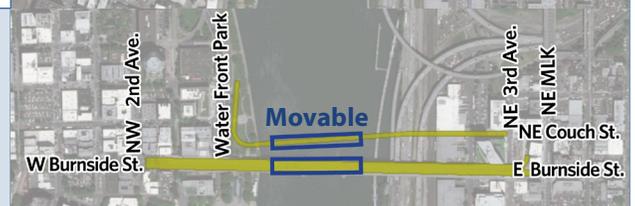
**Southeast Wishbone** – The west landing is full width on the existing Burnside Street alignment; the east landing splits into a one-way couplet with the existing NE Couch Street connection (WB) and the EB lanes diverting to SE Ankeny Street, reconnecting to Burnside Street between SE Grand Avenue and SE 6th Avenue.



**North Parallel Twin Multimodal** – This full couplet alignment carries EB traffic on the existing Burnside Street and carries WB traffic on a new river crossing connecting NE Couch Street to NW Couch Street, tying back into Burnside Street between NW 4th Avenue and NW 5th Avenue.



**North Twin Mode Separated** – Vehicular traffic is carried on the existing Burnside Street alignment while bicycle and pedestrian traffic are carried on a separate structure to the north from an extension of NE Couch Street at NE 3rd Avenue to Waterfront Park.

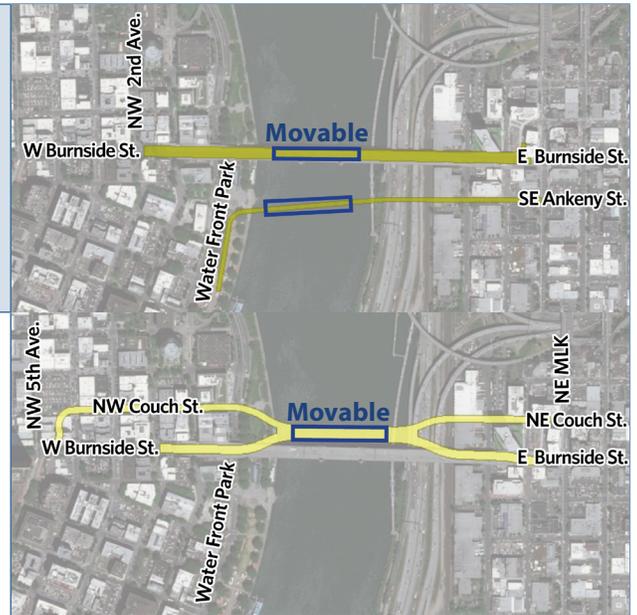


**South Parallel Twin Multimodal** – This full couplet alignment carries WB traffic on the existing Burnside Street alignment utilizing the NE Couch Street couplet connection; the EB alignment diverts south from Burnside Street between NW 5th Avenue and NW 4th Avenue, follows SW Ash Street to Waterfront Park, and moves back to the north to land at SE Ankeny Street, reconnecting to Burnside Street between SE Grand Avenue and SE 6th Avenue.



**South Twin Mode Separated** – Vehicular traffic is carried on the existing Burnside Street alignment while bicycle and pedestrian traffic are carried on a separate structure to the south from Waterfront Park to SE Ankeny Street.

**Low Double Wishbone** – This alignment was evaluated for the low profile only and combines the north parallel twin and wishbone concepts by using the single bridge cross-section over the water and the twin multimodal cross-sections for the Burnside Street-Couch Street couplet.



– **Question 2: Based on the roadway alignment, how many bridges should there be and what overall bridge widths should be considered?**

For example, should the bridge be a wide single bridge similar to the existing Burnside Bridge, or should it be split into narrower twin bridges to possibly conform better to the existing street network? To address these questions, and to establish a consistent and reasonable set of alternative impacts, benefits, and construction costs prior to performing detailed designs, five structural typical sections were developed and applied to each of the alternatives.

The typical sections, described below, do not represent a decision on bridge width, lane configurations, lane allocations, or even structure type. Instead, they serve as a basis of design to compare and contrast the various alternatives. These parameters are expected to change during either the NEPA or Final Design phase.

- » **Single Multimodal Bridges:** This bridge section provides EB and WB lanes for vehicles and sidewalks, as well as bike lanes on each side, for an overall width of 110 feet.
- » **Twin Multimodal Bridges:** This bridge section contains the same traffic features as the single bridge, though some reduced widths, but with EB and WB directions carried on separate structures. For the northern split alignments, the WB width reduces slightly to fit between existing buildings on NE Couch Street.
- » **Twin Mode Separated Bridges:** These alternatives completely separate the bicyclists and pedestrians from the vehicular traffic. The vehicular bridge carries the EB and WB lanes, as in the other sections, and the bicycle/pedestrian bridge has a two-way bike lane in the middle with a sidewalk on each side.

- » **Stacked Mode Separated Bridge:** This bridge section is a variation of the mode separated bridge on the existing alignment developed, for the low profile only, using a double deck vertical lift span and approach spans. The bicycle and pedestrian modes are carried on the lower deck, and the vehicular lanes are carried on the top deck.
- » **Tunnel:** Several tunnel concepts were developed, and the one carried into further evaluation uses the WB lanes stacked over the EB lanes for a 60-foot-diameter section. The bicycle and pedestrian modes are separated using the twin-north mode separated alignment. The evaluated tunnel section alignment is located under the existing Burnside Street.

**Step 4: Consider the Construction Method.** For each crossing alternative, multiple construction methods were considered. These can generally be summarized as those that maintained traffic on site during construction versus those that detour traffic to another adjacent bridge during construction. For each of the bridge replacement alternatives, cost estimates were developed for the two construction methodologies, as discussed below.

- **Traffic Detoured:** For this approach, Burnside Street would be closed to traffic and detours established to route traffic to other river crossings. The contractor would be unencumbered with traffic maintenance concerns over the river and able to focus on demolition of the existing bridge and construction of the new bridge. All other traffic and modes crossed by Burnside Street would have to be maintained and protected, except for short-term closures for construction activities, such as girder erection and deck placement.
- **Staged Construction:** This approach requires a temporary bridge, including temporary movable span (**Figure 10**), to divert traffic around the existing river spans. The existing bascule spans and deck truss spans do not lend themselves to partial demolition while still carrying traffic. The landside approaches would have to accommodate the more conventional approach of partial demolition and partial construction, in stages. The phasing would be complex, particularly where the finished grades are nearly the same. The split alignments would allow for some of the project to be built separate from traffic and may allow for some creative short-term traffic shifts to accommodate tie-ins on the existing alignment. The high profile alternatives may allow for some construction to occur over traffic being maintained below, but the cross-overs for diverting traffic would be pushed out toward the ends.

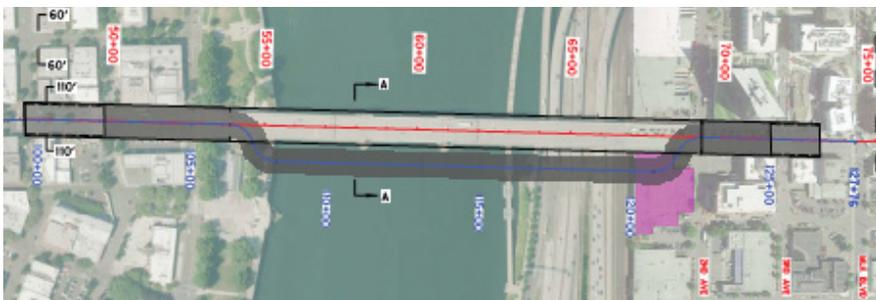


Figure 9: Staged Construction



Figure 10: Temporary Movable Bridge

## 4. PROCESS FOR SCREENING ALTERNATIVES

### 4.1. CRITERIA DEVELOPMENT

The alternatives screening process described in the *Alternatives Screening Technical Memorandum* (**Appendix C**) was conducted in three steps. Each step included developing screening criteria and applying them to the alternatives to eliminate unreasonable alternatives.

Screening criteria were developed based on the project's problem statement, stakeholder interests, and technical considerations. This included input from stakeholder interviews and project committees, which are comprised of representatives from multiple local, state, and federal agencies; neighborhoods; business and citizen groups; special interest groups and social service providers; and on-line events.

The ratings were informed through analysis based on aerial photos, plans and policies, existing data, maps, stakeholder input, and ArcGIS. The results were presented to the project committees for feedback and will be shared publicly through on-line events and in-person open houses.

The following sections provide more detail on each screening step and the results.

### 4.2. SCREENING OF ALTERNATIVES

#### 4.2.1. Screening Step 1: Pass/Fail

The first step in the screening process used pass/fail criteria that reflected the project's core intent. If alternatives could not meet the minimum threshold for one of more of these pass/fail criteria, they failed to advance to Step 2. The following describes each pass/fail criterion and how it was applied in the scoring process.

#### Pass/Fail Criteria

##### Criterion I. Compatibility with other major infrastructure

This criterion eliminated alternatives that caused prolonged, substantial interruption or degradation of the use or function of adjacent, major public infrastructure.

##### Criterion II. Seismically resilient and operational Willamette River crossing

This criterion eliminated alternatives that did not meet the project's definition of being "fully functional" following a CSZ 8+ earthquake.

### Criterion IIIa. Unobstructed Willamette River crossing lifeline route

This criterion eliminated alternative crossing locations (e.g., the Steel Bridge, Hawthorne Bridge, Tilikum Bridge, and others) that would have two or more earthquake-related blockages (on the access route to and from the Burnside lifeline route).

### Criterion IIIb. Rapid emergency response across the Willamette River

This criterion eliminated alternative crossing locations that would add excessive travel time because of distance from the Burnside corridor for emergency vehicles crossing the river and using the Burnside lifeline route.

### Criterion IIIc. Congestion avoidance on a Willamette River crossing

This criterion eliminated crossing alternatives that would have too little post-earthquake capacity to allow reliable and rapid emergency response after a major earthquake.

## Pass /Fail Results

Based on the pass/fail rating process, input from project stakeholders, project committees, and the project team, the following alternatives were recommended for elimination from further consideration:

**Preservation Alternatives:** All failed to meet one or more of the pass/fail criteria.

**Seismic Retrofit Alternatives:** These alternatives failed to pass Criterion I because construction of these alternatives would cause extended (6 months or longer) closures of I-5.

**Enhance Another Bridge Alternatives:** All bridges in this category, except the Morrison Bridge, did not meet the pass/fail criterion.

### 4.2.2. Screening Step 2: Preliminary Scoring

This step included 11 scored criteria organized into five topics. For each criterion, each alternative was assigned a score of 1, 3, or 5, depending on how well it performed. For many criteria, a score of 3 represented average performance or no improvement over existing conditions; a score of 1 typically represented well below average or worse than existing conditions, and a score of 5 typically represented well above average or a substantial improvement over existing conditions.

The first four screening criteria are similar in substance to four of the pass/fail criteria. The difference is that the pass/fail criteria determined whether alternatives could meet a minimum performance threshold, whereas the scoring criteria below evaluate how well the remaining alternatives address these subjects.

## Preliminary Scoring Criteria

### Topic 1: Achieve seismic resiliency

This criterion evaluated the expected seismic resiliency of the crossing.

### Topic 2: Allow reliable and rapid emergency response following a major earthquake

Three criteria evaluated different aspects of how well the crossing alternative accommodates emergency vehicle response and recovery functions, including:

- The extent to which seismic failure of and damage to overpasses and other structures could block emergency vehicle access to each crossing location.
- The extent to which alternative crossing locations would add travel distance/time to emergency response vehicles using the lifeline route.
- The extent to which limited capacity of each crossing would inhibit emergency vehicles crossing the alternative following a major earthquake.

### Topic 3: Serve multimodal needs for Burnside Street after the earthquake

Four criteria, as follows, generally evaluated how well each alternative would serve different modal needs following a major earthquake:

- General ADA mobility on and connections to the crossing
- General aspects of bicycle and pedestrian safety and options for connectivity
- General changes to safety and the options for connectivity to the surrounding street network for autos, buses, and truck freight
- General changes to the quantity (number of openings) and quality (width and height) of the navigational clearances

### Topic 4: Implement relevant seismic and emergency preparation/response plans

This criterion evaluated the extent to which each alternative is consistent or not consistent with relevant state and local transportation resiliency and emergency transportation routes plans and policies.

### Topic 5: Provide long-term functionality, independent of a seismic event

The two criteria that were not related to seismic resiliency were as follows:

- How much maintenance each alternative would require.

- How the alternatives generally affect daily safety, access, and/or connectivity for the following modes: auto, truck freight, bus, bicycle, pedestrian and people with disabilities (ADA).

### Preliminary Scoring Results

Based on the preliminary scoring process, one additional alternative was recommended to be dropped from further consideration:

**Enhance Another Bridge:** Morrison Bridge. The Morrison Bridge option received just 32 percent of the possible points and offers no significant advantages. Therefore, it does not warrant further consideration.

### 4.2.3. Screening Step 3: Alternatives Evaluation

Step 3 further evaluated the ability of the remaining alternatives to meet the project intent, as well as how the alternatives affected key environmental and stakeholder interests. The determination of which environmental impacts and stakeholder interests were evaluated in this step was based primarily on:

- Extent to which it addressed an important issue either from a regulatory perspective, expressed stakeholder perspective, or stated Multnomah County value
- Ability to measure impacts or performance with information available at this stage
- Ability to measure a meaningful difference between alternatives at this stage

### Alternatives Evaluation Criteria

Step 3 included 6 criteria divided into 17 scored measures. For all but one measure, each alternative was assigned a score of 1, 3, or 5 depending on how well it performed. For many measures, a score of 3 represented average or median performance; a score of 1 typically represented substantially worse than average or median, and a score of 5 typically represented notably better than average or median. The exception was the capital cost measure within the financial stewardship criterion. Because of the wide range in capital costs, alternatives were assigned a 1, 2, 3, 4, or 5 on this measure.



### Topic 1: Seismic Resiliency – Support Reliable and Rapid Emergency Response after an Earthquake

This step evaluated seismic resiliency in terms of vulnerability to traffic blockage from adjacent unreinforced masonry buildings and car crashes.



### Topic 2: Non-Motorized Transportation – Support Access and Safety for Bicyclists, Pedestrians and People with Disabilities

This evaluation looked specifically at non-motorized transportation from the following three specific measures of access and safety:

- How does the profile grade affect bicyclists, pedestrians, and people with disabilities' ease of use? This was measured in terms of percent and length of grade.
- How safe and convenient are the bike and pedestrian connections between the bridge and other planned bike and pedestrian facilities? The analysis compared how well the alternative connected to (a) existing bike and pedestrian facilities and (b) planned bike and pedestrian facilities.
- To what extent does the option support personal security for pedestrians and bicyclists? This measured the extent to which the option's design locates pedestrians and bicyclists where they can be easily observed by others. Lower visibility decreases personal safety/security.<sup>7</sup>



### Topic 3: Connectivity – Support Street System Integration and Function (Affects all Modes)

In this step, the evaluation looked specifically at street system integration and function using three specific measured:

- How well does the option connect with the existing and planned street network (for all modes)? It measured the number of streets that would be permanently closed or bypassed.
- Is the crossing roadway safe and convenient? Are the roadway connections to the existing and planned street grid safe and convenient at both ends? It evaluates the extent to which the crossing's grade and curvature potentially affect vehicle safety, the degree to which the option diverts vehicle traffic from an arterial to a non-arterial street, and the extent of non-standard intersection layouts and vehicle movements.
- Will bridge openings cause periodic delay in crossing time? This measure differentiates between bridges that are fixed and those that are movable (lifts cause occasional delay).



<sup>7</sup> This measures general consistency with the CPTED (Crime Prevention Through Environmental Design) principle of "Natural surveillance," which advocates for the placement of physical features, activities and people in such a way as to maximize visibility of the space and its users, fostering positive social interaction and reducing the risk of crime. Security concerns increase with features such as elevators or pedestrian-only underpasses where pedestrians and bicyclists are isolated from view by others.



### Topic 4: Equity – Minimize Adverse Impacts on Historically Marginalized Communities

Equity is a core Multnomah County value and was raised as a concern by multiple stakeholders. Two aspects of equity were measurable at this stage:

- To what extent would the option displace or impact access to existing social services (including overnight shelters)? This criterion evaluated whether social service providers would be displaced and whether any would have their existing access substantially diminished.
- To what extent would the option affect low income housing? This criterion measured the number of existing low income housing units that would be displaced, as well as the number of potential future low income housing units precluded.

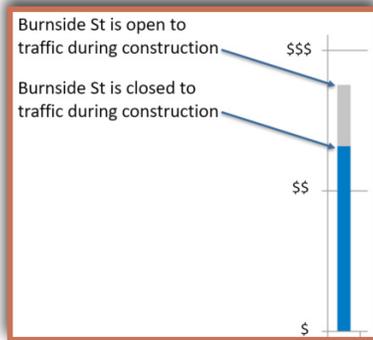


### Topic 5: Built Environment – Promote Land Use Compatibility and Minimize Impacts on Parks and Historic Resources

Available information enabled preliminary evaluation of certain impacts on land use, historic resources, and parks, including:

- To what extent does the option cause direct blockage of view, light, and/or access to buildings?
- How many commercial and industrial properties would be permanently displaced? This was measured by the number of businesses displaced and the number of employees displaced.
- How many units of long-term housing would be permanently displaced?
- To what extent would the option permanently displace park and recreation land? This measure evaluated the amount (area) of parkland permanently displaced and any substantial impacts on park circulation/ access.
- To what extent does the option impact National Register of Historic Places' resources and historic districts?





### Topic 6: Financial Stewardship – Ensure Public Funds are Invested Wisely

Financial stewardship is a Multnomah County value and was evaluated in terms of:

- What is the initial capital cost of the option?
- What are the relative levels of maintenance and operational requirements through the option’s design life?

### Alternatives Evaluation Results

For a summary of each alternative’s scoring results, see Attachment 4 of the *Alternatives Screening Technical Memorandum (Appendix C)*. Within the summary, the rating scores and their rationale are provided. The following alternatives, based on Step 3 analysis and input from project stakeholders, project committees, and the project team, were recommended to be eliminated from further consideration:

**120-Foot-High Fixed Bridges:** These alternatives received less than half the possible points, result in potentially significant impacts on historic districts and have little stakeholder support.

**Tunnel:** This alternative received less than half the points of the best performing alternatives. It posed substantial problems including very high displacement of businesses, employment, long-term housing and low income housing, and high capital cost.

**97-Foot-High Twin Multi-Modal Bridges:** These alternatives received less than half the possible points, result in potentially significant impacts on historic districts and have little stakeholder support.

**97-Foot-High Mode-Separated Bridges:** These two alternatives received about 60 percent or less of the possible points. They scored low on safety and connectivity for bicyclists and pedestrians because they visually isolate them from the view of passing motorists and require a tall spiral ramp to connect them to existing pedestrian/bicycle facilities. They also have higher impacts on historic resources and parks, and lower street network connectivity compared to the recommended alternatives. The bicycle and pedestrian community expressed safety concerns about, and little support for, all of the Mode-Separated Bridge alternatives.

**Low Mode-Separated Bridges:** These two alternatives scored low on safety for bicyclists and pedestrians because of the visual isolation. They also have higher impacts on parks and higher construction costs compared to the recommended alternatives. The narrow width of the motor vehicle bridge also makes this alternative more vulnerable to blockage from disabled vehicles and rubble after an earthquake. The City of Portland indicated that even though these alternatives include a separate bridge for bicyclists and pedestrians,

the project would likely be required to also include bicycle and pedestrian facilities on the motor vehicle bridge, which would add substantial additional cost.

**Double Wishbone Bridge:** This alternative received less than half the possible points and has potentially significant impacts on historic districts.

**97-Foot-High Wishbone Bridges:** These alternatives received only about 60 percent of the possible points. Compared to the Low Wishbone alternatives, they have higher historic resource impacts, lower performance for pedestrians and bicyclists, and lower connectivity for all modes.

**Low Southeast Wishbone Bridge:** This alternative received a relatively high score but decreases transportation safety and connectivity by adding two new 'S' curves on the east side Burnside-Couch couplet and offers no meaningful advantage compared to the similar but better-performing, and lower cost, Low Northeast Wishbone Bridge that is recommended to advance.

**Enhanced Seismic Retrofit – Widened:** This alternative scored moderately well overall but offered no distinct advantage over the Low Movable replacement and cost much more than that option. Further, the long-term maintenance cost scored significantly worse than the replacement options.

**Low Stacked Bridge:** This alternative scored moderately well overall but offers no distinct advantage over the other remaining Low Movable replacement or Enhanced Retrofit alternatives and it scored much lower for bicycle and pedestrian connectivity and for their safety due to visually isolating them beneath the vehicle deck. It also causes greater impacts to social services and historic resources and has a higher cost than the other Low Movable options.

### 4.3. SCREENING RESULTS

The three step screening process, including analysis and stakeholder input, led to the recommendation to advance the following bridge alternatives for further study in the Environmental Review phase.

### 4.3.1. Enhanced Seismic Retrofit

An upgrade of the unwidened existing bridge to meet current seismic standards. Because a retrofit over the I-5 corridor and railroad tracks is not feasible because of long-term closures of those facilities during construction, that portion of the bridge will be replaced.



### 4.3.2. Replacement: Movable Bridge

This alternative involves a new movable bridge at approximately the same height and location as the current bridge.



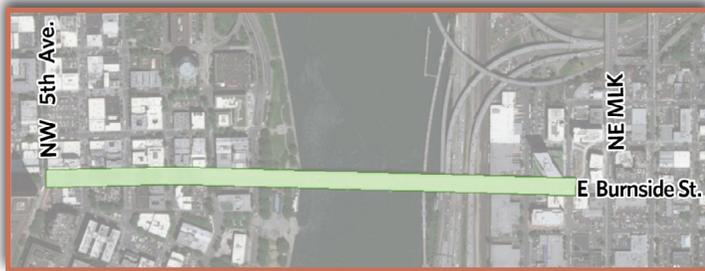
### 4.3.3. Replacement: Movable Bridge – NE Connection

This alternative involves a new movable bridge at approximately the same height as the current bridge. The east landing splits to connect to NE Couch Street. Westbound traffic enters from NE Couch Street.



## 4.3.4. Replacement: Fixed Bridge

This alternative involves a new fixed bridge with a maximum vertical clearance of 97 feet, at approximately the same location as the current bridge. It doesn't open but is tall enough to allow ships to pass without halting traffic. The west landing touches down about three blocks further west than the current bridge, near NW 5th Avenue.



While the 97-Foot-High Fixed Existing Alignment option was the highest scoring of the fixed bridge options, it was the lowest scoring of the four options recommended for further consideration. It scored lower than the others primarily because of higher impacts on land use, social service providers, and historic districts, as well as lower bicycle safety and convenience. Social service providers have expressed concern about how this option would adversely impact access to some of their facilities located on Burnside Street adjacent to the existing bridge. During the Feasibility Phase of the project, this option assumed a 97-foot maximum vertical clearance above the water for planning purposes. During the Environmental Review phase of the project it may be possible to reduce the vertical clearance. A navigation study and consultation with the United States Coast Guard will determine the permissible minimum vertical clearance. If the vertical clearance is less than 97-feet, the landing points on the west side of the river could move east, potentially reducing the impacts to properties and the street network.

## 5. PROJECT COST ESTIMATES

As part of the EQRB Feasibility Study, preliminary project cost estimates were developed for the 26 evaluated alternatives in Step 3 of the screening process. This section provides the approach, assumptions, and process used to generate and assemble the various costs that constitute the total project costs. The cost estimates are appropriate for a feasibility-level of design and were developed in conjunction with the Multnomah County Transportation Division.

### 5.1. CONSTRUCTION COST BASIS

The project cost estimates consider the complexity, nature of the work, and the difficulties with working within a dense urban environment with large amounts of anticipated public accommodation during construction.

The construction costs are based on four key estimating sources:

1. The Programmatic Cost Memorandum developed for the Willamette River Bridges Capital Improvement Plan Project, in May 2014. <https://multco.us/bridgeplan>
2. Average historical unit bid prices for similar work elements from relevant ODOT bridge cost data, Washington Department of Transportation bridge cost data, or similar projects constructed in the northwest (for estimated work items for which there is a suitable data source to draw from).
3. Average historical unit bid prices for similar work elements from relevant projects constructed outside of the northwest (for unique items such as movable bridge components) for which there are little cost data to draw from.
4. When pricing from similar projects or work elements was not available or incomplete, engineering judgment was used to develop the costs.

### 5.2. COST CATEGORIES

Cost estimates were compiled based on a combination of four categories. When summed, they form the total project cost for the alternative:

1. Construction cost
2. Right-of-way cost
3. Planning, engineering, and other project delivery costs
4. Inflation cost

### 5.2.1. Construction Cost

Construction costs involve the total of all work items necessary to construct the project. The costs were developed and organized into construction item work for which quantities could be estimated, unit costs assigned, and multiplied to yield a construction cost value. All construction cost items were then summed to form the cumulative construction value per section of work. The estimates are based on 2017 construction dollars and do not include any magnification factors for inflation, planning, engineering, or other project delivery phases (i.e., NEPA, Preliminary Engineering, and Construction Engineering and Inspection/Construction Administration).

Because the project is in an early conceptual stage, only major quantities of work were calculated. Further, while unit costs attempted to account for the complexity, nature of the work, and the difficulties with working within a dense urban environment with large amounts of anticipated public accommodation during construction, significant uncertainty remains. As such, a significant uncertainty contingency factor was applied to the estimate.

**Bridge Structure** This is defined as work associated with constructing the replacement alternative. Bridge bents (piers) are assumed to be round concrete columns with concrete crossbeams supported on drilled shaft foundations. Span arrangements and superstructure types were configured to fit the existing built environment with the least amount of disruption practical. Based on the span and structure type layouts, major structural component quantities were calculated and unit costs applied. The bridge cost summaries were subtotaled for the east and west approach spans, the main river spans, and vessel collision protection.

**Civil / Roadway** This is defined as work associated with constructing the bridge's approach roadways, roadways beneath the bridge, or facilities adjacent to the bridge.

Other related items work is associated with other features in conjunction with the bridge replacement work. These features are assessed at a high level to capture potential costs not yet defined. It includes the following subcomponents:

- Aesthetics premium – This is work associated with adding project value for bridge aesthetics. This may include ornate features added to the bridge, coatings and finishes, gateway elements, bridge lighting, railings and fences, or public art platforms.
- Willamette River mitigation – This includes mitigation of impacts on the Willamette River related to the bridge construction activities.
- Contractor access premium – Because of the limited available areas for construction equipment, staging and access costs were included to provide for staging yard areas.

**Uncertainties Contingency Factor** This is the magnification factor of the construction cost because of uncertainties in quantities or design type for the construction work, environmental mitigation, noise

mitigation, and other incidental project costs. For bridge feasibility studies, a typical contingency factor ranges from 25 to 45 percent. For this project, because quantities were developed and many costs often absorbed into the contingency value have been individually specified, a contingency factor of 30 percent was applied. The contingency value was applied to the total construction cost developed for each alternative.

### 5.2.2. Right-of-Way

Right-of-way costs are an expense because of impacts on properties, or property rights, owned by others. The amount of right-of-way impacts varies considerably among the replacement alternatives.

Buildings that require acquisition for the alternative to succeed are highlighted in the roadway alignment sheets. These, partial takes, and temporary construction easements were evaluated and a total dollar value applied. Land in some parcels would be required for construction access and staging, and other parcels would have existing accesses limited by construction activities.

### 5.2.3. Planning, Engineering, and Other Project Delivery Costs

Engineering and project delivery are administrative costs that include a combination of the following four categories (\$M):

1. NEPA phase - Costs include the necessary effort to develop an approved environmental clearance for the project. Because of project impacts, it was assumed that an environmental impact statement approved through the Federal Highway Administration would be required.
2. Engineering phase - Costs include the necessary effort to develop preliminary and final plans, specifications, and estimate to bid the project. It was assumed that the project would be designed and constructed using the conventional design-bid-build delivery model.
3. Construction engineering and inspection/construction administration phase - Costs include all project costs for overseeing the construction phase, including construction administration, engineering support, responding to contractor inquiries, construction inspection, and coordinating with the public. Construction engineering and inspection/construction administration costs were established as a percentage of construction costs inclusive of utilities, mobilization, temporary traffic control, contingency, and escalation.
4. County administration - Cost represents the cost for Multnomah County to oversee and administer the project. This cost was assumed as part of the preliminary engineering phase cost.

### 5.2.4. Inflation

The future cost inflation factor used was based on a Washington Department of Transportation projected inflation factor from a "Connecting Washington Bid Environment" presentation to the Joint Transportation Committee July 20, 2017 (Washington Department of Transportation 2017) and compared with recent

ODOT escalation forecasts. Based on these sources, a 3 percent per year inflationary rate was used to escalate design and construction costs from 2017 dollars to the mid-point of construction, assumed to be in 2027. A 5 percent per year inflationary rate was used to escalate right-of-way costs over a 6-year period.

### 5.3. PROJECT COST ESTIMATES

**Figure 11** contains the total preliminary project cost estimates for each of the 26 evaluated alternatives. The dark blue columns represent the project cost if traffic were detoured to another site during construction, and the light grey columns represent the project cost if the alternative maintained traffic at the site during construction.

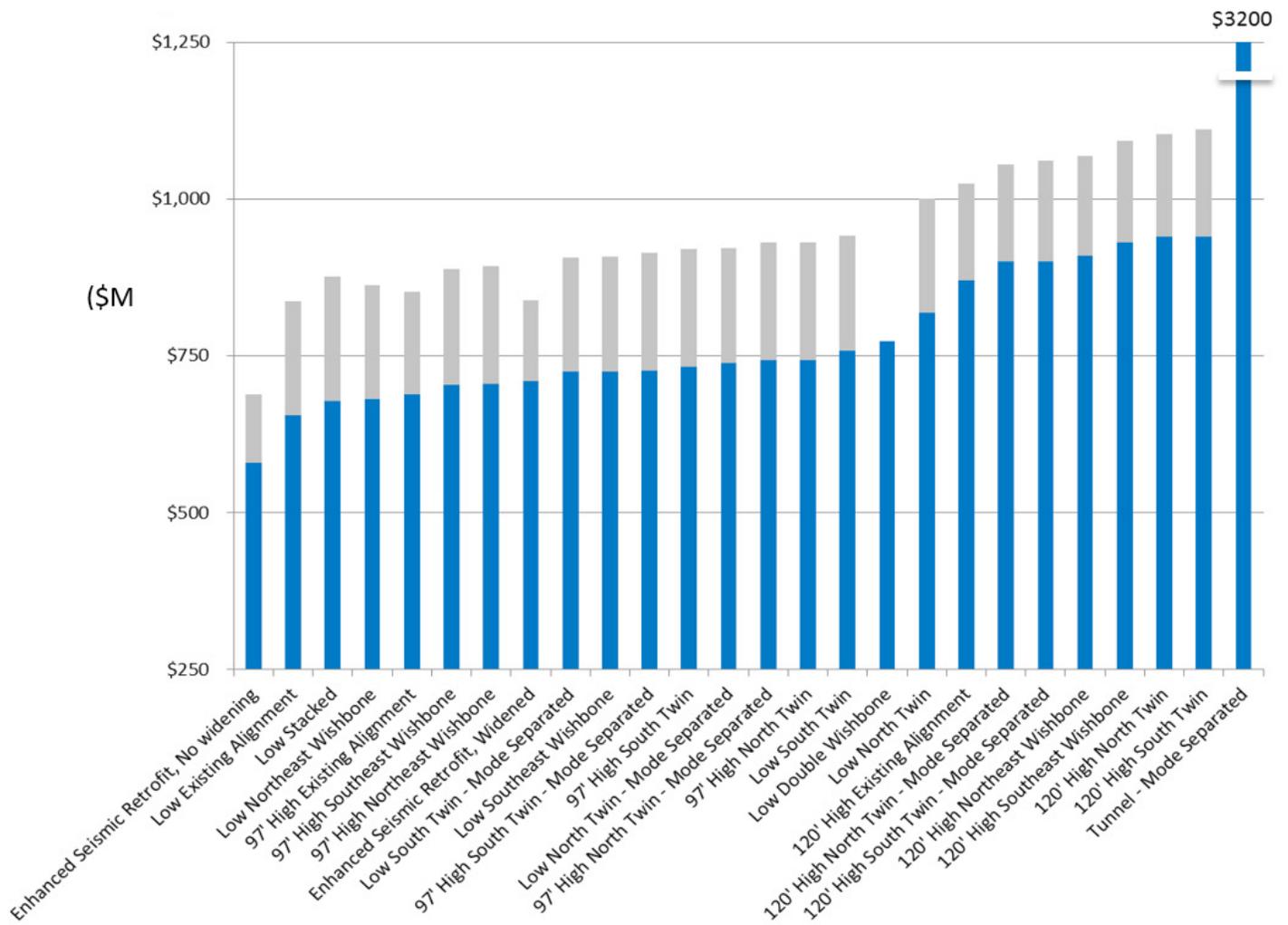


Figure 11: Total Preliminary Project Costs for 26 Evaluated Alternatives

## 6. REFERENCES

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Crime Prevention Through Environmental Design (CPTED)  
<http://www.cpted.net/>

## 7. APPENDICES

All appendices are available on-line at <https://multco.us/earthquake-ready-burnside-bridge/project-library>. If you would like a hard copy, please contact Mike Pullen at 503-209-4111 or [mike.j.pullen@multco.us](mailto:mike.j.pullen@multco.us).



# Earthquake Ready Burnside Bridge

## Feasibility Study Report

## APPENDIX A

# PROJECT PROBLEM STATEMENT AND PURPOSE AND NEED STATEMENT

App-A-1: Project Problem Statement, June 2017

App-A-2: Draft Purpose and Need Statement, December 2018

## APPENDIX B

# PUBLIC AND STAKEHOLDER ENGAGEMENT SUPPORTING DOCUMENTS

- App-B-1: EQRB Stakeholder Engagement Plan 11\_21\_2016
- App-B-2: EQRB Fact Sheets
- App-B-3: EQRB Stakeholder Interviews Summary
- App-B-4: EQRB Online Survey Summary - Summer 2017
- App-B-5: EQRB Emergency Management Workshop Notes 06\_14\_2017
- App-B-6: EQRB Online Briefing Summary - Spring 2018
- App-B-7: EQRB Stakeholder Briefings Summary 11\_14\_2018
- App-B-8: EQRB Social Services Workshop Meeting Notes 07\_31\_2018
- App-B-9: EQRB Mailer - August/September 2018
- App-B-10: EQRB Media Coverage
- App-B-11: EQRB Engagement Summary - September 2018



# Earthquake Ready Burnside Bridge

## Feasibility Study Report

## APPENDIX C

# ALTERNATIVES SCREENING TECHNICAL MEMORANDUM

- Attachment 1: Alternatives Evaluated
- Attachment 2: Screening Criteria and Scores Matrix
- Attachment 3: Step 3 Criteria and Scores Matrix
- Attachment 4: Options Cut Sheets
- Attachment 5: Project Problem Statement



# Earthquake Ready Burnside Bridge

## Feasibility Study Report

## APPENDIX D

# SEISMIC RETROFIT REPORT

- App-A: EQRB Seismic Deficiency Plans
- App-B: EQRB Seismic Design Criteria
- App-C: EQRB Geotechnical Report
- App-D: EQRB Seismic Site Utilities
- App-E: EQRB Concept Retrofit Plans
- App-F: EQRB Seismic Retrofit Cost Estimate



# Earthquake Ready Burnside Bridge

## Feasibility Study Report

## APPENDIX E

# BRIDGE REPLACEMENT TECHNICAL MEMORANDUM

App-A: Alternatives Concept Plans and Cost Estimates

App-B: Burnside Bridge Site Utilities



# Earthquake Ready Burnside Bridge

## Feasibility Study Report

## APPENDIX F

## RESOLUTION 2018-104