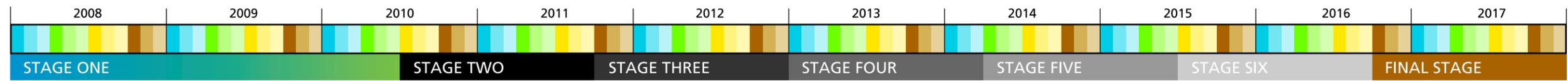


Construction Activities Chart

Timeline Assumes Full Project Funding



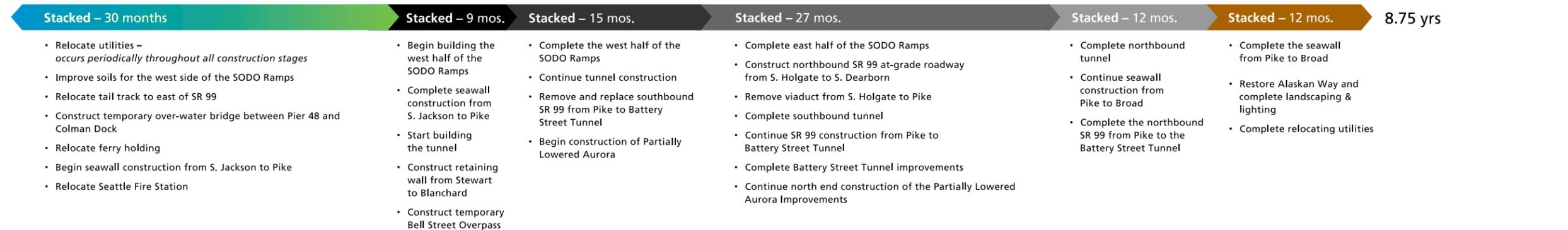
Shorter Construction Plan

Tunnel



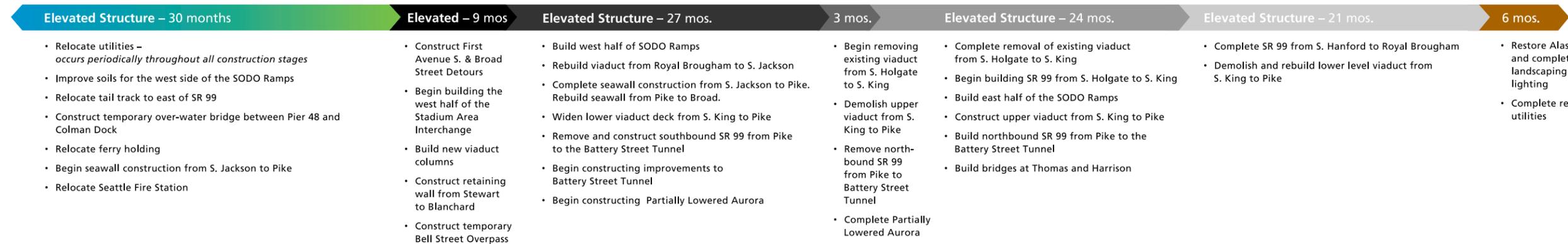
Intermediate Construction Plan

Tunnel



Longer Construction Plan

Elevated Structure



BOTH ALTERNATIVES COULD BE BUILT UNDER ANY OF THE CONSTRUCTION PLANS.

CHAPTER 6 - CONSTRUCTION

What's in Chapter 6?

This chapter describes the three construction plans and explains how they are evaluated in this document. It also explains how long construction would take and contains descriptions of how the project could be built. Chapter 7 describes how construction would affect the surrounding area and identifies potential mitigation measures.

1 What construction plans are evaluated in this document?

This document evaluates three new construction plans that would fully close SR 99 for 0 to 42 months. Some plans include construction detours on First Avenue S. and Broad Street. The Tunnel and Elevated Structure Alternatives could be built under any of the three construction plans.

The Draft EIS evaluated one construction plan that considered brief closures of SR 99 during construction, but otherwise assumed that at least two lanes would be provided in each direction on SR 99 or an alternate detour route. Many people asked the project partners to consider more than one construction plan to better understand the tradeoffs associated with closing SR 99 for years versus keeping it open for much of the construction period. Specifically, people wanted to know what would happen if SR 99 were fully closed during construction. Would closing the corridor reduce the amount of time it takes to build the project? To respond to this question, we are replacing the one construction plan evaluated in the Draft EIS with the three different construction plans evaluated in this document. In general, the time it takes to build the project decreases the longer SR 99

is closed; however, the intensity of effects to traffic increases when SR 99 is closed.

Shorter Construction Plan

The Tunnel Alternative would take an estimated 7 years to build if this plan were selected. With this plan, SR 99 traffic would be affected for 42 months when both directions of SR 99 would be closed between S. Spokane Street and Denny Way.

The Elevated Structure Alternative would take an estimated 6.5 years to build if this plan were selected. With this plan, SR 99 traffic would be affected for 36 months when both directions of SR 99 would be closed between S. Spokane Street and Denny Way.

Intermediate Construction Plan

The Tunnel Alternative would take an estimated 8.75 years to build if this plan were selected. With this plan, SR 99 traffic would be affected by closures or restrictions for a total of 63 months. For 27 months, both directions of SR 99 would be closed between S. Spokane Street and Denny Way. For 36 months, portions of SR 99 would be closed or restricted with lane and ramp closures.

The Elevated Structure Alternative would take an estimated 7.75 years to build if this plan were selected. With this plan, SR 99 traffic would be affected by closures or restrictions for a total of 57 months. For 18 months, both directions of SR 99 would be closed between S. Spokane Street and Denny Way. For 39 months, portions of SR 99 would be closed or restricted with lane and ramp closures.

Longer Construction Plan

The Tunnel Alternative would take an estimated 9.5 years to build if this plan were selected. With this plan, SR 99 traffic would be affected by closures and restrictions for a total of 72 months. SR 99 would not be completely closed in both directions at any time during construction. Instead, southbound SR 99 would be closed for 30 months and northbound SR 99 would be closed for 33 months. SR 99 would have ramp closures for an additional 9 months.

For the Elevated Structure Alternative, the longer plan is similar to the plan evaluated in the Draft EIS. If this plan were selected, the Elevated Structure Alternative would take an estimated 10 years to build. With this plan, SR 99 traffic would be affected by closures or restrictions for 84 months. Both directions of SR 99 would be closed from S. Spokane Street to Denny Way for 3 months. For the remaining 81 months, portions of SR 99 would be closed or restricted with lane and ramp closures.

2 How are the construction plans evaluated in this document?

The Tunnel and Elevated Structure Alternatives could be built under any of the three construction plans. However, for the Tunnel Alternative, only a side-by-side tunnel could be built under the longer plan. A stacked tunnel requires building transition sections at both ends of the tunnel where it converts from a stacked tunnel to a side-by-side tunnel. To build these transitions, the existing viaduct would need to be torn down and closed for at least 27 months.

How long will it take to build the project?

It will take between 6.5 and 10 years to build the project. These are baseline durations, meaning these estimates don't take various construction risks into account. When risk is included, the total construction duration ranges from 6.5 to 11.5 years. The total construction duration depends on the alternative and construction approach selected. Durations shown below do not take various construction risks into account.

- Shorter Construction Plan – 6.5 to 7 years
- Intermediate Construction Plan – 7.75 to 8.75 years
- Longer Construction Plan – 9.5 to 10 years

Why would it take longer to build the tunnel than the elevated structure for the shorter and intermediate construction plans?

The elevated structure would take less time to build under both of these plans because the tunnel is more complicated to build than the elevated structure.

Why would it take longer to build the elevated structure than the tunnel with the longer construction plan?

To build the elevated structure, contractors would work around traffic for all but 3 months of construction. For the tunnel, one direction of SR 99 would be closed for several years. It is easier and faster for contractors to build a roadway when large portions of the facility are closed to traffic, which explains why the tunnel would take less time to build under this plan.

This document doesn't evaluate in detail the three different ways each of the alternatives could be built. Instead, we've evaluated the effects of one alternative for each plan, as shown in Exhibit 6-1.

Exhibit 6-1

Construction Plans Fully Evaluated in This Document

	Tunnel Alternative	Elevated Structure Alternative
Shorter Construction Plan	Yes	No
Intermediate Construction Plan	Yes	No
Longer Construction Plan	No	Yes

Note: Both alternatives could be built under any of the construction plans.

The combination of construction plans and alternatives evaluated in this document covers the possible range of effects. The combinations were selected because the Tunnel Alternative is more complicated to build than the Elevated Structure Alternative and therefore benefits more from full or partial closure of SR 99. The effects on traffic and surrounding areas from closing SR 99 are similar for either the Tunnel or Elevated Structure Alternative.

3 How were the construction durations for the project developed?

The estimated construction durations were developed using the Washington State Department of Transportation's (WSDOT) Cost Estimate Validation Process (CEVP®). The CEVP estimates the length of time it would take to build a project by considering preliminary engineering plans and potential project risks. For example, based on CEVP calculations, it would take 6.5 to 8.5 years to build the Tunnel Alternative with the shorter construction plan. These durations represent the 10 to 90 percent probability range for estimated construction duration. This means that there is a 10 percent chance that it would take less than 6.5 years to build the alternatives and a 90 percent chance that it would take less than 8.5 years.

The CEVP estimates assume that construction could occur up to 24 hours a day, 7 days a week. They also assume that construction activities, specifically utility relocation, would begin in January 2008, though the start date depends on project funding. The construc-

tion durations represent the project partners' current thinking about how the project would get built, and the durations assume that all of the money needed to build the project would be available at the time indicated on the overall project construction schedule. If the project partners don't have all of the money needed, construction durations and the order in which project components get built may change.

4 How would construction activities be sequenced?

The Construction Activities Chart on page 72, shows how construction activities could be sequenced for both alternatives. As previously mentioned, construction sequencing and phasing are dependent on funding. If the project is funded in pieces, the order in which project components get built may change, and certain portions of the project might get delayed until additional funding could be secured.

Construction activities have been organized into several stages that include distinct traffic detours. Construction would occur simultaneously at several locations throughout the project area, and the intensity of construction activities would vary.

An individual section of the project area, such as the Seattle Aquarium, would not have construction activities underway in front of the facility for the entire construction duration. Instead, construction activities would progress throughout the project area so that a specific location would experience the construction activity until that activity moves to an adjacent location. The specific location would then experience a lapse in construction activities—or at least a different intensity until the next construction activity advances in front of the specific location. The duration of each construction activity would vary greatly, ranging from a few days to several months depending on the type of activity. For both alternatives, construction would pass by properties located in the construction zone more than once.

Throughout construction, contractors would store materials and equipment within the project area and existing road right-of-way. Throughout construction, crews would need a wide variety of construction

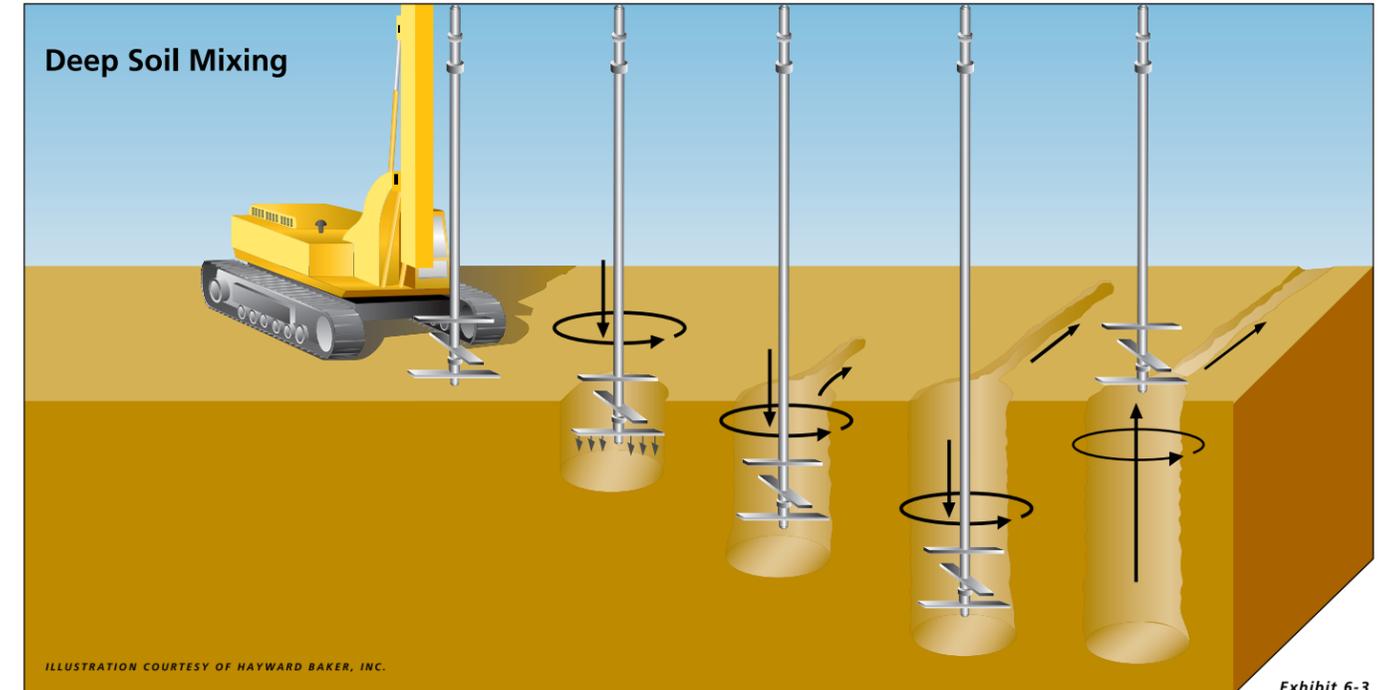


Exhibit 6-3

equipment such as trucks, cranes, backhoes, excavators, loaders, forklifts and manlifts, jackhammers, various pumps, grading and paving equipment, compressors, generators, and welding equipment. For viaduct and seawall demolition activities, crews would most likely use crunching/shearing attachments, concrete saws, concrete splitters, and cutting torches. For soil improvement, work crews would need specialty equipment such as drilling rigs with mixing augers, gravel chutes, and vibrators. Crews may also require additional equipment such as pile drivers, barges, and conveyor belts.

Questions 5 through 7 describe how components of the alternatives are currently proposed to be built, though these methods and sequences may change and be refined as the project design progresses.

5 How would the project be built in the south section?

At this time, the project partners propose to build the Reconfigured Whatcom Railyard for either the Tunnel or Elevated Structure Alternative. This means that proposed construction activities in the south would be the same for both alternatives.

What is the CEVP®?

Construction durations and overall project costs were determined using the Cost Estimate Validation Process (CEVP®). CEVP is not a casual look at a project; rather, CEVP is the outcome of an intense workshop process, somewhat resembling the design review process called value engineering.

In these intense workshops, a team of engineers and risk managers from local and national private firms and public agencies examine a transportation project and review project details with engineers from the Federal Highway Administration (FHWA), WSDOT, and the City of Seattle.

The CEVP workshop team uses systematic project review and risk assessment methods to identify and describe cost and schedule risks and evaluate the quality of the information at hand. The process examines how risks can be lowered and cost vulnerabilities can be managed or reduced from the very beginning of a project. A benefit of CEVP is that it identifies risks early in the project development process. This allows the team to work on ways to reduce risks that would add cost or extend the time needed to construct the project.

Soil Improvements

For either alternative, soil in the south section would need to be improved, or strengthened around and under proposed aerial structures and retained fills to adequately support them.

There are several methods contractors can use to strengthen soil. As described in the Draft EIS, the deep soil mixing method would most likely be used to improve soil supporting aerial structures and retained fills in the south. Deep soil mixing involves strengthening soil by mixing it with cement grout injected under pressure. As the soil is mixed, it creates columns of strengthened soil, as shown in Exhibit 6-3. Another method of soil improvement being considered is stone columns, where drilled holes are back-filled with gravel and vibrated into place.

In the south section, soil improvements are expected to take about 15 months for either alternative.

Aerial Structure Construction

New aerial structures would be built in the south as part of the Reconfigured Whatcom Railyard design. These new aerial structures would include both bridges and structures built on retained fill. In the Draft EIS, very few retained fills were proposed in the south, and most of the aerial structures proposed in the south section were bridges.

For both alternatives, two aerial sections, one for the northbound lanes and one for the southbound lanes, would be built over the railroad track connecting the Whatcom and Burlington Northern Santa Fe Railway Company (BSNF) Seattle International Gateway (SIG) Railyards between S. Holgate and S. Atlantic Streets. These aerial sections would mostly be supported by retaining walls and fill, though a small section spanning the railroad track would be supported by bridges. Near the stadiums, both designs would build new on- and off-ramps to SR 99. These ramps would be built using a combination of retained fill and aerial structures. The aerial structures would be constructed of reinforced concrete columns, crossbeams, girders, roadway decks, and guard rail. Most of the concrete

for the aerial structures would be cast in place, though precast components could be used. A general description of aerial structure construction activities is provided in the text that follows.

As described in the Draft EIS, new aerial structures would be supported underground by drilled shafts or driven piles. Drilled shafts in the south section would range from 8 to 14 feet in diameter and would extend between 60 and 150 feet into the soil. In general, drilled shafts would be built by drilling soil out to the desired circumference and depth, installing rebar (reinforcing bars of steel), and filling the hole with the concrete that forms the new drilled shaft. The stability of the excavated hole could be maintained either by keeping the hole continuously filled with a sealing mixture or by advancing a steel casing while drilling. Typically, contractors would be able to construct one drilled shaft each day per drilling crew, though it may be possible to increase production if conditions are favorable.

Driven Piles and Pile Caps

In areas where the soil conditions allow, driven piles and pile caps may be used to support aerial structures instead of drilled shafts. As described in the Draft EIS, driven piles and pile caps could be used for building new aerial structures south of S. Atlantic Street and for building new viaduct foundations in the central section.

The area for the pile cap would be excavated and shored up as needed. Next, piles would be driven into the ground in the area of the excavation. If hammering methods are used, pile driving activities would be disruptive, increasing noise substantially in areas where this activity occurs. However, methods such as pushing or vibrating piles in the ground would be much less disruptive and not as loud. Piles could be constructed in various sizes using several different materials. At this time, it is expected that 30-inch-diameter piles constructed of steel casings filled with reinforced concrete would be used.

Once a cluster of several piles is driven, the pile cap would be finished to connect the cluster of piles together to form a new foundation. The pile cap

would be constructed by placing concrete forms in the excavated area, installing rebar, and placing concrete within the concrete form.

Columns and Crossbeams

After the foundation of the aerial structure is built, construction of the aboveground columns and crossbeams could begin. The columns and crossbeams would typically be cast in place using concrete forms.

Superstructure (Girders, Roadway Deck, and Railing)

Girders would most likely be constructed off-site and delivered to the project area; however, they could be cast in place. Roadway deck and bridge railing would be cast in place using concrete.

Removing the Viaduct

The existing viaduct would be removed and demolished for both alternatives. It would take about 6 months to remove the viaduct in the south section. As described in the Draft EIS, the viaduct would be demolished by a combination of cutting and lifting segments out of the structure, pulverizing the structure, and jackhammering and core drilling to break up concrete. Concrete from the viaduct could be crushed into aggregate to be reused on-site as part of the construction operation, though it would most likely be hauled to an off-site location for processing. Rebar in the existing structure may be separated and recycled. The old viaduct material would be hauled away by truck, rail, or barge.

At-Grade Roadway Construction

Both alternatives would require constructing sections of at-grade roadway. As described in the Draft EIS, at-grade roadways would be built by removing existing roadways, clearing and grading the area, installing the roadway drainage, laying the aggregate roadway foundation, and placing an asphalt or concrete roadway surface. Sidewalks, promenades, lighting, and landscaping would also be built. Construction of at-grade roadway sections in the south would be expected to take 9 to 12 months.

What's the difference between aerial structures that are bridges versus those that are built on retained fill?

Aerial structures can be supported in different ways. For this project we are proposing a mixture of aerial structure types. In areas where we need to extend up and over existing facilities such as roadways or railroad tracks, we will build bridges supported by drilled shafts or piles, columns, and crossbeams. In other areas, aerial structures may be supported by retaining walls and fill dirt. These differences won't change conditions for drivers, but they will provide different views at the street level since people can see under and around bridges and they can't see through structures supported by retained fill.

How would construction in the south section be different if the Relocated Whatcom Railyard were built?

Construction activities for the Relocated Whatcom Railyard would be similar to those described above for the Reconfigured Whatcom Railyard. The main difference is that fewer aerial structures would be needed because the Relocated Whatcom Railyard wouldn't bridge over the railroad track connecting the Whatcom Railyard and the BNSF SIG Railyard. Instead, the Whatcom Railyard would be combined with the BNSF SIG Railyard, eliminating the need for the connecting track.

6 How would the project be built in the central section?

In the central section of the project area, construction activities vary between the Tunnel and Elevated Structure Alternatives, because these alternatives propose to build two very different structures. As such, the following text describes construction activities common to both alternatives, followed by construction activities specific to each alternative.

Construction Activities Common to Both Alternatives

Construction activities common to both alternatives are:

- Relocating utilities
- Building the temporary Colman Dock Ferry Terminal Access Road
- Rebuilding the seawall
- Removing the viaduct
- Replacing SR 99 from Pine Street to the Battery Street Tunnel
- Replacing the Alaskan Way surface street

Relocating Utilities

Utilities would need to be relocated in all sections of the project area (south, central, and north). However, there are more utilities located in the central section of the project area, so these activities are briefly described in this section. Utilities would be relocated during all stages of the project, though a sizable por-

tion of this work would be done during the first 30 months of construction (Stage 1). This is a change from the Draft EIS, which estimated that the early utility relocation work would take 18 months.

In Stage 1, utilities would be moved from their existing locations under Alaskan Way to the east, under the existing viaduct or east of the existing viaduct. Throughout the first 30 months of construction, a single waterfront pier could expect construction crews to pass by up to 12 times for a period of 1 to 5 weeks for each pass. Activities could occur up to 24 hours a day, 7 days a week. Over the entire 30-month period, crews would be working directly in front of a fixed point for a total period of about 6 to 12 months. During this construction stage, noise and disruptions to pedestrians and traffic on Alaskan Way would be localized and considerably less than in future construction stages.

Building the Colman Dock Ferry Terminal Access Road

Both alternatives would construct a new temporary over-water bridge between S. Washington Street and Yesler Way. Since the Draft EIS was published, this proposed bridge is now smaller than originally proposed, and it would be a temporary structure rather than a permanent fixture of the project. The temporary bridge would provide vehicle access to and from the ferry terminal during construction. The new bridge would extend over Elliott Bay and connect the upland portion of Pier 48 to the Colman Dock Ferry Terminal. It would be constructed by placing steel or precast concrete piles and by placing a precast or cast-in-place over-water roadway deck on the pilings. It would take approximately 3 months to build this temporary structure. Once project construction is completed, the temporary bridge would be removed, and drivers would access the ferry terminal directly from the completed Alaskan Way.

Rebuilding the Seawall

The seawall would be replaced from S. Jackson Street to just north of Broad Street. Both alternatives would make soil improvements and replace face paneling

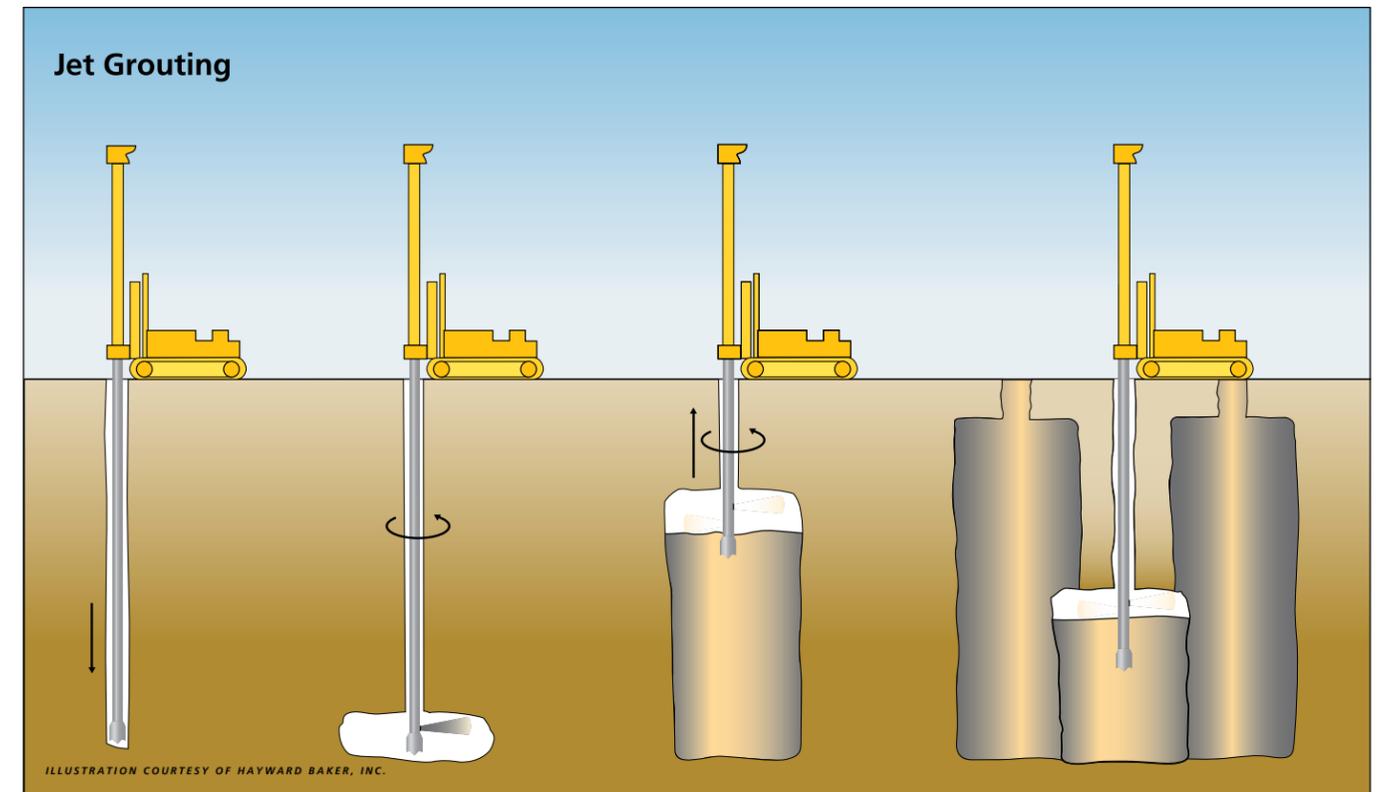


Exhibit 6-4

where the failing bulkhead is located between S. Jackson Street and S. Washington Street.

For the Tunnel Alternative, the existing seawall would be replaced with the outer wall of the tunnel from S. Washington Street up to Union Street. For most of the areas between Union and Broad Streets where a tunnel is not proposed, the seawall would be replaced by strengthening the soil and replacing the existing seawall with a new face panel and L-wall support structure. Near Pier 66, between Blanchard and Battery Streets, only soil improvements are needed since other improvements have already been made to this section of the seawall.

The Elevated Structure Alternative proposes to replace the seawall from S. Washington Street to just north of Broad Street using the same seawall design proposed north of Union Street for the Tunnel Alternative.

How can soil be strengthened?

Soil can be strengthened by mixing it with cement grout.

The construction steps for the tunnel wall are described in a subsequent section, whereas the steps for rebuilding the seawall are described below.

Step 1, Remove Sidewalk (above seawall) – In areas where the seawall would be rebuilt, crews would remove the existing sidewalk that extends out over the seawall. This activity is expected to take about 2 to 3 days for a 100-foot section of sidewalk. The sidewalk would be removed using concrete saws and cranes. Pedestrian access directly in front of the work zone would be rerouted. To help maintain pedestrian access along the waterfront, the project partners are considering the feasibility of constructing temporary over-water pedestrian walkways between some piers.

Step 2, Install Protective Wall – Once the sidewalk is removed, crews may remove riprap adjacent to the seawall. During this activity, cranes and excavators would be parked on the landward side of the seawall. Once the riprap is removed, a sheet pile wall, silt curtain, or equivalent protective measure would be installed in front of the existing seawall to prevent construction debris from reaching Elliott Bay. If a sheet pile wall was installed, it would most likely be installed using vibration to limit effects to surrounding aquatic life. These activities would take about 2 to 3 weeks at each 100-foot section.

Step 3, Remove Soil – Next, crews would excavate down to the seawall's relieving platform, which is about 15 feet below the Alaskan Way surface street. The excavated area would be about 15 feet deep and 40 feet wide. Backhoes and cranes would be used to dig and remove debris, and the material would most likely be removed from the site in trucks. Each 100-foot section would take 2 to 3 days to excavate.

Step 4, Improve Soil – Once the sheet pile wall or protective measure is in place and soil is removed, crews would begin strengthening the soil using a process called jet grouting, as shown in Exhibit 6-4. Jet grouting is a process by which cement grout is injected under high pressure to mix with weak soil. Jet grouting would create a solid block of strengthened soil behind the existing seawall. The extent of required jet grouting depends on soil conditions in

the immediate area, but in general, grout would be injected below the relieving platform into an area up to 40 feet wide and 60 feet deep.

Step 5, Construct Seawall Components – Once grouting is completed, new seawall components would be constructed. These components are shown in Exhibit 6-5 and include a new mud slab, tie slab, L-wall, and H-pile wall. These components would either be pre-cast concrete or they would be built in place. Once these components are built, the excavated area would be filled with soil, the existing seawall face would be removed and replaced, and a new sidewalk would be built.

Removing the Viaduct

In the central section, the viaduct would be removed for either alternative using the same methods described in Question 5 for the south section. In the central section, it would take 6 to 12 months to remove the existing viaduct.

Replacing SR 99 from Pine Street to the Battery Street Tunnel

Both alternatives would replace SR 99 from Pine Street to the Battery Street Tunnel. The Tunnel Alternative would configure SR 99 under Elliott and Western Avenues and includes the choice to replace SR 99 with an aerial structure over Elliott and Western Avenues. The Elevated Structure Alternative would replace SR 99 with an aerial structure over Elliott and Western Avenues.

For the Tunnel Alternative, SR 99 would be built under Elliott and Western Avenues. Between Pine and Lenora Streets, SR 99 would be built over the BNSF railroad tunnel and tracks with an aerial structure. Between Lenora Street and the Battery Street Tunnel, SR 99 would be lowered by excavating soil in a retained cut.

For the Elevated Structure Alternative, SR 99 would be replaced with new aerial structures between Pine Street and the Battery Street Tunnel.

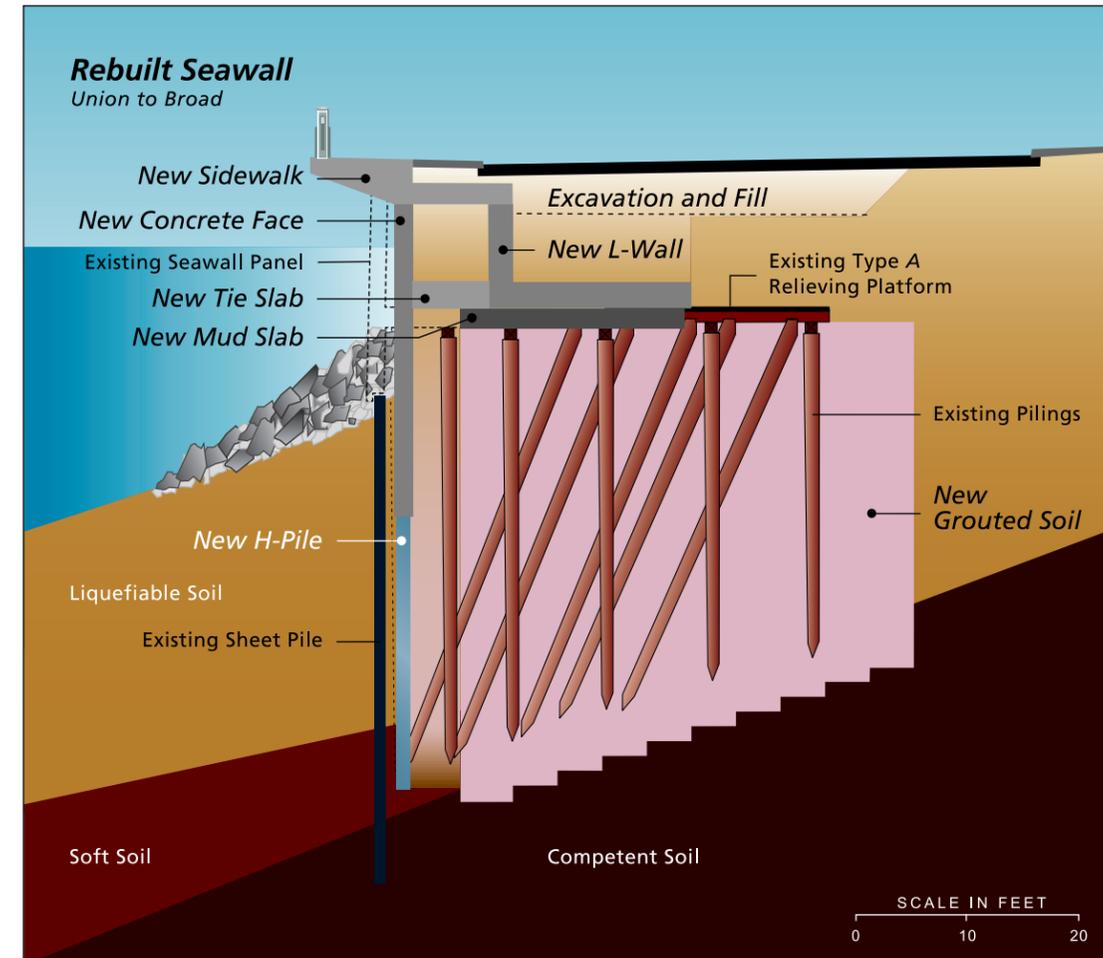


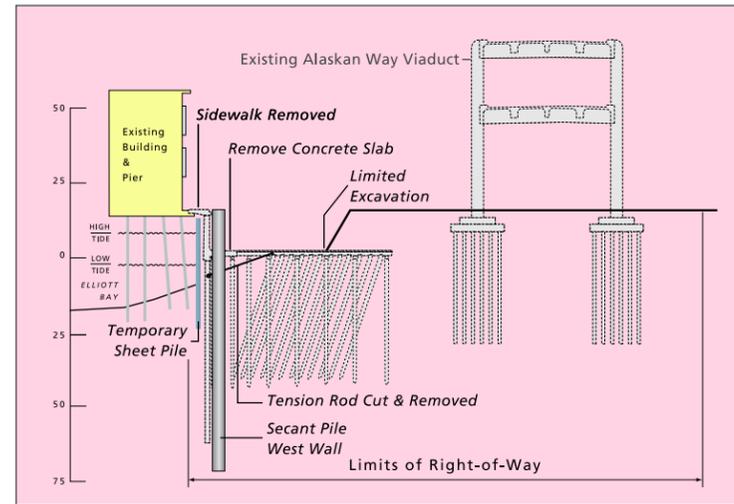
Exhibit 6-5

Replacing the Alaskan Way Surface Street

Both alternatives would replace the existing Alaskan Way surface street. The new roadway would be built by clearing and grading the area, installing the roadway drainage, laying the aggregate roadway foundation, and placing an asphalt or concrete overlay. Sidewalks, promenades, lighting, and landscaping would also be built. It would take about 6 months to replace Alaskan Way for the Elevated Structure Alternative and 12 months for the Tunnel Alternative. It would take longer to rebuild Alaskan Way for the Tunnel Alternative because of the configuration of Alaskan Way near Pine Street, the double streetcar tracks, and the larger area to landscape. Also, work to replace Alaskan Way could begin earlier in construction for the Elevated Structure Alternative than it could for the Tunnel Alternative.

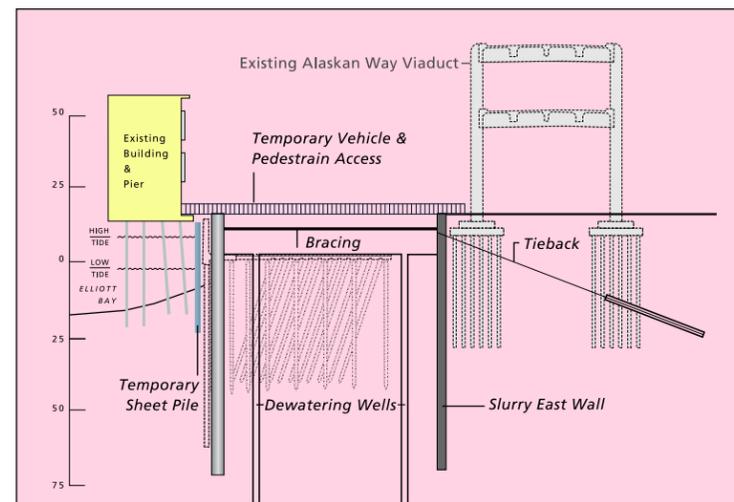
Stacked Tunnel Construction

Central Waterfront Section – S. Washington to Pike



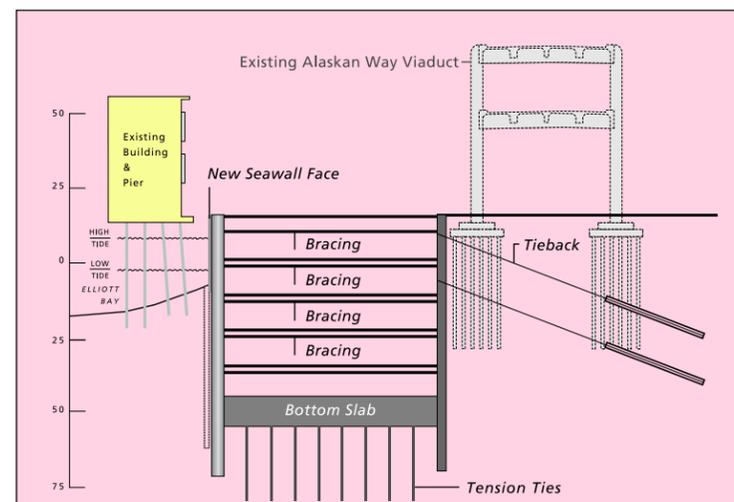
Step 1 – Install West Tunnel Wall

1. Remove parking and waterfront streetcar.
2. Relocate utilities—this will continue throughout construction.
3. Begin building the new west tunnel wall/seawall from S. Dearborn to Pine.
 - A. Remove sidewalk adjacent to piers; provide temporary access for pedestrians as needed.
 - B. Remove riprap adjacent to seawall and install temporary sheet pile wall or other protective measure waterward of the existing seawall.
 - C. Excavate soil landward of seawall; brace as needed. The excavation will be about 15 feet deep and up to 40 feet wide.
 - D. Dewater as needed.
 - E. Remove obstructions as needed.
 - F. Begin building west secant pile wall.



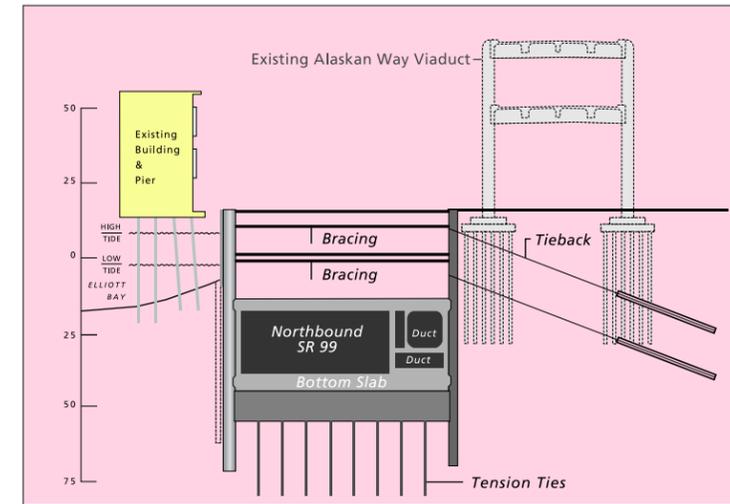
Step 2 – Install East Tunnel Wall

1. Begin building the east wall—slurry wall.
2. Complete west wall construction.
3. Complete the east (slurry) wall.
4. Continue excavating to top of relieving platform for full tunnel width.
5. Install top level bracing and tiebacks.
6. Construct temporary vehicle and pedestrian access to piers where needed.
7. Install dewatering wells and begin dewatering.



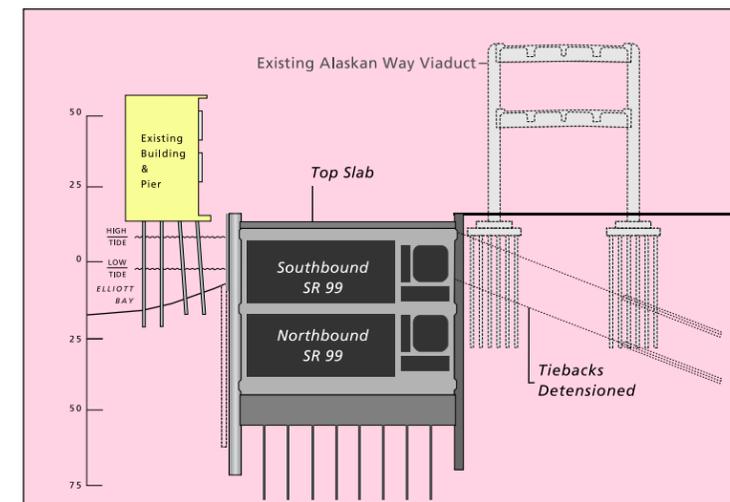
Step 3 – Tunnel Excavation

1. Remove seawall relieving platform.
2. Continue excavation to the bottom of the proposed tunnel; install tiebacks as needed.
3. Cast bottom slab connecting walls and install tension wires.
4. Discontinue dewatering.
5. Replace existing seawall panels; remove sheet pile wall.



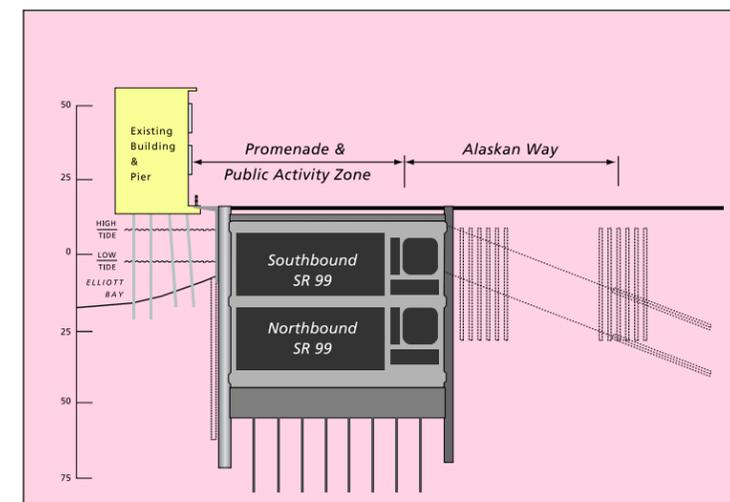
Step 4 – Northbound Tunnel Construction

1. Remove lower level bracings.
2. Install waterproofing membrane on bottom slab and east and west walls.
3. Cast northbound tunnel bottom slab, side walls, and ducts.
4. Cast the northbound tunnel roof slab.



Step 5 – Southbound Tunnel Construction

1. Detension upper rows of tiebacks.
2. Install waterproofing membrane.
3. Cast southbound tunnel roadway, side walls, and ducts.
4. Cast the top tunnel slab.



Step 6 – Complete Tunnel Construction

1. Install waterproofing over tunnel top slab.
2. Relocate utilities and backfill over tunnel.
3. Remove existing viaduct.
4. Construct Alaskan Way and surface improvements.

Construction Activities Required for the Tunnel Alternative

The construction sequence for the Tunnel Alternative is shown in Exhibit 6-6. The Tunnel Alternative assumes that a stacked tunnel would be built along the waterfront. Components of the Tunnel Alternative are described below.

Secant Pile Wall Construction

The western wall of the tunnel would most likely be a secant pile wall. A secant pile wall is a wall of interlocking drilled shafts. Between Pier 48 and the Seattle Aquarium, the secant pile wall would replace the existing seawall and form the outer wall of the tunnel.

As described in the Draft EIS, the wall would most likely be constructed of 4- or 5-foot-diameter drilled shafts that would extend 90 feet below the street's surface. The shafts would overlap to form a continuous wall from where the tunnel begins near S. Dearborn Street to where the tunnel ends near Pine Street. For the most part, the secant pile wall would be built behind the existing seawall. Between Pier 48 and Colman Dock, a section of the secant pile wall would extend into Elliott Bay.

It would take about 18 months to build the secant pile wall from S. Dearborn Street to Pine Street, assuming multiple crews are working at the same time. Construction steps for the secant pile wall are described below; steps 1, 2, and 3 are similar to rebuilding the seawall, but step 4 is unique to secant pile wall construction.

Step 1, Remove Sidewalk (above seawall) – In areas where the seawall would be rebuilt, crews would remove the existing sidewalk that extends out over the seawall. This activity is expected to take about 2 to 3 days for a 100-foot section of sidewalk. The sidewalk would be removed using concrete saws and cranes. Pedestrian access directly in front of the work zone would be rerouted. To help maintain pedestrian access along the waterfront, the project partners are considering the feasibility of constructing temporary over-water pedestrian walkways between some piers.

Step 2, Install Protective Wall – Once the sidewalk is removed, crews may remove riprap adjacent to the seawall. During this activity, cranes and excavators would be parked on the landward side of the seawall. Once the riprap is removed, a sheet pile wall, silt curtain, or equivalent protective measure would be installed in front of the existing seawall to prevent construction debris from reaching Elliott Bay. If a sheet pile wall were installed, it would most likely be installed using vibration to limit effects to surrounding aquatic life. These activities would take about 2 to 3 weeks at each 100-foot section.

Step 3, Remove Soil – Next, crews would excavate down to the seawall's relieving platform, which is about 15 feet below the Alaskan Way surface street. The excavated area would be about 15 feet deep and 40 feet wide. Backhoes and cranes would be used to dig and remove debris, and the material would most likely be removed from the site in trucks. Each 100-foot section would take 2 to 3 days to excavate.

Step 4, Build Secant Pile Wall – Crews would now begin building the secant pile wall from S. Dearborn Street to Pine Street. This wall would be constructed by building drilled shafts that overlap to form a secant pile wall. In general, the drilled shafts for this section would be built by drilling soil out of the shafts to the desired size (in this case, the shafts would have a circumference of about 4 to 5 feet and extend as far as 90 feet down to reach competent soil), installing rebar, and filling the hole with the concrete that forms the new drilled shaft.

Approximately 1,500 4-foot-diameter shafts would be required for either the stacked or the side-by-side tunnel. The number of shafts required would depend on the final project design, which could call for shafts that are 1 or 2 feet larger or smaller. Engineers expect that it would take about 1 day to build each drilled shaft, though it's possible that up to two shafts could be built each day. Based on these production rates, it would take about 1 month to construct a 100-foot section of the secant pile wall (or a total of 29 drilled shafts). Each shaft needs 3 to 5 days for the concrete to cure before the overlapping shaft is installed, so if a

construction crew were building a 100-foot section, they would build about 15 shafts along the entire 100 feet, and then they would come back and build the overlapping shafts to complete the section.

Slurry Wall Construction

For both the stacked and side-by-side tunnels, a slurry wall may be constructed to form the eastern tunnel wall. As described in the Draft EIS, the wall would be about 3 feet wide and 90 feet deep along the entire length of the proposed tunnel. Construction of the eastern wall would most likely lag behind the secant pile wall construction by about 2 to 3 months so that the operations do not conflict. Both walls would be completed about the same time.

In general, slurry walls are constructed as described below:

- Concrete guide walls would be constructed on each side of the proposed 3-foot-wide slurry wall. The guide walls are usually constructed in a trench 3 to 5 feet deep.
- Slurry wall excavation would proceed in the trench between the guide walls. Excavated material would be replaced with a slurry mixture, which keeps the walls of the hole from caving in as excavation progresses. The excavation and slurry injection would continue down to the desired depth of the wall (from 75 to 90 feet in the central waterfront).
- Once the area is excavated, rebar (or steel beams) would be lowered into the hole through the slurry mixture.
- The hole would be filled with concrete. As the concrete fills the hole, the slurry material would be pumped out and stored for reuse. Slurry wall construction would continue until the wall is the desired length.

Tunnel Excavation

As described in the Draft EIS, tunnel construction would require extensive excavation of soil. Soil would be excavated and tested for contamination and monitored for cultural and historic artifacts. Once tested, the soil would be transported to an appropriate disposal facility. Soil would be transported by truck, rail, or barge.

What is a secant pile wall?

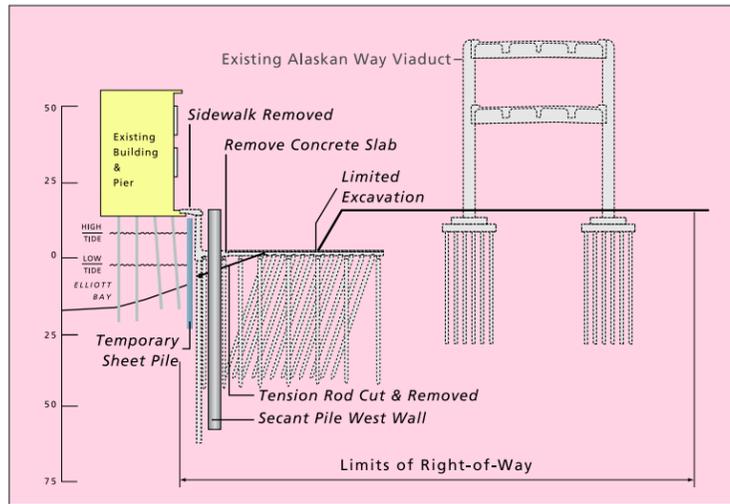
A secant pile wall is built by placing two concrete drilled shafts apart from each other. Then another shaft is placed between the first two shafts. This forms a continuous wall of interlocking shafts, called a secant pile wall.

What is a slurry wall?

A slurry wall is a reinforced concrete wall, constructed in an excavated trench. During excavation, a sealing mixture called slurry (made of bentonite and water) is used to support the excavated trench. Bentonite is clay that expands to help seal off groundwater flow and support the trench during excavation.

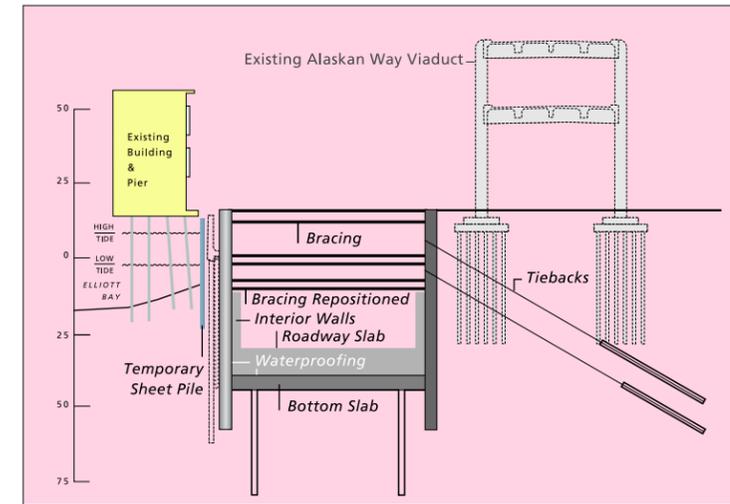
Side-By-Side Tunnel Construction

Central Waterfront Section – S. Washington to Pike



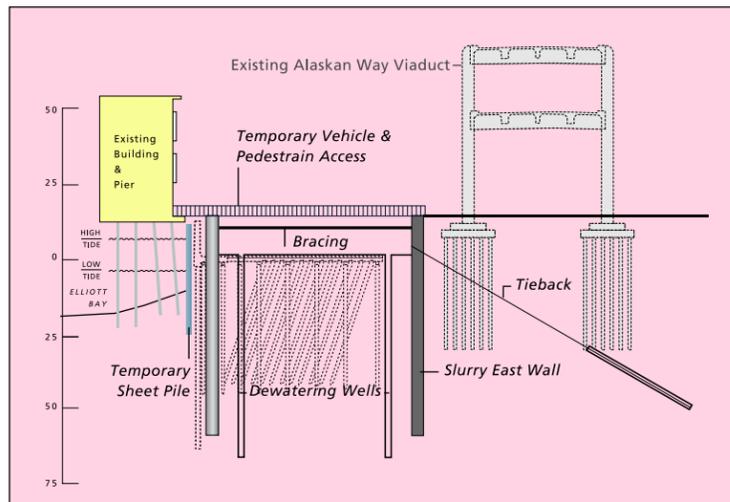
Step 1 – Install West Tunnel Wall

1. Remove parking and waterfront streetcar.
2. Relocate utilities—this will continue throughout construction.
3. Begin building the new west tunnel wall/seawall from S. Dearborn to Pine.
 - A. Remove sidewalk adjacent to piers; provide temporary access for pedestrians as needed.
 - B. Remove riprap adjacent to seawall and install temporary sheet pile wall or other protective measure waterward of the existing seawall.
 - C. Excavate soil landward of seawall; brace as needed. The excavation will be about 15 feet deep (to the top of the relieving platform), and up to 40 feet wide.
 - D. Dewater as needed.
 - E. Remove obstructions as needed.
 - F. Begin building west secant pile wall.



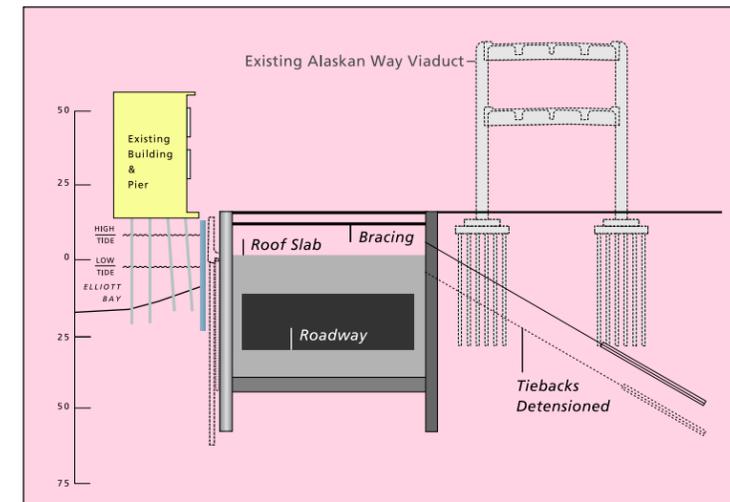
Step 4 – Continue Southbound Tunnel

1. Cast southbound tunnel bottom slab.
2. Install waterproofing membrane on bottom slab and walls.
3. Construct southbound tunnel roadway slab.
4. Remove lower level bracings and detension tiebacks in lower rows.
5. Install waterproofing.
6. Construct interior walls.
7. Install bracing between interior walls.



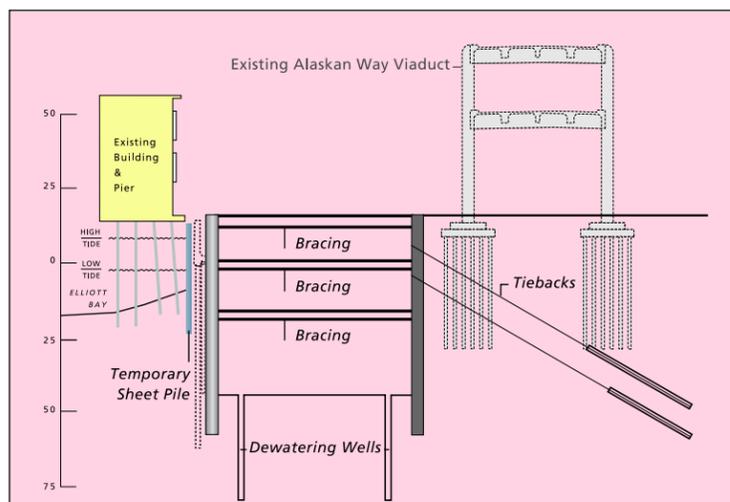
Step 2 – Install East Tunnel Wall

1. Begin building the east wall—slurry wall.
2. Complete west wall construction.
3. Complete the east (slurry) wall.
4. Continue excavating to top of relieving platform for full tunnel width.
5. Install top level bracing and tiebacks.
6. Construct temporary vehicle and pedestrian access to piers where needed.
7. Install dewatering wells and begin dewatering.



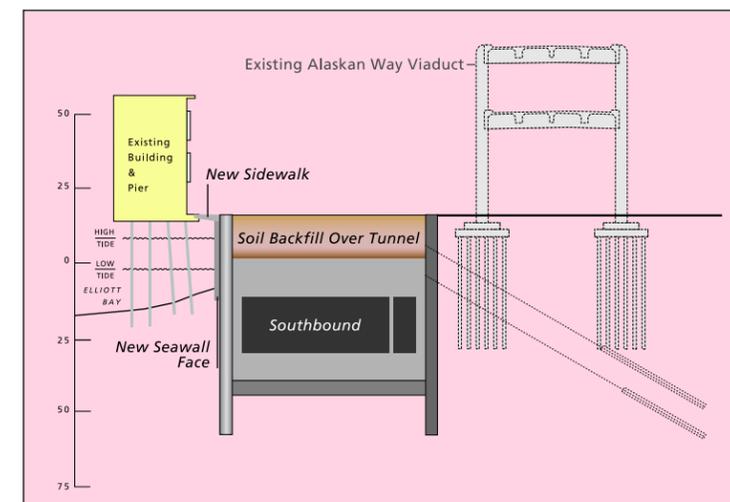
Step 5 – Southbound Tunnel Construction

1. Maintain dewatering.
2. Reposition bracing as needed.
3. Detension tiebacks and install roof waterproofing.
4. Construct roof structure and install roof waterproofing.
5. Remove bracing.
6. Discontinue dewatering.
7. Complete southbound tunnel ventilation, egress stairs, and tunnel finishes.



Step 3 – Tunnel Excavation

1. Remove seawall relieving platform.
2. Continue excavation to the bottom of the proposed tunnel; install tiebacks as needed.
3. Maintain dewatering.



Step 6 – Complete Southbound Tunnel Construction

1. Remove traffic decking and top bracing.
2. Backfill above tunnel. Relocate utilities where required to permanent locations.
3. Replace existing seawall panels; remove sheet pile wall.
4. Shift southbound traffic from viaduct to new southbound tunnel.

Dewatering

As described in the Draft EIS, tunnel construction would require dewatering in advance of excavation to keep construction areas dry and to control the stability of the excavation. Water pumped out of the tunnel construction zone would either be reinjected back into the ground or discharged into Elliott Bay. If water quality monitoring indicated that the water required treatment, it would be treated prior to being discharged.

How would tunnel construction be different if a side-by-side tunnel were built?

Construction activities would be similar to those described above if a side-by-side tunnel were built. The primary differences are that a side-by-side tunnel would be built in two passes instead of one. Also, the sequence of construction activities would be different, as shown in Exhibit 6-7.

Construction Activities Required for the Elevated Structure Alternative

The Elevated Structure Alternative would require constructing a new viaduct in the central section from S. Dearborn Street to Pine Street. The construction sequence has changed since the Draft EIS was issued. Exhibit 6-8 on the next page shows the updated construction approach for building the new viaduct.

In addition to the steps outlined in Exhibit 6-8, the foundation of the existing viaduct would be replaced by building new foundations made of drilled shafts. Driven piles and pile caps may be used in place of drilled shafts in some cases. The superstructure would be completely replaced using precast components as much as feasible.

7 How would the project be built in the north section?

North end construction activities would be similar for the Tunnel and Elevated Structure Alternatives, since they both propose to upgrade the Battery Street Tunnel and construct the Partially Lowered Aurora improvements. Proposed construction activities are discussed below.

Upgrading the Battery Street Tunnel

Both the Tunnel and Elevated Structure Alternatives would improve the Battery Street Tunnel to meet safety requirements for fire and seismic events, and the tunnel floor would be lowered to increase the vertical clearance in the tunnel to 16.5 feet. Construction activities, which are expected to take 24 months, could require the following:

- Constructing air intakes on the south and north ends of the existing tunnel.
- Constructing up to four emergency exits (two on each side of the tunnel). These emergency exits are expected to be located near the intersections of Second Avenue and Battery Street and Fifth Avenue and Battery Street.
- Building tunnel vent support structures near the intersections of Western Avenue and Battery Street and John Street and Eighth Avenue.
- Replacing and upgrading the lighting system in the tunnel.
- Lowering the existing tunnel floor to increase the vertical clearance to 16.5 feet. The tunnel would be lowered by excavating soil in the existing tunnel and replacing the existing roadway in the tunnel.

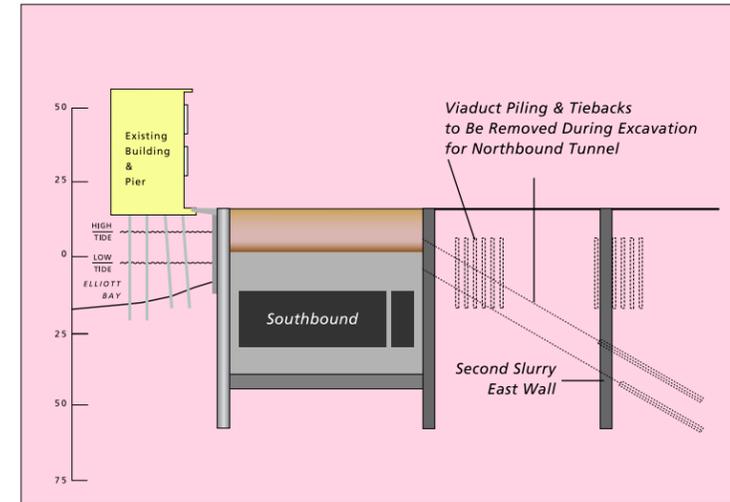
Building Partially Lowered Aurora

Building Partially Lowered Aurora could require the following:

- Lowering the roadway profile of SR 99/Aurora Avenue N. by up to 45 feet between Denny Way and Republican Street. The northbound lanes of SR 99 (or the east half) would be about 20 feet lower than the southbound lanes to allow for the northbound on-ramp from Denny Way.
- Widening Mercer Street to accommodate two-way traffic.
- Connecting the street grid with new bridges over SR 99 at Thomas and Harrison Streets.
- Rebuilding the Denny Way ramps.
- Building cul-de-sacs at John, Valley, and Aloha Streets.
- Closing and filling Broad Street from Fifth to Ninth Avenues N.

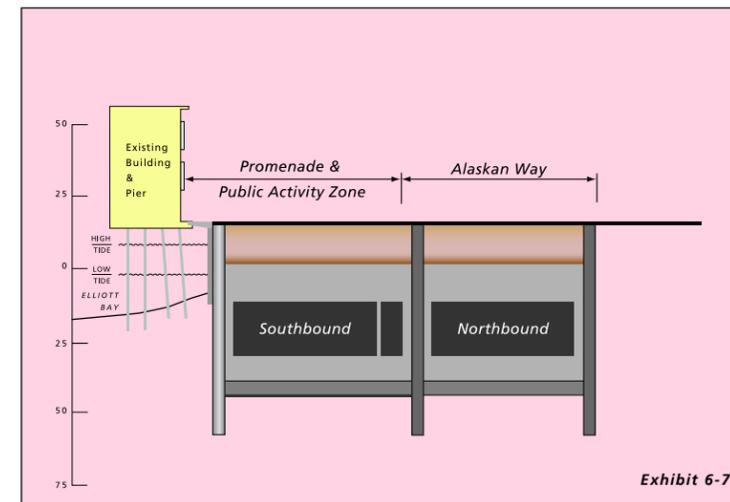
Side-By-Side Tunnel Construction

Central Waterfront Section – S. Washington to Pike



Step 7 – Northbound Tunnel Construction

1. Demolish existing viaduct.
2. Relocate utilities as required for northbound tunnel excavation.
3. Construct new east wall.
4. Continue northbound tunnel construction as described in Steps 3 – 5. Tiebacks would not be used.



Step 8 – Complete Northbound Tunnel Construction

1. Backfill above northbound tunnel.
2. Complete northbound tunnel ventilation, tunnel finishes, and systems.
3. Open northbound tunnel to traffic.
4. Complete Alaskan Way and surface improvements.

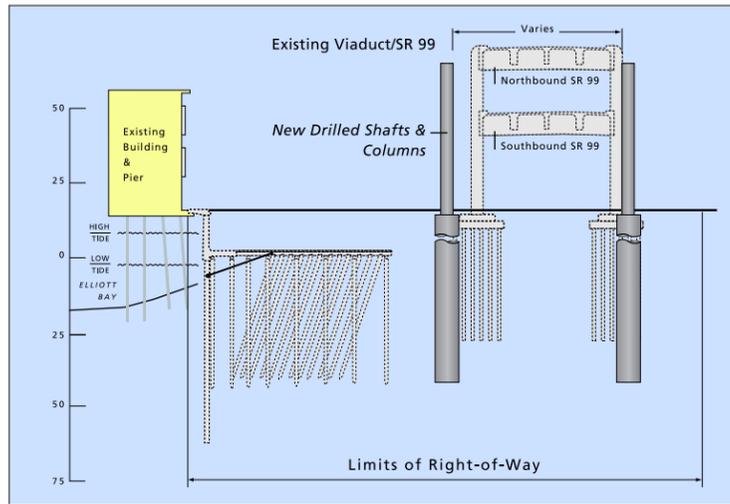
Exhibit 6-7

It would take 36 to 42 months to build Partially Lowered Aurora. Construction crews would first relocate utilities and begin building the west half, or southbound lanes, of SR 99. A temporary retaining wall would be built in the middle of SR 99 to support the east half, or northbound lanes, of the roadway while the southbound lanes are under construction. Construction activities for the west half are:

- Building retaining walls from the north portal of the Battery Street Tunnel up to Harrison Street.
- Demolishing the southbound lanes of SR 99.

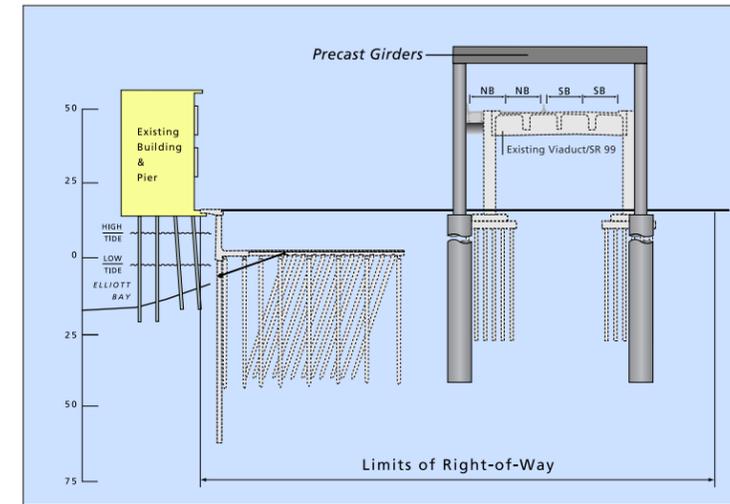
Elevated Structure Construction

Central Waterfront Section - S. Washington to Pike



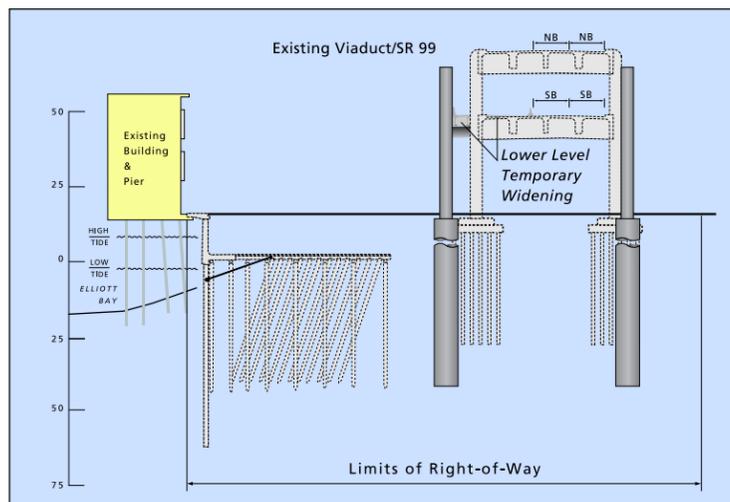
Step 1

1. Construct new drilled shafts and columns.



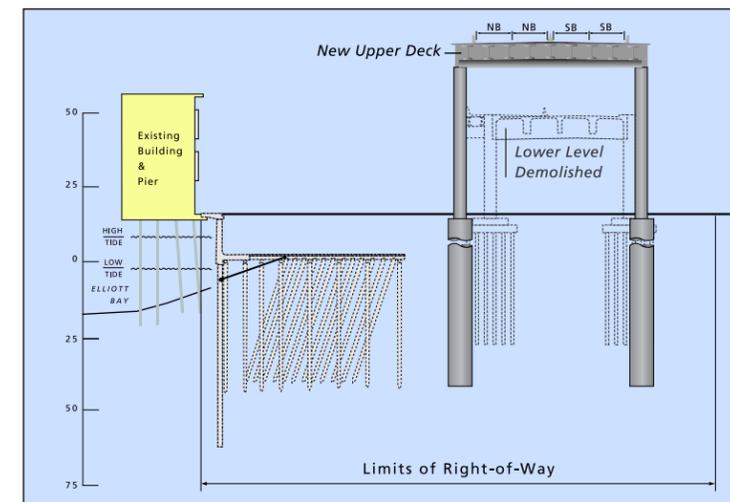
Step 4

1. Shift traffic to lower level.
2. Construct new upper level. Use night closures to set precast girders.



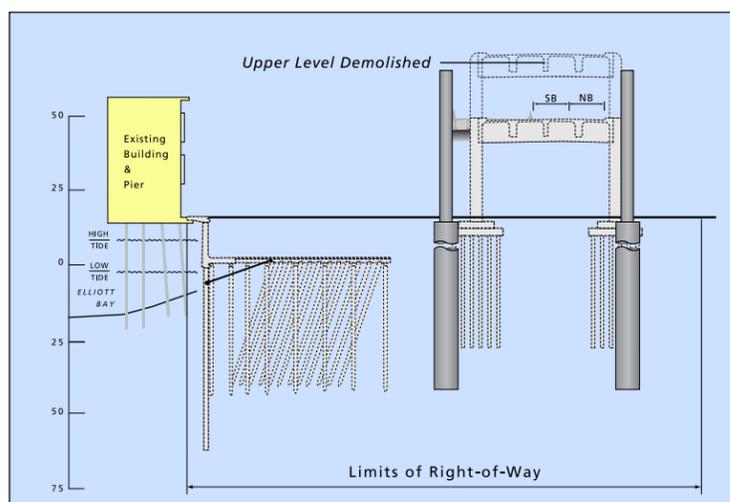
Step 2

1. Restrict traffic to two lanes in each direction.
2. Construct lower level temporary widening for entire length of double-level viaduct.



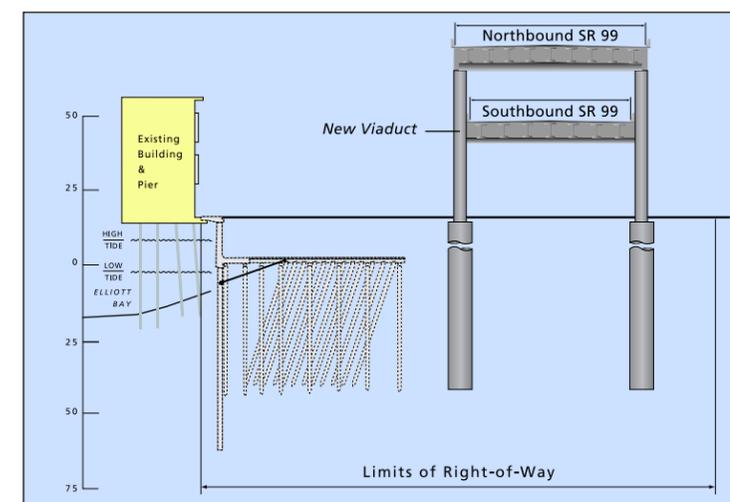
Step 5

1. Shift all traffic to new upper level, 2 lanes in each direction.
2. Demolish remaining lower viaduct deck.



Step 3

1. Demolish the viaduct upper level. Approximate duration, 3 months.



Step 6

1. Construct new lower level.
2. Shift southbound traffic to lower level.

- Excavating the west half of SR 99 for the new lowered roadway, which could include dewatering if groundwater is encountered.

Once excavated, the new roadway bed would be built and opened to traffic. It would take about 18 to 24 months to build the southbound lanes.

Once the west half is completed, then the east half, or northbound lanes, of SR 99 would be constructed. Construction activities would be similar to those described for the west half, except the retaining wall would be deeper for the east side. Additionally, a wall would be built between the northbound and southbound lanes from Denny Way to Republican Street. It would take 12 to 18 months to build the northbound lanes.

Broad Street would be closed and backfilled from approximately Fifth Avenue N. to Ninth Avenue N., allowing the street grade to be reconnected. Mercer Street would be widened to seven lanes (three lanes each way with a center turn lane). Bridges would be built at Thomas and Harrison Streets, and portions of Sixth and Taylor Avenues N. and Harrison, Thomas, and Roy Streets would be restored and constructed. The northbound on-ramp from Denny Way would be built, and utilities would be installed in their final locations.

How would construction activities be different if the choice was made to widen the Battery Street Tunnel curves and build Lowered Aurora?

Widening the Curves

The Tunnel and Elevated Structure Alternatives include the choice to widen the curves on both ends of the Battery Street Tunnel in addition to the upgrades described in the previous section. If the choice to widen the curves is selected, construction activities in and around the Battery Street Tunnel would take an additional 12 months, which wouldn't change the total duration of north end construction, but it would increase the length of time it takes to construct the Battery Street Tunnel improvements. In addition, to widen the curves, about half of the lid over the Battery Street Tunnel would need to be

removed, requiring both the Battery Street Tunnel and Battery Street to be closed to traffic for 12 to 18 months. At the southwest end of the tunnel, the lid would be removed from the portal near First Avenue to about Second Avenue. At the northeast end, the lid would be removed from the portal to about Fifth Avenue. Temporary roadway decking would be placed over the Battery Street Tunnel at First Avenue, Fifth Avenue, Sixth Avenue, and Denny Way so traffic could continue to use these cross-streets during construction. Battery Street would not need to be closed if the curves remain as they are today.

Lowered Aurora

The Lowered Aurora improvements would:

- Lower SR 99 by up to 25 feet from the Battery Street Tunnel up to Comstock Street.
- Rebuild the Denny Way ramps.
- Widen Mercer Street.
- Connect the street grid with new bridges over SR 99 at Thomas, Harrison, Republican, Mercer, and Roy Streets.
- Build new ramps at Republican and Roy Streets.
- Build cul-de-sacs at John, Valley, Aloha, and Ward Streets.
- Close and fill Broad Street from Fifth Avenue N. to Ninth Avenue N.

Construction crews would first relocate utilities and build temporary bridges at John and Thomas Streets that would be used to route traffic off of Mercer and Broad Streets. Once these preliminary activities are completed, crews would begin building the west half, or southbound lanes, of SR 99. Construction activities for the west half, which would take about 24 months, are:

- Building a retaining wall from the north portal of the Battery Street Tunnel up to Prospect Street.
- Demolishing the southbound lanes of SR 99.
- Dewatering and excavating the west half of SR 99 for the new lowered roadway.

Next, the east half (northbound lanes) of SR 99 would be lowered and rebuilt using the same steps described for the west half. It would take about 18 months to

build the northbound lanes. During construction of the northbound lanes, Broad Street and Mercer Street would be filled and regraded, allowing a new bridge to be built over SR 99 for Mercer Street. Once Mercer Street is completed, new portions of Sixth Avenue N. could be rebuilt, and bridges would be built at Republican, Harrison, and Thomas Streets. Ramps and cul-de-sacs would also be built at this time.