

Seattle Department of Transportation

2nd Avenue Extension S & S Jackson Street Bridge Replacement Planning Study

EXECUTIVE SUMMARY



July 2026



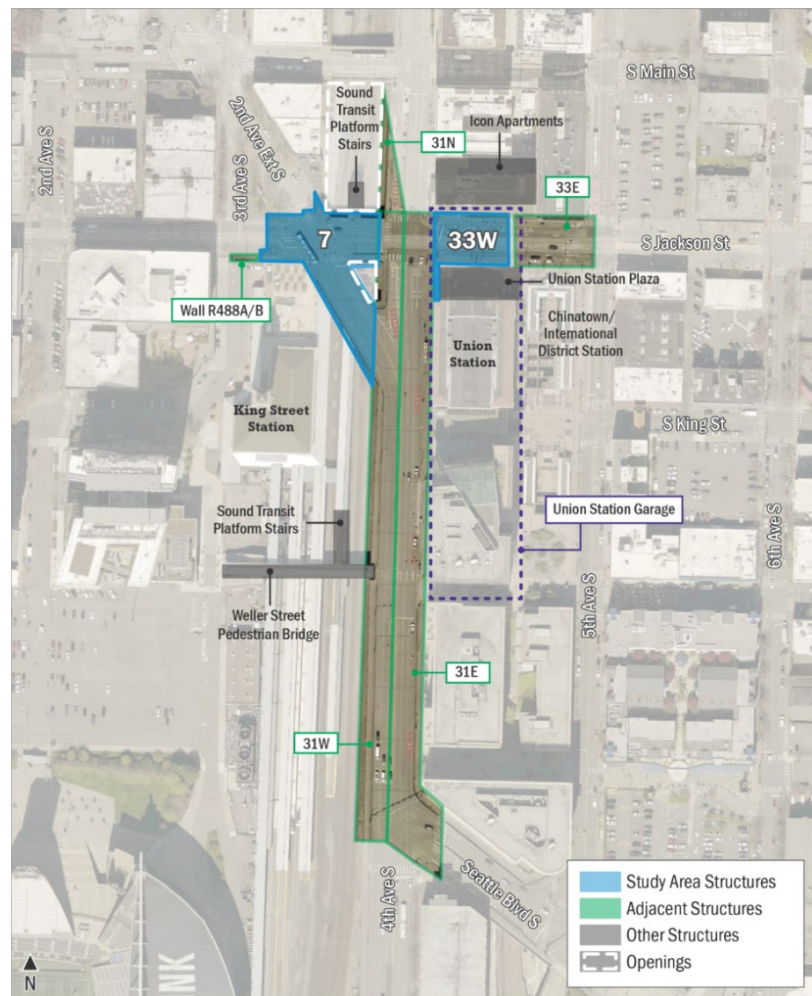
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Project Overview

The 2nd Avenue Extension S and S Jackson Street Bridge Planning Study was initiated to look at options for rehabilitating or replacing two aging bridges in the Jackson Hub area in Seattle. Jackson Hub area is located between Pioneer Square and Chinatown/International District, serving as one of the city's major transportation hubs, with people walking and biking, buses, light rail, streetcar, passenger and freight rail, automobiles, and freight trucks traveling to and through the area. Jackson Hub is also home to a complex and interconnected network of bridges and walls.

The two study bridges, Bridge 7 and Bridge 33W, were originally built in the early 1900s. Both bridges were rehabilitated in the 1980s and seismically retrofitted in the 2010s. With regular maintenance and monitoring, many bridges last well beyond their design life but it is still important to plan ahead especially when the need for future rehabilitation and replacement is not driven by a poor bridge condition state.

Bridge 7 is shaped like a backward number "7". It is located on 2nd Avenue Extension S between S Jackson Street and 4th Avenue S and on S Jackson Street between 2nd Avenue Extension S and 4th Avenue S. It crosses the BNSF Railway railroad tracks, which are also used by Amtrak and Sound Transit Sounder trains. Bridge 33W is located on S Jackson Street on the portion of the block



between 4th and 5th Avenues S in front of Union Station. Below the bridge structure, there is an underground parking garage accessible from 4th Ave S that is currently used by Sound Transit.

Under the Seattle Department of Transportation's (SDOT) Bridge Rehabilitation and Replacement Program and supported by the Levy to Move Seattle, the purpose of the bridge planning study was to:



Develop rehabilitation and replacement options for the study bridges.



Evaluate the options to determine what is possible, identify tradeoffs across many competing needs, and develop preliminary plans and cost estimates.

The findings from this study will help us plan for the long-term future of these two essential bridges and prepare for future investments. It is important to note that this study does not recommend a preferred solution for each bridge but rather to highlight the opportunities and challenges with different options and serve as a basis for future decision-making. Also, because there are many other projects planned in the area, including an extension of Sound Transit's Link line as part of the Ballard Link Extension, the study findings will help us coordinate with other transportation investments being considered in this area.

Current Conditions

It was important to consider many factors when identifying and evaluating options for repair or replacement of Bridge 33W and Bridge 7. These factors apply to a final outcome for the bridges as well as potential impacts during construction.

STRUCTURAL CONDITIONS

Each bridge has several deficiencies related to different structural elements, such as their abilities to support heavy loads and maintain stability during seismic events. Bridge 7 crosses the BNSF railroad tracks and does not meet the current functional requirements associated with bridge height (vertical clearance) or distance from structural features such as piers (horizontal clearance). While failure to meet BNSF requirements alone does not present a need to improve Bridge 7, these requirements will be important considerations for any future repairs or new construction.

SOILS AND GROUNDWATER

Much of the Jackson Hub area was originally tidal flats that have undergone large-scale municipal grading as the city developed. The soil conditions from this grading are a key consideration when determining the type of bridge improvements that are needed. The soils near Bridges 7 and 33W consist of loose fill and soft natural deposits near the surface, which are susceptible to liquefaction. The layers beneath consist of dense glacial soils. The seismic analysis for the project found that the soils are likely to experience liquefaction during a major earthquake. Additionally, groundwater conditions in the project area vary due to seasonal changes, stormwater runoff during rain events, and proximity to Puget Sound. These factors will also influence the opportunities for bridge rehabilitation, seismic retrofit, and replacement options.

HISTORIC DISTRICTS AND CULTURAL RESOURCES

The Jackson Hub area is at the intersection of the Pioneer Square Preservation District and the International Special Review District, which are focused on preserving unique historic and architectural characters. Changes to either bridge must align with the established design guidelines meant to preserve the unique historic and architectural characteristics of these neighborhoods. In addition, an assessment of impacts to their historic elements is required to ensure compliance with state and federal environmental regulations.

TRANSIT SERVICE AND INFRASTRUCTURE

Jackson Hub is served by many transit services. More than 1,400 Metro and Sound Transit buses pass over Bridges 7 and 33W every weekday. The Seattle Streetcar crosses both bridges on S Jackson Street. The Seattle Streetcar and Metro's trolley buses are powered by overhead electric lines on many streets in Jackson Hub. Link light rail, Sounder commuter rail service, and Amtrak also provide service on the platforms and tracks below Bridge 7 in the study area.

TRANSPORTATION FACILITIES

Streets in the Jackson Hub area provide critical connections within and between the Pioneer Square and Chinatown-International District (CID) neighborhoods. The busiest roadways carry almost 27,000 vehicles every day across a mix of one- and two-way streets. Many people navigate the complex street network in this area using the sidewalks, crosswalks, and bike lanes to get home, visit local businesses, use transit, and access services.

HEAVY RAIL

The BNSF railroad tracks that pass under Bridge 7 are used to transport freight. Amtrak and Sound Transit Sounder passenger trains also use these tracks. Many of the services that operate on the tracks do so on a fixed schedule that must be considered as part of the analysis of potential construction impacts.

Community Engagement

SDOT's engagement approach for this study was developed to address the unique needs of the neighborhoods, particularly surrounding community members who have been historically marginalized from participating in infrastructure projects. Because there were many other activities underway during the study, in-person community engagement activities were conducted along with other events so that people could learn about multiple projects at a single event.

Community engagement reached key stakeholders, property owners, community-based organizations, and local businesses via workshops, door-to-door outreach, mailers, emails, phone calls, and maintaining the project website. Key messages we heard during engagement focused on safety, comfort, and connectivity, most notably related to crossing multiple arterials along the S Jackson Street corridor.

Agency Coordination

An interdisciplinary SDOT team was established to include subject matter experts from a variety of agency divisions. The study work was completed alongside a consultant team as well as a Technical Advisory Committee (TAC), which included representatives from transit and railroad organizations, city agencies, and additional SDOT groups. Meetings provided opportunities to collaborate on developing and evaluating design ideas as well as documenting costs, risks, benefits, and trade-offs.

Developing and Evaluating Ideas

Developing and evaluating options for the bridges was undertaken as a two-step process.

LEVEL 1: Concept Evaluation

- Individual concepts or techniques to improve these bridges were developed. Examples of rehabilitation/retrofit concepts included replacing the bridge deck or retrofitting bridge columns, and replacement concepts looked at replacing the bridges within their existing footprint or with a new design.

- Evaluation was primarily a qualitative review that compared concepts to each other and identified those that are feasible and/or meet the required minimum structural requirements described below.
- Concepts with the highest performance were advanced into Level 2 evaluation as alternatives for additional evaluation.

LEVEL 2: Alternatives Evaluation

- Alternatives represented combinations of Level 1 concepts to create complete alternatives rather than improvements to individual components of a bridge. They had more detail and thus allowed for a more in-depth evaluation.
- Evaluation included a mix of qualitative and quantitative review of alternatives. The results highlight the opportunities, challenges, risks, and critical tradeoffs of each alternative.
- Preliminary plans and cost estimates were developed for each alternative.

EVALUATION CRITERIA

Both the Level 1 and Level 2 evaluations used 30 criteria across the 7 categories described below. For each criterion, the concepts and alternatives received a rating of low, medium, or high performance. With the exception of the Baseline Requirements, concepts were compared to each other for each criterion.

Baseline Requirements: These criteria address specific minimum design standards that are established by different agencies. They include the ability to support heavy loads and survive seismic events as well as meet BNSF clearance requirements.

Constructability: The constructability criteria were used to assess impacts to rail service and facilities and parking as well as evaluate construction durations for implementation. Because BNSF has limited construction "windows" during which work can occur near or over its tracks, the evaluation incorporated those windows when determining overall construction durations.

Mobility: The mobility criteria evaluated impacts and benefits to people walking, biking, and taking transit as well as traffic operations for cars and trucks. These impacts were assessed for both the final project condition as well as during construction. The mobility criteria also looked at opportunities to improve safety.

Environmental/Historic Preservation: These criteria were used to evaluate permanent and construction impacts to business or residential properties and the people who live or work at these locations. These criteria also looked at the potential to encounter contaminated soils and opportunities to minimize impacts to historic properties.

Equity: The equity criteria focused on alignment with community needs during construction and once construction is complete.

Compatibility/Consistency with Plans and Projects: There are several projects and plans for the Jackson Hub area, including West Seattle Ballard Link Extension, King Street Station improvements, Seattle Streetcar improvements, Jackson Hub Planning study, Seattle Transportation Plan/Future funding package, and South Downtown Hub Planning. These criteria evaluated compatibility with these other projects and plans.

Cost Summary: The cost summary criteria assessed the costs associated with each concept or alternative, including construction and qualitative life cycle costs.

Level 1: Concept Evaluation

Twenty-eight distinct structural concepts were prepared for Level 1 evaluation. These concepts represented individual elements or treatments to rehabilitate, seismically retrofit, or replace portions or all of the bridges. Recognizing that, if implemented, some structural improvements would result in major changes to the immediate transportation network and infrastructure, six transportation planning concepts were developed.

RESULTS

Although they were evaluated for all criteria, those that showed how effective the concept would be were primarily associated with the baseline requirements:

- Through coordination with BNSF, we maintained a concept that would keep existing horizontal clearances for study and comparison to other concepts that improve clearance. Concepts that maintain or improve horizontal clearances were prioritized to advance to Level 2 evaluation over concepts that reduce horizontal clearances.
- BNSF also indicated during this phase of the study that SDOT should assume that existing vertical clearance issues must be resolved for all tracks with any new structure for Bridge 7. Improving the vertical clearance to meeting BNSF's requirements would result in a grade rise of S Jackson Street between 3 and 7 feet, depending on the replacement concept. This change in grade would require 4th Avenue S to also be replaced and would affect access to properties adjacent to 4th Avenue S, S Jackson Street, and potentially along 2nd Avenue Extension S. Finally, if a replacement option is selected for Bridge 7, it would also require replacement of Bridge 33W to match the new roadway grade.
- One concept included removal of the portion of the Bridge 7 structure under 2nd Avenue Extension S, south of S Jackson Street. However, preliminary traffic analysis showed that these changes to roadway network and circulation in the neighborhood would not be feasible with today's bus and vehicle volumes.

Level 2: Alternatives Evaluation

After completion of the Level 1 analysis, four alternatives were developed for Bridge 7 and two for Bridge 33W. Preliminary plans and cost estimates were prepared for each of the alternatives.

The criteria for the Level 2 evaluation were the same as those applied for Level 1. When compared with the concepts evaluated in Level 1, the Level 2 alternatives represented complete improvements rather than improvements to individual components of a bridge, had more detail, and thus contributed to a more in-depth evaluation for many of the measures. The Bridge 7 alternatives were compared to each other, and the Bridge 33W alternatives were compared to each other for all criteria except the Baseline Requirements. The key findings for the Level 2 evaluation are summarized below.

Alternative 7-1

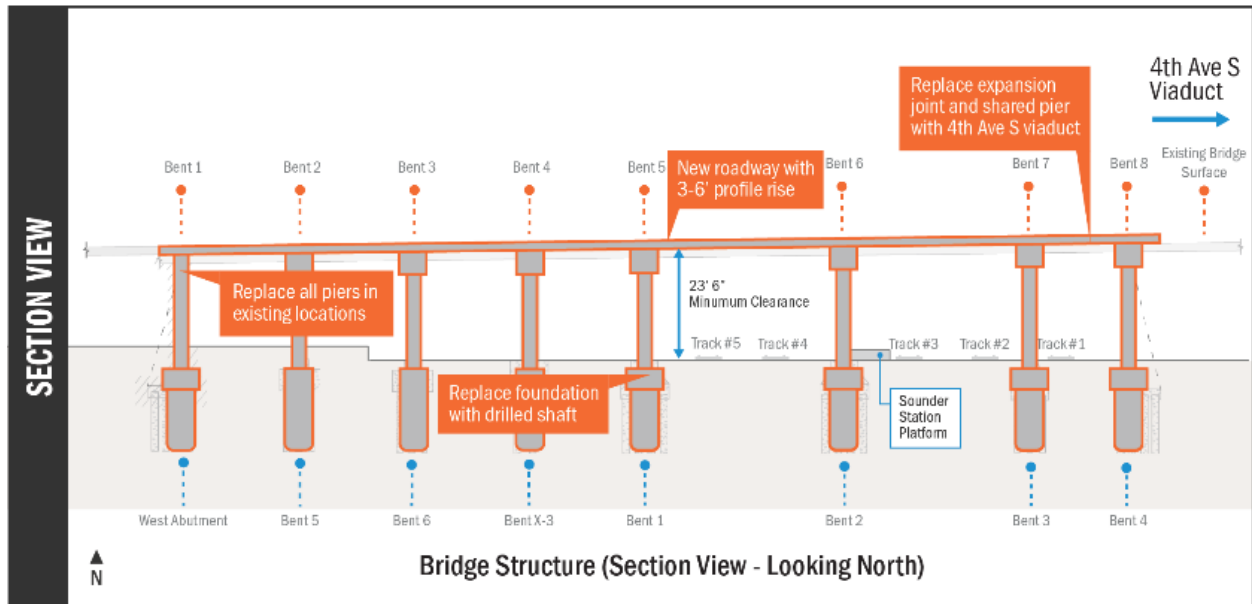
Bridge 7 replacement with bents in the existing locations

Estimated Elevation Change of S Jackson Street: 3.5 feet

Estimated Cost: \$116M to \$222M

NOTE: Elevation change requires construction of Alternative 33W-1 at an additional \$32M to \$66M

Estimated Construction Duration: 7 to 12 years (assuming 4-hour work windows on BNSF tracks)



Opportunities

- Replaces structure while minimizing elevation change.

Challenges

- (Along with Alt 7-4), lowest-performing in constructability due to replacing piers adjacent to active BNSF railroad tracks.
- Longer construction duration (7 to 12 years), assuming typical work windows in the railroad (4 hour).
- Lowest-performing in environmental/historic preservation categories relative to other alternatives.

Alternative 7-2

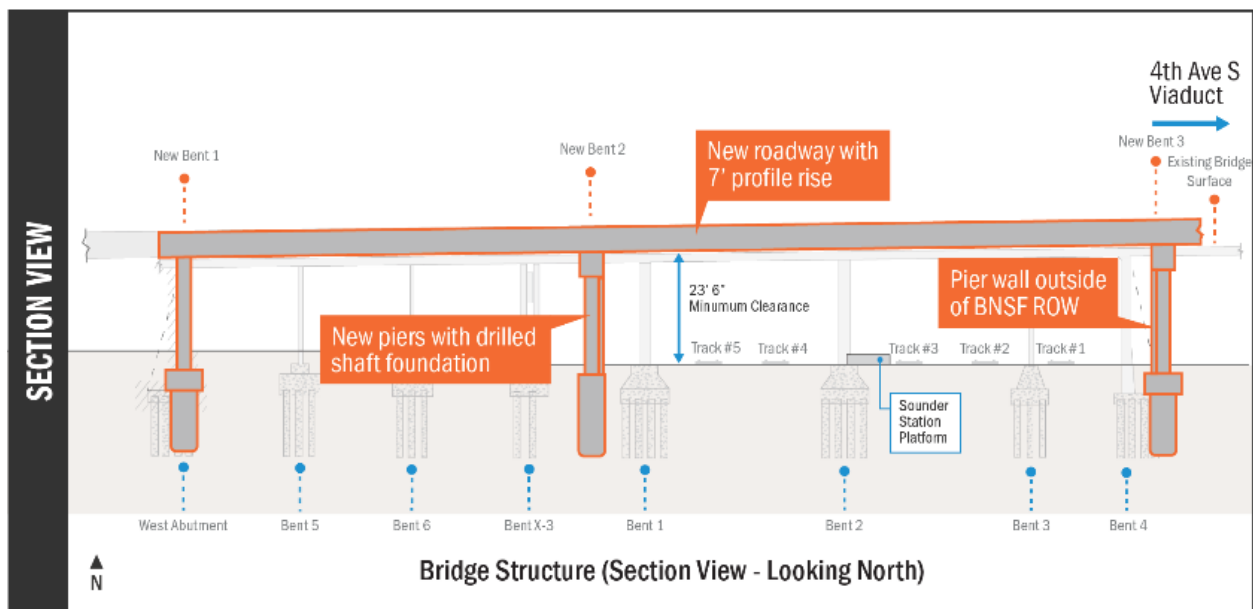
Bridge 7 replacement with a conventional bridge spanning the BNSF right-of-way

Estimated Elevation Change of S Jackson Street: 7.0 feet

Estimated Cost: \$99M to \$210M

NOTE: Elevation change requires construction of Alternative 33W-1 at an additional \$32M to \$66M

Estimated Construction Duration: 3.5 to 4 years



Opportunities

- Highest-performing in compatibility/consistency with projects and plans, relative to other alternatives (along with Alt 7-2).
- Removes piers from BNSF right-of-way, resulting in improved constructability compared to Alt 7-1 and 7-4.

Challenges

- S Jackson Street elevation change and grade change areas of impact are the greatest challenges relative to other alternatives

Alternative 7-3

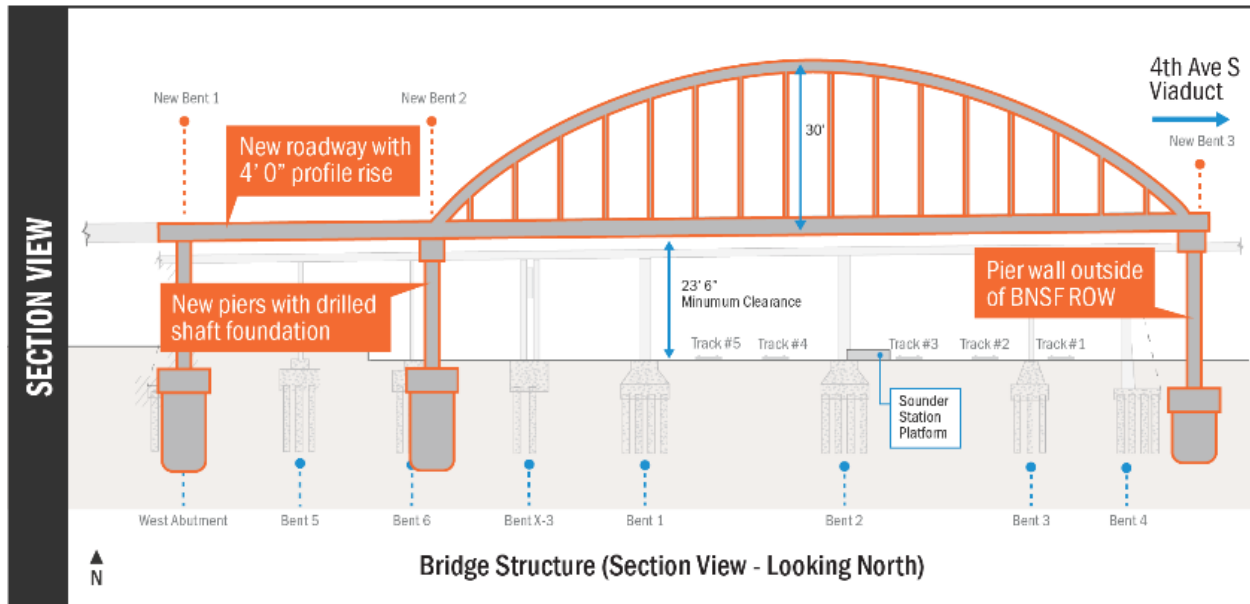
Bridge 7 replacement with an arch bridge spanning of the BNSF right-of-way

Estimated Elevation Change of S Jackson Street: 4.0 feet

Estimated Cost: \$68M to \$145M

NOTE: Elevation change requires construction of Alternative 33W-1 at an additional \$32M to \$66M

Estimated Construction Duration: 2 to 2.5 years



Opportunities

- Similar to Alt 7-2, highest performing in compatibility/consistency with projects and plans, relative to other alternatives.
- Removes piers from BNSF right-of-way, resulting in improved constructability compared to Alt 7-1 and 7-4.

Challenges

- Changes historic elements by introducing a new structure type.
- Has significant negative affect to transit and traffic operations in the permanent condition (after construction) by removing a portion of 2nd Avenue Extension S.

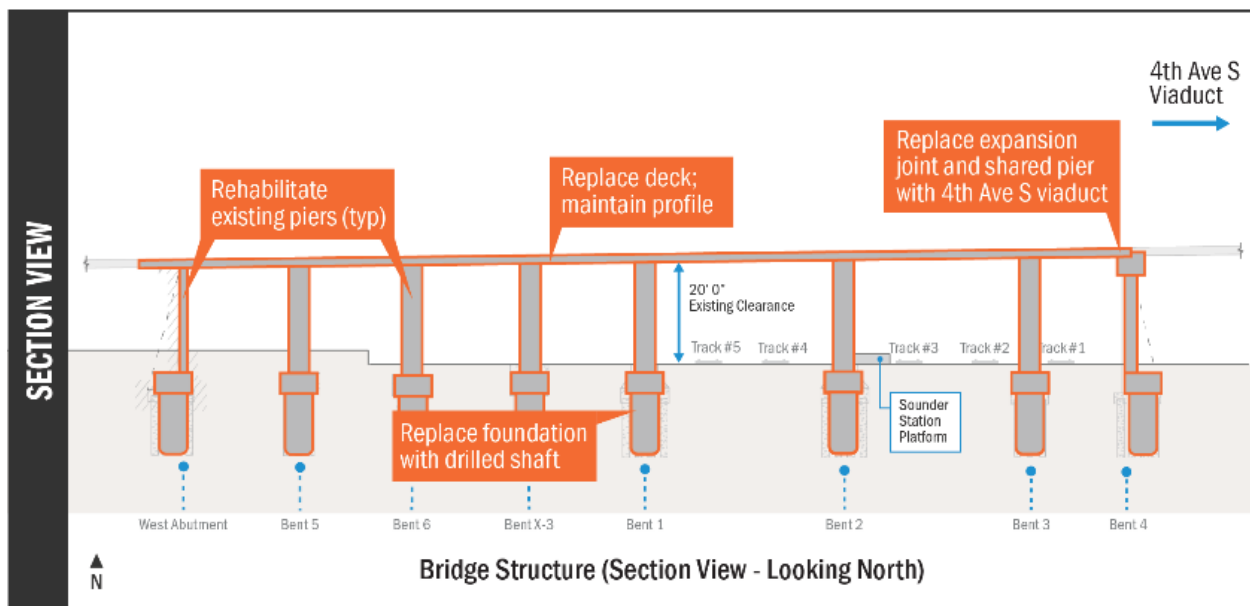
Alternative 7-4

Bridge 7 rehabilitation with deck replacement and seismic retrofit of existing piers

Estimated Elevation Change of S Jackson Street: 0 feet

Estimated Cost: \$87M to \$160M

Estimated Construction Duration: Approximately 12 years (assuming 4-hour work windows on BNSF tracks)



Opportunities

- Improves existing structure to full design requirements without increasing elevation of S Jackson St.

Challenges

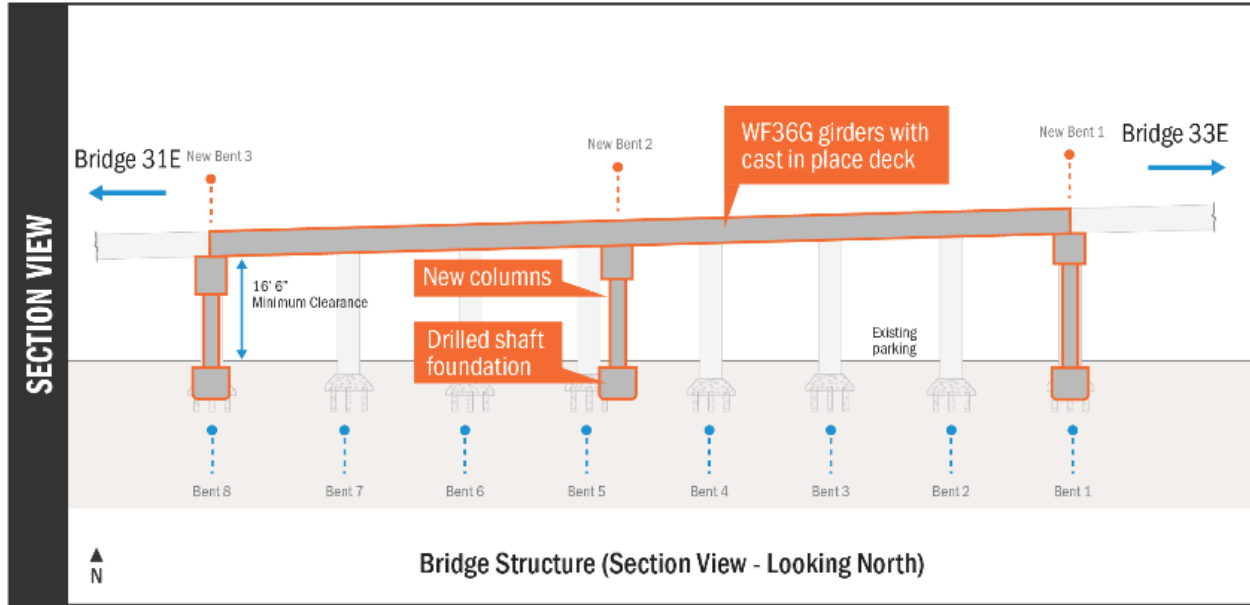
- Does not meet BNSF vertical clearance requirement, based on initial BNSF guidance that deck replacement would not trigger requirements.
- Along with Alt 7-1, lowest performing in constructability due to replacing piers adjacent to active BNSF railroad tracks.
- Longest construction duration (12 years) compared to other alternatives, assuming typical work windows in the railroad (4 hour).
- Costs more than replacement options Alt 7-2 and 7-3 while only rehab/retrofitting the structure.

Alternative 33W-1

Bridge 33W bridge replacement with a conventional bridge structure with fewer bents

Estimated Cost: \$32M to \$66M

Estimated Construction Duration: 1.5 to 2 years



Opportunities

- Increases potential parking capacity under the structure with a reduced number of piers.
- Fully improves structure to meet current structural requirements.

Challenges

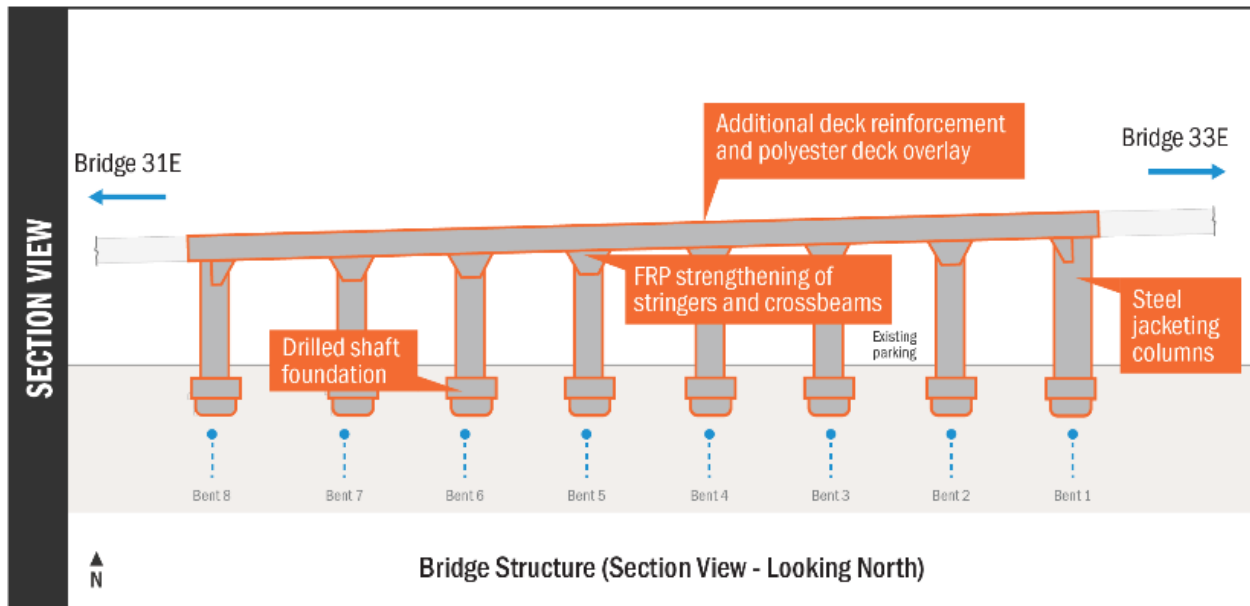
- Has typical construction conflicts that occur within a built environment.

Alternative 33W-1

Bridge 33W bridge rehabilitation and seismic retrofit of existing piers

Estimated Cost: \$36M to \$76M

Estimated Construction Duration: 1.5 to 2 years



Opportunities

- Provides similar structural improvements as Alt 33W-1 by rehab/retrofitting to meet current structural requirements.

Challenges

- Costs more than the replacement Alt 33W-1 without providing a new structure.
- Maintains the same conflicts with piers within the Sound Transit portion of the Union Station parking garage.

Key Takeaways and Next Steps

The work completed so far provides a snapshot in time of important elements that will need to be considered as part of the planning process, but there is more work to do. Below is a summary of the major takeaways and how they will inform the next phase of work.

Major takeaways from this study	What comes next
Existing structure assessments, geotechnical evaluations, and plan sets were based on existing available information which is common for early planning phases.	• New investigations or field inspections are required for future work to inform more detailed designs and cost estimates. • Survey data would better inform how much would be affected at the street level if Bridge 7 is built back higher to meet railroad clearance requirements.
For Bridge 7, addressing BNSF horizontal and vertical clearance requirements result in significant grade changes along S Jackson Street and require rebuilding portions of adjacent streets and structures..	• Additional coordination with BNSF will be necessary to determine what, if any, deviations from clearance requirements are acceptable. • Verification of the vertical clearance requirements apply to all tracks or whether there might be an exception for the auxiliary tracks that serve Amtrak and Sounder passenger platforms.
BNSF indicated a 4-hour construction work window would be typical for this area. For Bridge 7 alternatives that assume the piers remain in BNSF right-of-way (Alternatives B7-1 and B7-4), assuming 4-hour work windows resulted in a significant construction duration (ranging from 7 to 12 years).	• Additional coordination with BNSF will be necessary to identify whether there are other opportunities to allow longer work windows, particularly for foundations work. • Refine construction phasing activities to optimize the available work windows.

Major takeaways from this study	What comes next
Construction requires full or partial closures of 2nd Avenue Extension S, S Jackson Street, and 4th Avenue S through the study area. These closures will significantly affect travel for all modes. And Alt 7-3 permanently closes 2nd Avenue S, south of S Jackson Street which is currently considered infeasible. A high-level quantitative analysis identified potential detour routes and improvements.	• Different construction sequencing and/or roadway closures may change assumed traffic impacts. Also, improvements along detour routes should be fully defined, including whether the roadways would need additional lanes, parking removed, and changes to stop control (such as adding signals or stop signs).
Impacts to transit service—such as Metro and Sound Transit buses, Seattle Streetcar, Amtrak, or Sound Transit Sounder—were identified due to the road closures described above as well as changes to grades and construction at the railroad level.	• A detailed analysis would need to be completed to understand opportunities to provide transit priority through detour routes while understanding the trade-offs to traffic operations, including local circulation, identification of bus stop locations during construction, and access requirements to Amtrak and the Sound Transit Sounder station.
The completion of the Level 2 evaluation identified remaining constructability issues and identified additional design refinements for later study.	• As the design phase advances, different alternatives could be combined to create a hybrid solution that is more feasible to construct.

Major rehabilitation or replacement of these structures, especially Bridge 7, will be expensive, take years to construct, and involve significant disruptions to adjacent neighborhoods. Even with these challenges, as with the Seattle Waterfront project, the City has demonstrated that it can leverage these major infrastructure projects to deliver broader community benefits. Recent community planning efforts have taught us that there is an appetite for transformational change in the Jackson Hub area.

As a City, we will need to be creative and opportunistic in our approach to funding and delivering this project including considering options that involve public-private partnerships. As we work toward that larger vision, we will continue to monitor and maintain these critical bridges so they can support all the ways people use them to get where they need to go.