Alternatives Construction Chart

Timeline Assumes Full Project Funding

Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14

STAGE ONE | STAGE TWO | STAGE THREE | STAGE FOUR | STAGE FIVE | ESTIMATED DURATIONS

All alternatives have similar activities but different durations

Includes Stages Two - Five

Stage One – 18 months

Preliminary Construction

Similar activities for all alternatives

The activities in this stage are not included in the total duration times in the last column.

- Establish construction staging areas
- Remove parking underneath the existing Viaduct and construct a temporary roadway for traffic detours.
- Relocate utilities as needed and set up temporary services
- Remove Whatcom Railroad Yard
- Construct alternate ferry holding
- Construct access road between Pier 48 and Colman Dock Ferry Terminal
- Remove the Waterfront Street Car and track
- Relocate Seattle Fire Station

Rebuild

Rebuild - 24 months

- Rebuild Seawall
- Construct at-grade SR 99 from S. Holgate to S. King
- Construct west half of ramps to SR 519
- Start rebuilding Viaduct

Rebuild - 54 months

- Complete rebuilding the Viaduct and ramps from S. King to the Battery Street Tunnel
- Demolish the Viaduct from S. Holgate to S. King
- Construct east half of SR 519 interchange

8 mos.

- Complete relocation of utilities
- Restore Alaskan Way surface street
- Route traffic to final configurations

7. 5 years

Aerial

Aerial - 36 months

- Construct aerial structure from S. Stacy to S. Royal Brougham
- Rebuild Seawall
- Construct temporary Viaduct along waterfront
- Establish Broad St. Detour and construct temporary trestles
- Widen Mercer Underpass

Aerial - 30 months

- Remove southbound aerial structure (Pike to Battery Street Tunnel)
- Construct new southbound aerial structure (Pike to Battery Street Tunnel)
- Improve southbound Battery Street Tunnel

Aerial - 48 months

- Remove Viaduct (S. Holgate to Battery Street Tunnel)
- Construct new Viaduct from S. Royal Brougham to Pike
- Construct new northbound aerial structure (Pike to Battery Street Tunnel)
- Improve northbound Battery Street Tunnel

15 months

- Complete relocation of utilities
- Restore Alaskan Way surface street
- Route traffic to final configurations
- Remove temporary structure

11 years

Tunnel

Tunnel - 24 months

- Rebuild Seawall in areas where tunnel does not fix Seawall
- Establish Broad Street Detour and construct temporary trestles
- Build southbound tunnel with ramps from Union to Virginia
- Widen Mercer Underpass
- Start southbound tunnel construction from S. King to Union
- Start building west half of ramps to SR 519

Tunnel - 36 months

- Remove southbound aerial structure (Pike to Battery Street Tunnel)
- Construct new southbound aerial structure (Pike to Battery Street Tunnel)
- Improve southbound Battery Street Tunnel
- Complete southbound tunnel (S. King to Virginia)
- Complete west half of ramps to SR 519

Tunnel - 36 months

- Remove northbound aerial structure (Pike to Battery Street Tunnel)
- Construct new northbound aerial structure (Pike to Battery Street Tunnel)
- Improve northbound Battery Street Tunnel
- Remove existing Alaskan Way Viaduct from S. Holgate to Pike
- Construct northbound Tunnel
- Construct east half of ramps to SR 519

13 months

- Complete relocation of utilities
- Restore Alaskan Way surface street
- Route traffic to final configurations

9 years

Bypass Tunnel

Bypass Tunnel - 24 months

- Rebuild Seawall in areas where tunnel does not fix Seawall
- Establish Broad Street Detour and construct temporary trestles
- Widen Mercer Underpass
- Start Bypass Tunnel construction
- Start building the west half of ramps to SR 519

Bypass Tunnel - 30 months

- Remove southbound aerial structure (Pike to Battery Street Tunnel)
- Construct new southbound aerial structure (Pike to Battery Street Tunnel)
- Improve southbound Battery Street Tunnel
- Complete Bypass Tunnel construction
- Complete west half of ramps to SR 519

Bypass Tunnel - 30 months

- Remove northbound aerial structure (Pike to Battery Street Tunnel)
- Construct new northbound aerial structure (Pike to Battery Street Tunnel)
- Improve northbound Battery Street Tunnel
- Construct east half of ramps to SR 519

18 months

- Complete relocation of utilities
- Restore Alaskan Way surface street
- Route traffic to final configurations

8.5 years

Surface

Surface - 30 months

- Rebuild Seawall
- Establish Broad Street Detour and construct temporary trestles
- Widen Mercer Underpass
- Start building the west half of ramps to SR 519
- Build temporary southbound SR 99 at-grade roadway for traffic detour above Seawall

Surface - 30 months

- Remove southbound aerial structure (Pike to Battery Street Tunnel)
- Construct new southbound aerial structure (Pike to Battery Street Tunnel)
- Improve southbound Battery Street Tunnel
- Complete west half of ramps to SR 519

Surface - 30 months

- Remove the existing Viaduct
- Construct new northbound aerial structure (Pike to Battery Street Tunnel)
- Construct northbound Battery Street Tunnel Improvements
- Construct SR 99 at-grade roadway from S. Holgate to Pike
- Construct east half of ramps to SR 519

8 mos.

- Complete relocation of utilities
- Restore Alaskan Way
- Route traffic to final configurations

8 years

Exhibit 10-1

CHAPTER 10 - CONSTRUCTION IMPACTS AND MITIGATION

1 How long will it take to build the project?

How will this project be built, how long will it take, how much will it cost, and how will people in and around the city be affected? As we answer these questions and plan for the future, it is important to remember our past. Did you know that it took over 8 years to build the original viaduct back in the 1950s? That was before the viaduct was part of a major state highway route supporting over 110,000 trips a day. The seawall was built separately from the viaduct, and it took more than 3 years to build.

So, how long will it take to build a replacement viaduct and seawall? Current estimates show that it will take between 7.5 and 11 years. These durations do not include an additional 18 months that will be required to begin relocating utilities and prepare the site for construction. These preliminary construction activities could begin in mid-2006, with major construction activities beginning in 2008.

The order of major construction activities and the time it will take to build the project are shown in Exhibit 10-1. Construction activities have been organized into five stages that are defined by proposed traffic detours. The timeframes assume that construction could occur 24 hours a day, 7 days a week. Continuous construction is proposed to minimize overall project costs and to shorten the time it takes to build the project.

The construction sequences and timelines have only been developed for the proposed alternatives. Estimates will be developed for options if they are selected as part of the preferred alternative. The estimated construction durations were developed using WSDOT's Cost Estimate Validation Process (CEVP®). The durations represent the 90th percentile value for estimated construction duration. This means that there is a 90 percent chance that the construction duration will be less than this value and a 10 percent chance that it will be greater.

To estimate construction durations, some overall assumptions had to be made. The estimated durations for each alternative are contingent upon these two primary assumptions:

1 All of the money needed to build the entire project will be available when construction begins.
2 SR 99 would not be completely closed. Two lanes of traffic would be maintained in the AWV Corridor during peak traffic hours or an alternate route would be provided. Some partial closures of SR 99 would be allowed. These partial closures are described in more detail in Question 4 of this chapter.

If these baseline assumptions were changed, then the estimated construction durations and overall costs would also change. As the project evolves, these baseline assumptions may change as engineers continue to try to find new ways to shorten the construction durations and/or lower the project cost. One way to shorten construction may be to completely close SR 99 for several years. Although this would cause congestion and disrupt traffic throughout much of the Seattle area, it could lessen the total construction time. Shortened construction time could save many millions of dollars because there would be less exposure to inflation and lower construction period financing costs. If SR 99 were completely closed, methods to mitigate and reduce the impacts would be identified.

2 How would the alternatives and options be built?

Exhibit 10-2 shows the type of construction activities for each alternative and option. Many construction activities are similar between the alternatives and options (e.g., soil improvements) and some of them are unique (e.g., tunnel construction).

Construction will occur simultaneously at several locations throughout the project area. The intensity of construction activities will vary. At times, there may not be any work being done in front of a specific property (such as a business located along the waterfront). However, for all of the alternatives, construction will pass by properties located in the construction zone more than once.

The text below describes how components of the alternatives and options are proposed to be built.

At-Grade Roadway Construction

All of the alternatives have sections of at-grade roadway construction. At-grade roadways would be built by clearing and grading the area, laying the aggregate roadway foundation, and placing an asphalt overlay. Construction equipment such as backhoes, excavators, front loaders, pavement grinders, jackhammers, trucks, and grading and paving equipment would be used.

Aerial Structure Construction

All of the alternatives include constructing new aerial structures somewhere in the project area. Aerial structures would be supported by drilled shafts or driven piles. Aboveground structures would be built of concrete columns, crossbeams, girders, roadway decks,

How long will it take to build the project?

The estimated construction time for each of the alternatives is shown below:

Rebuild	=	7.5 years
Aerial	=	11 years
Tunnel	=	9 years
Bypass Tunnel	=	8.5 years
Surface	=	8 years

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.

A CEVP® examines the project by using top engineers from private firms and public agencies around the country who are experienced in project management delivery.

WSDOT, FHWA and City of Seattle engineers are also involved in the workshop process.

The CEVP® helps determine overall project costs and construction durations by considering preliminary engineering plans, project risks, individual unit costs, and inflation.

The durations presented in this chapter represent the 90th percentile value for estimated construction time. This means there is a 90 percent chance that the construction duration will be less than this value and a 10 percent chance that it will be greater.

Construction Activities Chart

At-Grade · Aerial · Tunnel · Seawall

	SOUTH S. Spokane - S. King	CENTRAL S. King - Battery St. Tunnel	N. WATERFRONT Pike - Broad	NORTH Battery St. Tunnel - Ward	**Seawall** S. King - Bay Street Seawall at Pier 66/Cruise Ship Terminal not included
Rebuild	**At-Grade** • Build at-grade roadway • Build aerial structures for SR 519 connection • Soil Improvements	**Rebuild** • Rebuild aerial structures • Retrofit aerial structures • Build at-grade roadway	**Surface Street Improvements & Detours** • Build at-grade roadway	**No Improvements**	**Rebuild** • Soil improvements • Drilled Shafts
Aerial	**Stacked Aerial** • Build at-grade roadway • Build new aerial structure for SR 99 • Soil Improvements *Or*	**Aerial** • Build new aerial structures • Build at-grade roadway	**Surface Street Improvements & Detours** • Build at-grade roadway • Build temporary Viaduct • Build temporary Broad Street Detour *Or*	**Widened Mercer Underpass** • Upgrade Battery Street Tunnel • Widen Mercer • Build aerial structure across SR 99 at Thomas • Backfill and close Broad Street *Or*	**Rebuild** • Soil improvements • Drilled shafts *Or*
Options	**At-Grade** • Build at-grade roadway • Build aerial structures for SR 519 connection • Soil Improvements		***Surface Street Improvements & Detours*** • *Build at-grade roadway* • *Build temporary Viaduct* • *Build temporary Battery Street Flyover Detour*	***Lowered Aurora/SR 99*** • *Upgrade Battery Street Tunnel* • *Excavate Aurora* • *Build aerial structures across SR 99 connecting 5 Streets* • *Backfill and close Broad Street*	***Frame*** • *Continuous drilled shafts (secant pile wall)* • *Slurry wall*
Tunnel	**At-Grade** • Build at-grade roadway • Build aerial structures for SR 519 connection • Soil Improvements *Or*	**Tunnel** • Build tunnel • Build aerial structures • Build at-grade roadway *Or*	**Surface Street Improvements & Detours** • Build at-grade roadway • Build temporary Broad Street Detour *Or*	**Widened Mercer Underpass** • Upgrade Battery Street Tunnel • Widen Mercer • Build aerial structure across SR 99 at Thomas • Backfill and close Broad Street	**Tunnel Wall and Rebuild** • Tunnel construction • Soil improvements • Drilled shafts
Options	***Side-by-Side Aerial*** • *Build at-grade roadway* • *Build new aerial structures for SR 99* • *Soil Improvements*	***Ramps to Elliott/Western*** • *Same as above, only build aerial ramps to Elliott and Western*	***Surface Street Improvements & Detours*** • *Build at-grade roadway* • *Build temporary Battery Street Flyover Detour*		
Bypass Tunnel	**At-Grade** • Build at-grade roadway • Build aerial structures for SR 519 connection • Soil Improvements	**Bypass Tunnel** • Build tunnel • Build aerial structures • Build at-grade roadway *Or*	**Surface Street Improvements & Detours** • Build at-grade roadway • Build temporary Broad Street Detour *Or*	**Widened Mercer Underpass** • Upgrade Battery Street Tunnel • Widen Mercer • Build aerial structure across SR 99 at Thomas • Backfill and close Broad Street	**Tunnel Wall and Rebuild** • Tunnel construction • Soil improvements • Drilled shafts
Options		***Roadway to Elliott/Western*** • *Same as tunnel, only build aerial roadway from Alaskan Way to Elliott and Western*	***Surface Street Improvements & Detours*** • *Build at-grade roadway* • *Build temporary Battery Street Flyover Detour*		
Surface	**At-Grade** • Build at-grade roadway • Build aerial structures for SR 519 connection • Soil Improvements *Or*	**At-Grade** • Build at-grade roadway	**Surface Street Improvements & Detours** • Build at-grade roadway • Build temporary Broad Street Detour	**Widened Mercer Underpass** • Upgrade Battery Street Tunnel • Widen Mercer • Build aerial structure across SR 99 at Thomas • Backfill and close Broad Street *Or*	**Rebuild** • Soil improvements • Drilled Shafts
Options	***At-Grade with SR 519 At-Grade*** • *Build at-grade roadway with signals*			***Existing Aurora/SR 99 with Signals*** • *Add signals at Harrison, Republican and Roy*	

Exhibit 10-2

and traffic rail. Most of the concrete for the aerial structures would be cast-in-place, though precast components could be used.

New aerial structures would be supported underground by drilled shafts or driven piles. Drilled shafts would range from 8 to 14 feet in diameter and would extend between 60 and 150 feet into the soil, depending on the soil conditions in the immediate area. In general, drilled shafts are built by drilling soils out to the desired circumference and depth, installing rebar, and filling the hole with the concrete that forms the new drilled shaft. The stability of the excavated hole may be maintained either by keeping the hole continuously filled with a sealing mixture or by advancing a steel casing concurrently with the drilling operation.

In some areas, driven piles will be used to support aerial structures instead of drilled shafts. For this project, piles with footings would most likely be used for construction of new aerial structures south of S. Atlantic Street proposed with the Aerial Alternative and for rebuilding the existing viaduct foundations in the central section.

Piles can be constructed in various sizes using several different materials. At this time, it is expected that 30-inch-diameter piles would be constructed of steel casings filled with reinforced concrete. A cluster of several piles will be driven into the ground to support one column of the aerial structure.

There are two ways that pile casings are typically installed:

- A steel plate is welded onto the tip of the pile casing. This provides a dry, clean hole, which will be filled with reinforced concrete.
- If the pile casing is driven with an open end, the soil and water in the casing will be drilled or pumped out and the bottom of the empty casing will be filled with concrete to create an impervious plug.

Once the required number of piles is driven, a pile cap is built to connect the piles together and support the load from the column of the aerial structure. Pile caps are built by excavating soils, placing a concrete form, installing rebar, and filling the hole with concrete. After the foundation of the aerial structure is built, construction of the aboveground columns and girders proceeds. The columns and girders are typically cast-in-place using concrete forms.

Construction equipment used for aerial structure construction includes cranes, pile drivers, drilling rigs and augers, backhoes and excavators, jackhammers, concrete pumping equipment, and slurry processing equipment.

Soil Improvements

Soil improvements are proposed in many areas to strengthen existing liquefiable soils. Soil improvements will be required for all of the alternatives south of S. King Street where aerial structures are proposed. Soil improvements are also proposed as part of replacing the seawall in the central and north waterfront areas.

Deep soil mixing and jet grouting are the methods that will most likely be used for this project. Deep soil mixing will most likely be used to improve soils supporting aerial structures in the south. Jet grouting will most likely be used as part of seawall construction.

Soil improvements involve installing a series of mixing augers, 18 to 36 inches in diameter, attached to crane-supported equipment. As the augers are advanced into the ground, a cement grout is injected under pressure into the soil. The auger penetrates and breaks the soil loose and lifts it to the mixing blades, which blends the soil and cement grout. As the auger continues to advance, additional mixing blades remix the soil and slurry. Individual columns are constructed in an overlapping manner to create continuous zones of improved soil.[1]

The extent of soil improvements required for south end construction depends on the alternative or option selected. The stacked aerial structure proposed as part of the Aerial Alternative would require a larger area of soil improvements compared with the single-level aerial structures proposed for the other alternatives.

Jet grouting will most likely be used where the seawall will be rebuilt. Jet grouting is also a process by which cement grout is injected into weak soils under high pressure and then mixed. Jet grouting would create a solid block of improved soil behind the existing seawall that is imbedded into competent soils. The extent of soil improvements for this project depends on the type of roadway or seawall being built and the soil conditions at the site.

Construction equipment needed for making soil improvements includes drilling rigs and augers, concrete pumping equipment, and slurry processing equipment.

Appendix B contains additional information about construction activities.

What is a girder?

A girder is a beam often used as a main horizontal support in bridge construction.

What is an auger?

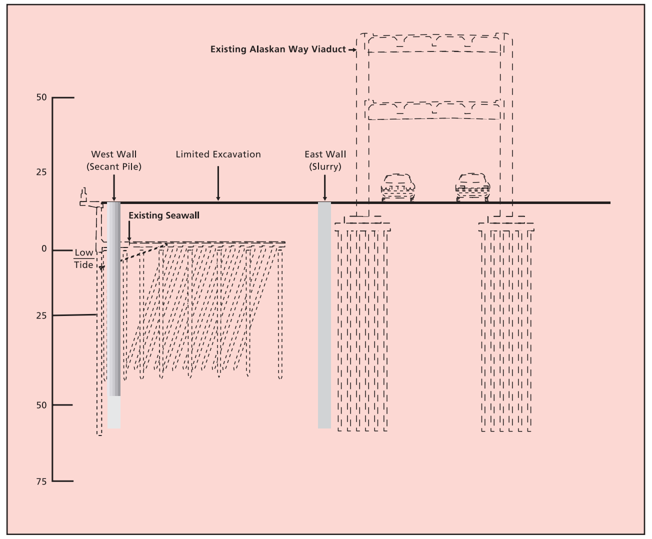
An auger is a construction tool used to drill holes in the ground.

Exhibit 10-3

Simulation of the temporary aerial structure.

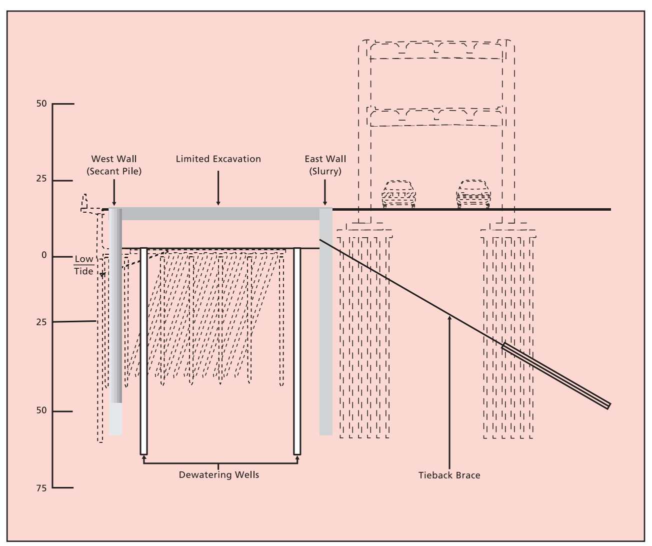
[1]Parsons Brinckerhoff 2003

Tunnel Construction



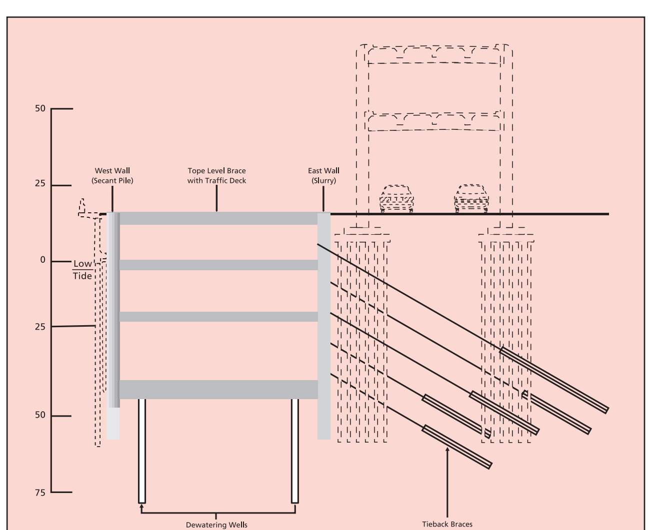
Step 1 - Excavate Tunnel

1. Remove existing waterfront streetcar track.
2. Temporarily or permanently relocate utilities as required for tunnel excavation and construction.
3. Detour Alaskan Way traffic to 1 lane in each direction under existing viaduct.
4. Construct east wall.
5. Construct west wall replacing seawall in sections along alignment.
   A. Install silt curtain outboard of seawall adjacent to work zones.
   B. Excavate adjacent to and in stages along seawall to top of relieving platform. Temporarily brace existing seawall panels.
   C. Perform limited soil improvement, dewatering and temporary bracing to enable installation of west wall.
   D. Install west wall.
   E. Remove existing seawall panels.



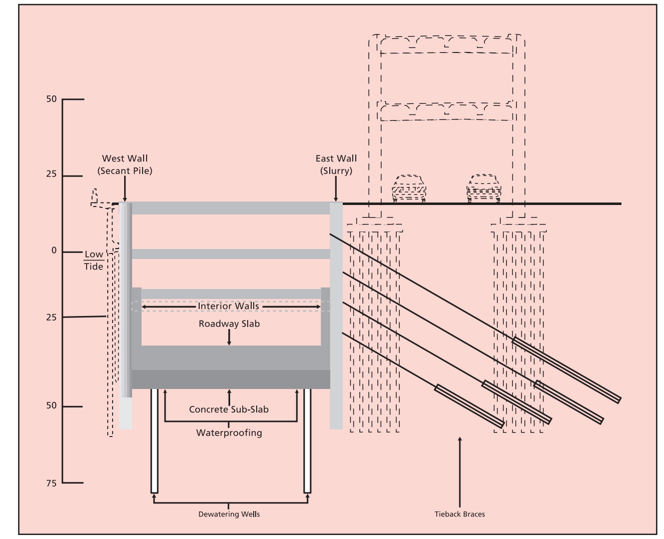
Step 2

1. Excavate to top of relieving platform the full width of the tunnel.
2. Install dewatering wells and begin dewatering.
3. Install top level bracing and tiebacks.
4. Install traffic deck where required to maintain surface traffic and local access to waterfront.
5. Begin removal of seawall relieving platform.



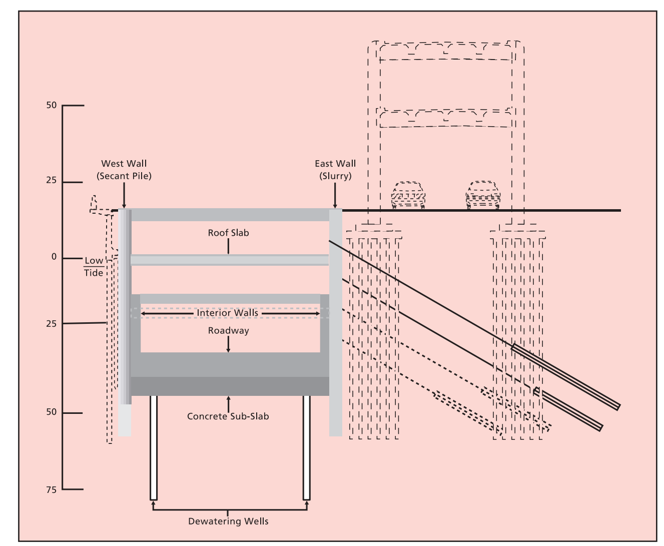
Step 3

1. Excavate in stages to 2 ft. below each tieback or bracing level.
2. Install tiebacks at each level prior to excavating to the next level.
3. Maintain dewatering.
4. Excavate in stages to the next level.



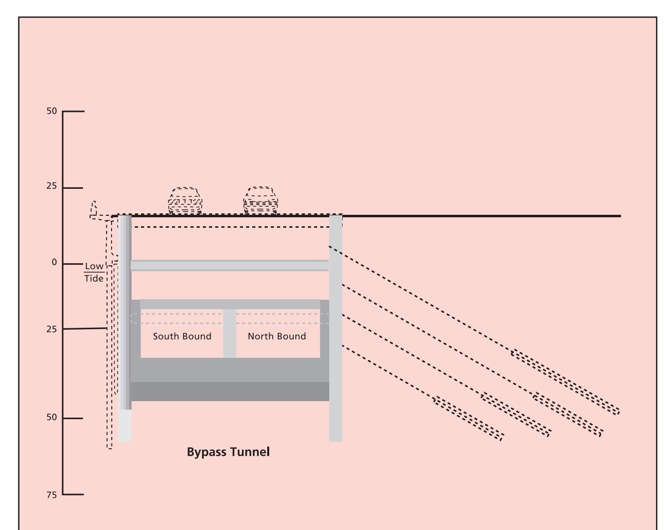
Step 4 -Construct Tunnel

1. Maintain dewatering.
2. Construct tunnel concrete subslab and waterproofing.
3. Construct interior walls and roadway slab.
4. Remove lower level brace.
5. Detension tieback in lower rows.
6. Install bracing between interior walls.



Step 5

1. Maintain dewatering.
2. Detension second row of tiebacks and install wall waterproofing to roof level.
3. Construct roof structure.
4. Install roof waterproofing.
5. Construct roof top slab.
6. Remove bracing.
7. Discontinue tunnel dewatering.



Step 6

1 Remove traffic decking and detension upper row of tiebacks.
2. Backfill above tunnel and remove top level bracing. Relocate utilities to permanent or temporary locations.
3. Complete installation of seawall face panels and sidewalk.
4. Construct Alaskan Way surface street on top of tunnel.
5. Complete ventilation tunnel finishes, systems, and exit stairs.
6. Shift SR 99 traffic into tunnel, Alaskan Way surface traffic to above.
7. Complete aerial connection to Battery Street Tunnel, then shift traffic from existing viaduct into southbound tunnel.
8. Remove existing Alaskan Way Viaduct.
9. Restore Waterfron Streetcar (Bypass only).
10. The Bypass Tunnel is complete. Continue to Step 7 for description of remaining steps for the Tunnel Alternative

Exhibit 10-4

Building the Colman Dock Ferry Terminal Access Road

All of the alternatives propose to construct a new over-water pier between S. Washington Street and Yesler Way. The new pier would extend over Elliott Bay and connect 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 piling. Equipment needed for building the access road includes pile-placement equipment, cranes, a barge, and silt curtains.

Rebuilding the Existing Double-Level Viaduct

The Rebuild Alternative proposes to rebuild the viaduct in the central area from Yesler Way to Pike Street.The foundation of the existing viaduct will be rebuilt by replacing the existing piles, pile caps, and footings. The construction methods used for rebuilding the foundation are similar to what was described for constructing new aerial structures.

In addition to replacing the foundations, the supporting side columns, upper and lower supporting beams, roadway decking, and traffic rails will be replaced or strengthened. It is anticipated that most of the new viaduct components will be constructed of cast-in-place concrete. The viaduct would be supported by external bracing and supports during construction so that people could continue to drive on it.

Retrofitting the Single-Level Viaduct

For the Rebuild Alternative, the existing ramps at Columbia and Seneca Streets and the single-level structures from Pike Street up to the Battery Street Tunnel would be retrofitted. That means that the existing structures will be improved by adding columns, steel jackets, strengthened girders, and improved foundations to meet structural requirements. In addition, the existing decking will be removed and replaced as part of the retrofit.

To maintain traffic during the retrofit, the sections of single-level viaduct would be externally braced and supported as needed during construction. Equipment needed includes cranes, excavators, concrete equipment, pile drivers, drilling equipment, and some demolition equipment.

Building the Temporary Viaduct

The Aerial Alternative requires building a temporary viaduct as a construction detour. The temporary viaduct would be a single-level aerial structure with two lanes in each direction. The length of the temporary viaduct will depend upon the type of roadway selected in the south end and the detour route selected, but generally, it would run from S. Royal Brougham Way to just north of Pike Street.

The temporary viaduct structure would be built with similar methods previously described for new aerial structures. The temporary structure is expected to remain in place for 4 to 7 years, depending on the detour used. It would be constructed immediately after the seawall was replaced. Traffic would be removed from the existing viaduct to allow the existing viaduct to be removed and replaced with the new aerial structure.

Building a Tunnel

The construction approach for the tunnel is best shown in Exhibits 10-4 and 10-5. Specific components of this construction sequence are described below.

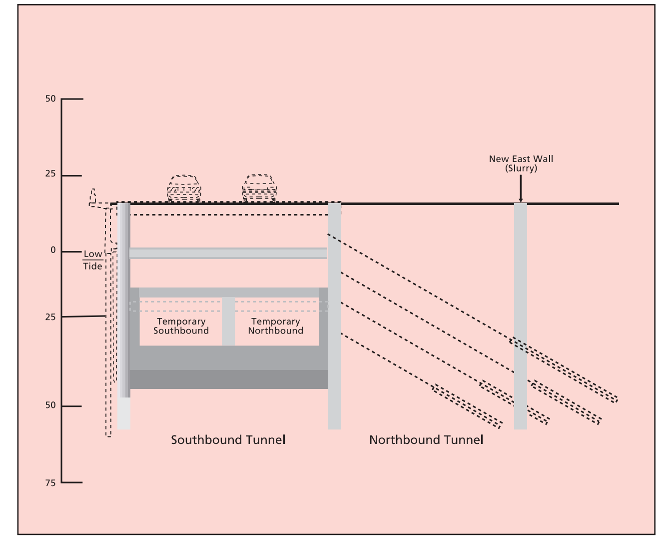
Excavation

Construction of either tunnel alternative would require extensive excavation of soils. Soils would be excavated and tested for contamination. Once tested, the soils would be transported to an appropriate disposal facility. Soils would be transported by truck, rail, or barge.

Dewatering

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 most likely be clean enough for discharge into Elliott Bay. If water quality monitoring indicated that the water required treatment, it would be treated prior to being discharged.

Northbound Tunnel Construction



Step 7 -Construct Northbound Tunnel

1. Relocate utilities as required for northbound tunnel excavation.
2. Construct new east wall.
3. Continue northbound tunnel construction as described in step 2 - 5. Tiebacks will not be used.

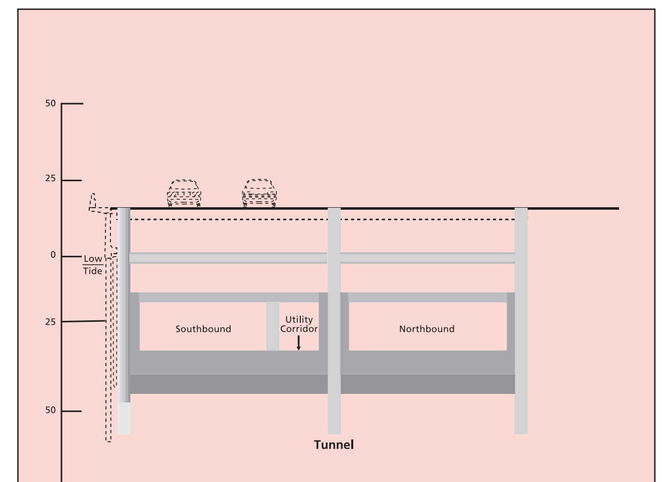


Exhibit 10-5

Step 8 - Complete Northbound Tunnel

1. Remove traffic decking and level bracing.
2. Backfill above tunnel. Relocate utilities where required to permanent locations.
3. Complete northbound tunnel ventilation, tunnel finishes, and systems.
4. Complete Alaskan Way and surface improvements. Restore Waterfront Streetcar. Shift Alaskan Way traffic to permanent location.
5. Shift northbound traffic from the shared tunnel to the permanent northbound tunnel.
6. Remove bracing.
7. Modify southbound tunnel to final configuration maintaining southbound traffic in southbound tunnel
8. Construction of the Tunnel Alternative is complete.

Secant Pile Wall Construction

The western wall of either tunnel alternative would most likely be a secant pile wall. The secant pile wall would serve a dual purpose. It would replace the existing seawall, and it would form the outer wall of the tunnel.

The wall would be constructed of 4-foot-diameter drilled shafts that would extend up to 90 feet below the ground. The shafts would overlap to form a continuous wall from where the tunnel begins near S. King Street to where the tunnel ends near Pike Street. For the most part, the secant pile wall would be con-

What is a secant pile wall?

A secant pile would be built by placing two drilled shafts next to each other. Then another shaft is drilled between the first two drilled shafts, overlapping both of them and eliminating voids. This forms a continuous wall of interlocking drilled 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 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.

structed behind the existing Alaskan Way Seawall. Between Pier 48 and Colman Dock, a section of the secant pile wall would extend into Elliott Bay.

The equipment used would be similar to what is needed to build drilled shafts and would include cranes, drilling rigs and augers, concrete pumping equipment, and slurry processing equipment.

Slurry Wall Construction

A slurry wall would most likely be constructed to form the eastern tunnel wall. The wall would be about 3 feet wide and 90 feet deep along the entire length of the proposed tunnel.

In general, slurry walls are constructed as described below:

- A section of the proposed wall area would be excavated.
- Guide walls would be inserted into the excavated area and excavation would proceed between the guide walls. Excavated material would be replaced with slurry. The slurry material keeps the walls of the hole from caving in as the excavation progresses. The excavation and slurry injection would continue down to the desired depth of the wall (which ranges from 75 to 90 feet).
- Once the area is excavated, rebar (or steel beams) will be lowered into the hole.
- The hole would be filled with concrete. The slurry material will be pumped out of the hole and reused as the operation continues. Slurry wall construction continues until the wall is the desired length.

Equipment used for tunnel construction includes cranes, drilling rigs and augers, backhoes and excavators, concrete pumping equipment, slurry processing equipment, and pumps for dewatering.

Removing the Viaduct

Under all of the proposed alternatives, all of the viaduct (or portions of the viaduct, in the case of the Rebuild Alternative) would be removed and demolished. The timing for removing the viaduct and the amount of material removed varies between alternatives; however, the methods of removing the viaduct are the same or very similar.

The viaduct would be demolished by cutting and lifting segments out of the structure, pulverizing and shearing the structure, and jackhammering and core drilling to break up concrete. Concrete from the viaduct could be ground into aggregate to be reused on-site as part of the construction operation, or it could be hauled to an off-site location for processing. Rebar in the existing structure may be separated and recycled. The old viaduct material will be hauled away by truck, rail, or barge.

Depending upon the alternative, the quantity of concrete expected to be demolished and removed from the existing viaduct ranges from 80,000 to 110,000 cubic yards plus up to 40,000 cubic yards of concrete removed from the temporary trestles, aerial structures, roadway slabs, and other existing concrete structures.

Rebuilding the Seawall

The seawall will be replaced by constructing concrete drilled shafts in combination with a continuous block of jet-grouted soil behind the existing seawall. Replacing the seawall is proposed in various locations for all of the alternatives being analyzed. The only difference between the alternatives is where the seawall will be replaced with soil improvements and drilled shafts or where other methods (such as the tunnel or the Seawall Frame option) might be used.

Building the Seawall Frame Option

The Seawall Frame option would replace the seawall with a structural frame. A continuous secant pile wall would be constructed directly behind the existing seawall, and a row of drilled shafts (spaced 10 to 20 feet apart) would be constructed 30 to 60 feet east of the seawall. The secant pile wall and drilled shafts would be connected by concrete beams with up to 15 feet of fill on top of the concrete frame. The concrete beam would be constructed in a similar manner as a pile cap. The secant pile wall and drilled shafts would be constructed using methods previously described.

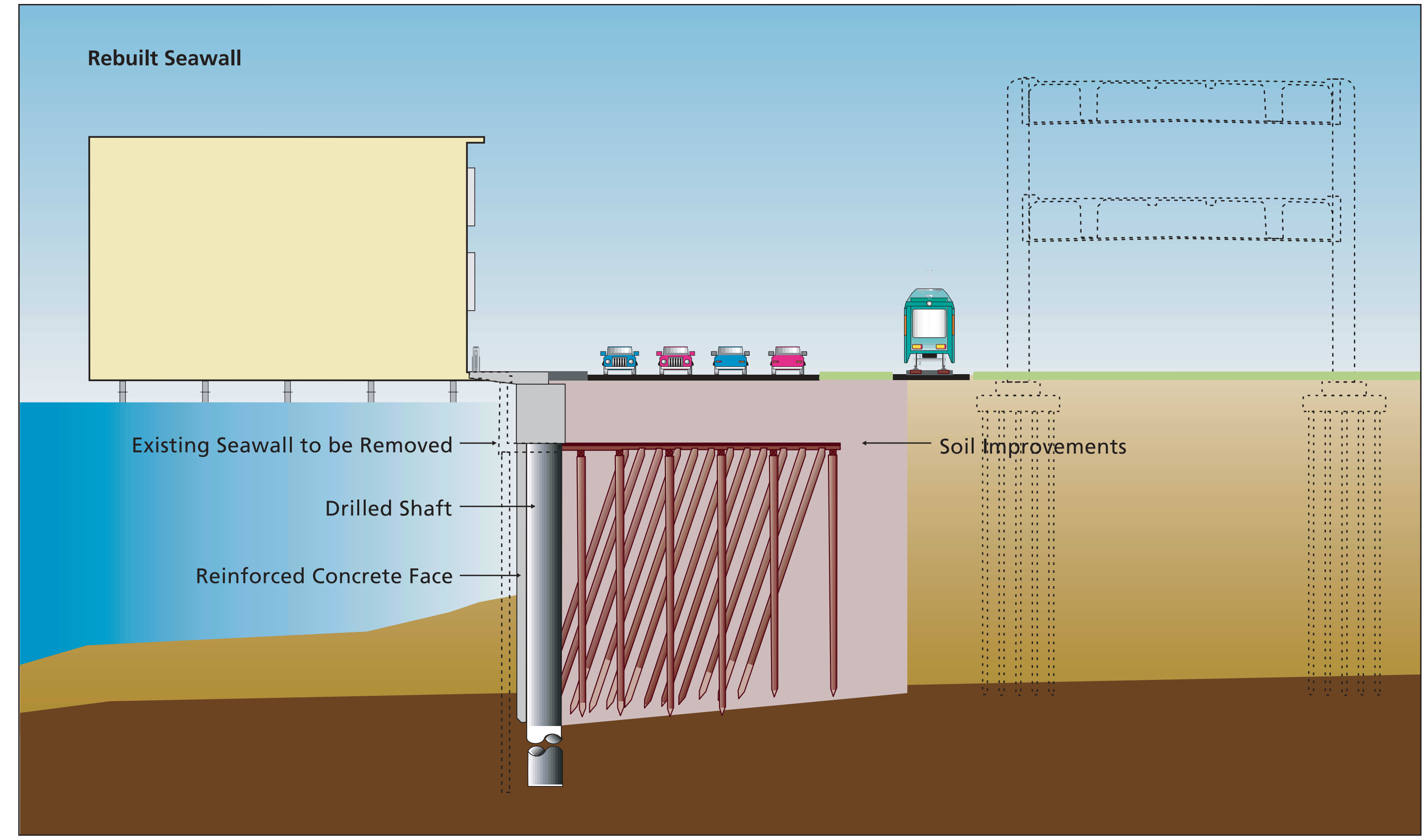


Exhibit 10-6

Upgrading the Battery Street Tunnel

Fire and life safety improvements to the Battery Street Tunnel are proposed for all of the alternatives except the Rebuild Alternative. Construction activities associated with the proposed Battery Street Tunnel improvements include the following:

- Extend the tunnel portals. The northbound tunnel portal will be extended about 130 feet to the south, and the southbound tunnel portal will be extended about 120 feet to the north of the existing tunnel portals. The extension is required to construct jet fans needed to improve tunnel ventilation.
- Construct air intakes on the south and north ends of the existing tunnel.
- Build tunnel vent support structures near the intersections of Western Avenue and Battery Street and John Street and Eighth Avenue.
- Construct up to four emergency egress points (two on each side of the tunnel). These emergency egress points are expected to be located near the intersections of Second Avenue

and Battery Street and Fifth Avenue and Battery Street.

Equipment needed to build these improvements would include backhoes, excavators, pile drivers, cranes, concrete trucks, and grading and paving equipment.

3 **What traffic detours are proposed during construction?**

The Traffic Detour Chart shown in Exhibit 10-8 on the next page shows the proposed traffic detour stages for each alternative. Many detours will be needed through the south section and along the central waterfront throughout construction. Differences between the alternatives occur in Stages 2, 3, and 4. There are two primary detour routes being studied in this EIS: the Broad Street Detour and the Battery Street Flyover Detour option. These detours are not the only detours that will be needed for the project; detours on other city streets would be required. These two detours are unique because they involve constructing large temporary structures that would serve as a detour for the SR 99 mainline. Exhibit 10-9 shows what detours are paired with the proposed alternatives. The project construction timeframes assume the Broad Street Detour would be used for all alternatives except the Rebuild Alternative. Traffic would still travel on SR 99 during construction of the Rebuild Alternative. The Battery Street Flyover Detour option could be selected under the Aerial, Tunnel, or Bypass Tunnel Alternatives, if desired.

Exhibit 10-9

Proposed SR 99 Construction Detours

Alternative	*Proposed Detour*	*Detour Option*
Rebuild	No detour, traffic uses SR 99	None
Aerial	Broad Street	Battery Street Flyover
Tunnel	Broad Street	Battery Street Flyover
Bypass Tunnel	Broad Street	Battery Street Flyover
Surface	Broad Street	None

Broad Street Detour

For this detour, the improvements associated with the Widened Mercer Underpass would need to be constructed north of the Battery Street Tunnel, prior to detouring traffic to help traffic flow. The Widened Mercer Underpass improvements include constructing a new bridge across Thomas Street and widening Mercer Street and turning a portion of it into a two-way street (Mercer is currently a one-way street). In addition, these improvements would provide some long-term benefits to improve east-west traffic flow across SR 99. The potential long-term benefits are described in Chapters 6, 7, 8, and 9.

With the Broad Street Detour, southbound SR 99 traffic would be diverted off of Aurora Avenue/SR 99 at Broad Street. This would require widening the existing Aurora/SR 99 off-ramp to Broad Street from one lane to two lanes. Also, Broad Street would be reconfigured so traffic headed eastbound near Denny Way could be diverted to the new bridge at Thomas Street. A two-lane temporary aerial trestle would be built over the Burlington Northern Santa Fe (BNSF) railroad tracks from approximately the intersection of the Alaskan Way surface street and Vine Street up to the intersection of Broad Street and Western Avenue. Traffic would be routed down Broad Street and over the BNSF railroad tracks to the Alaskan Way surface street. Southbound SR 99 traffic would continue to travel south on the Alaskan Way surface street until it would connect to either the temporary viaduct near Pike Street (for the Aerial Alternative), the existing viaduct, or the new tunnel (for the tunnel alternatives). The Broad Street Detour would increase traffic using Broad Street over existing conditions. Northbound traffic would continue to use the Battery Street Tunnel.

Other features of the Broad Street Detour include:

- Southbound traffic from the Ballard/Interbay area would travel under the railroad tracks at Broad Street by using an underpass. Northbound traffic would use ramps on Elliott and Western Avenues. Routes would frequently change throughout construction, but access would be provided.
- The Battery Street Tunnel would not need to be closed entirely throughout construction.

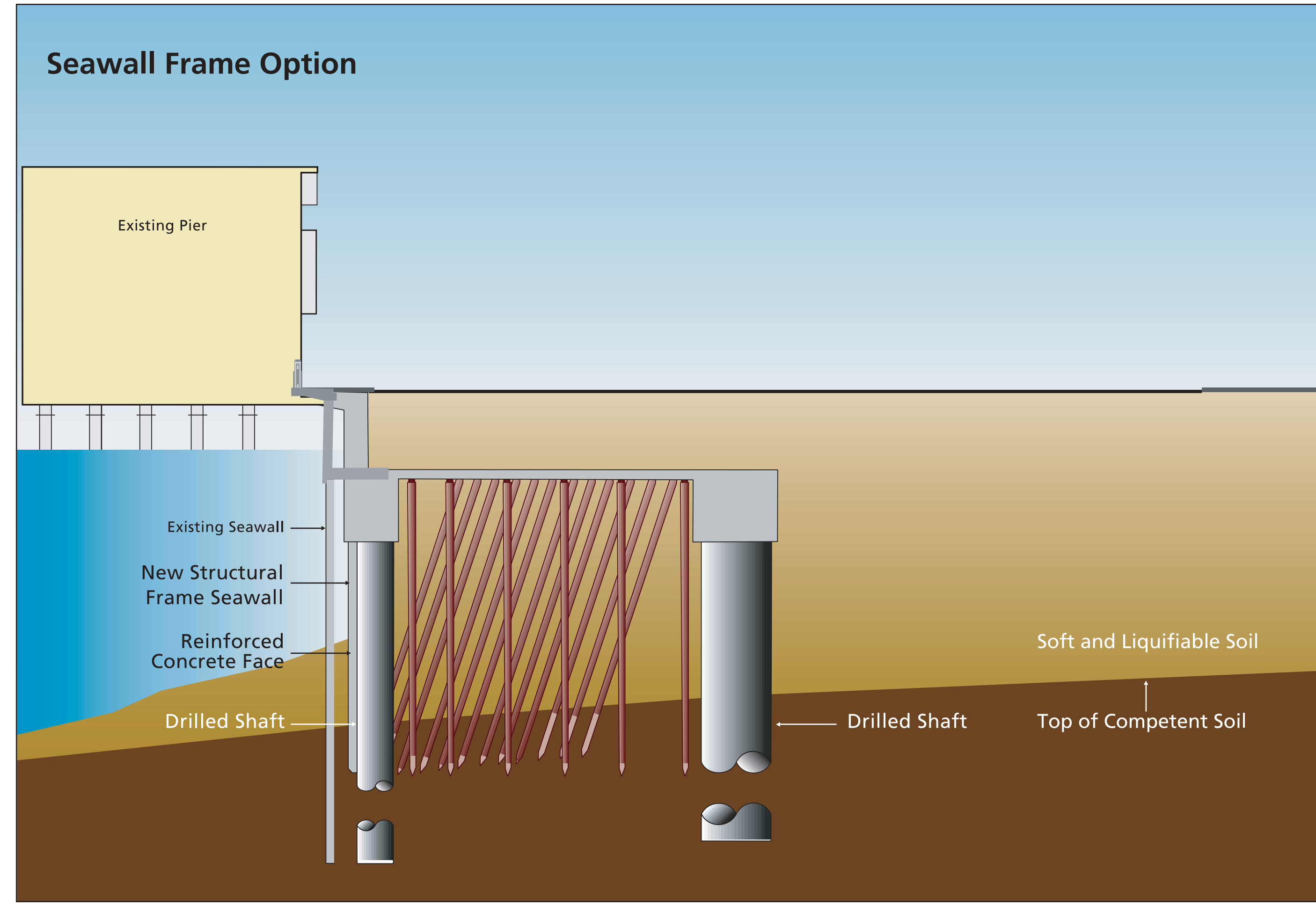


Exhibit 10-7

Battery Street Flyover Detour Option

The Battery Street Flyover Detour option could be used instead of the Broad Street Detour. This option involves constructing a temporary side-by-side aerial structure that would connect to the Battery Street Tunnel near First Avenue and Battery Street. It would rise over existing buildings between Western Avenue and Alaskan Way surface street and touch down at street level. This detour would allow northbound and southbound traffic to travel on the temporary aerial flyover while the existing Battery Street Tunnel connection is torn down and rebuilt.

Other features of the detour option include the following:

- Ramps would be provided on the structure connecting to Elliott and Western Avenues.

Appendices B and C contain additional information about traffic and construction detours.

Alternatives Traffic Detour Chart

Timeline Assumes Full Project Funding

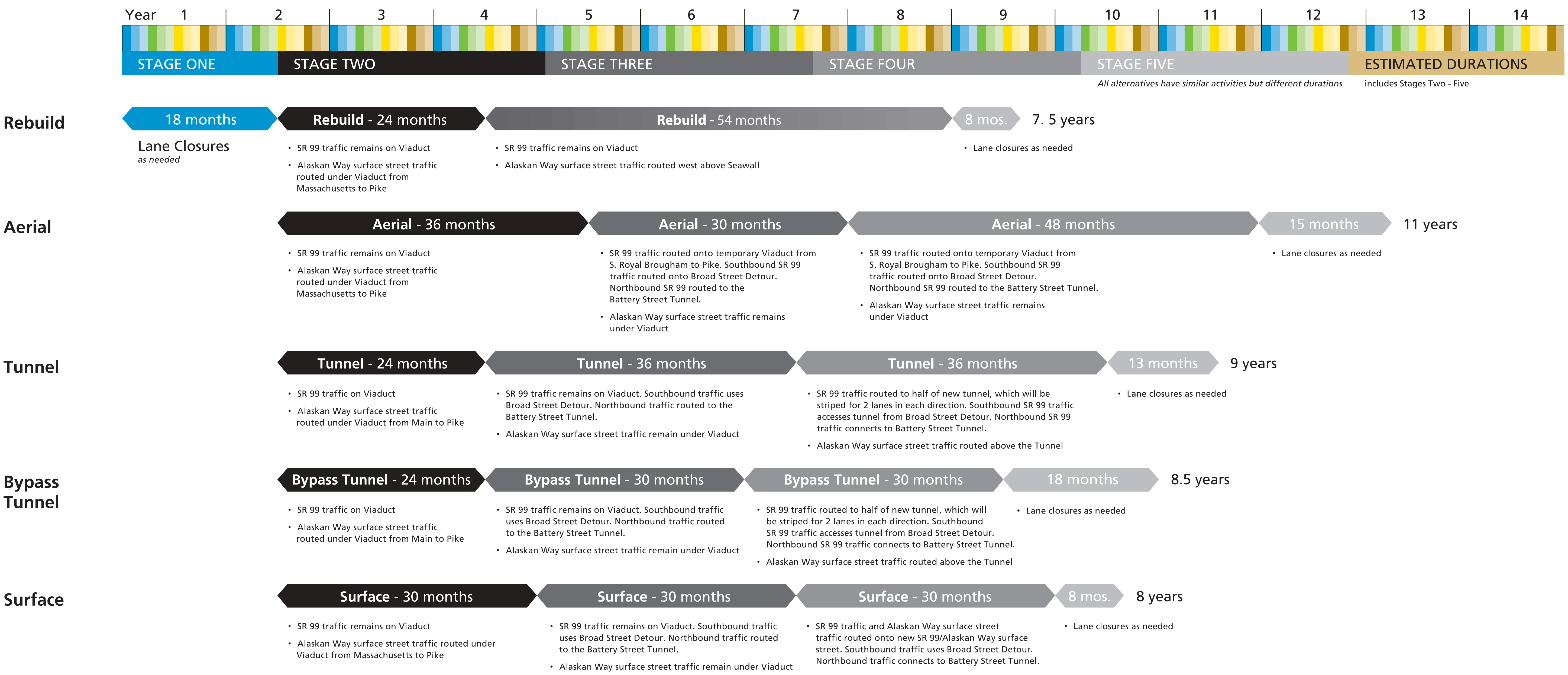


Exhibit 10-8

- No improvements would be required to SR 99 or other streets north of the Battery Street Tunnel.
- The Battery Street Tunnel may need to be closed for up to 10 weeks during one summer in order to upgrade the Battery Street Tunnel to protect for fire and life safety.

4 How will traffic and drivers be affected during construction?

The primary ways that all traffic and drivers will be affected during construction of any of the alternatives will be as follows:

- The roadway capacity in the corridor will be reduced on both SR 99 and the Alaskan Way surface street, which will increase congestion.
- Traffic detours will change frequently throughout construction, so drivers will need to adapt to changing conditions. Detours will also change access to some areas outside of the immediate project area.

For the project to be constructed in the estimated timeframes (7.5 to 11 years), it is assumed SR 99 would not be completely closed. Two lanes of traffic would be maintained in the AWV Corridor during peak traffic hours or an alternate route would be provided. Some partial closures of SR 99 would be allowed as described below.

- SR 99 may be closed during off-peak traffic hours, such as nights and weekends.
- Multiple closures of SR 99 may be required for several weeks.
- One summer closure of SR 99 could be needed for up to 10 weeks between Pike Street and Denny Way (including the Battery Street Tunnel) for all alternatives except the Rebuild Alternative.
- Access to SR 99 at S. Royal Brougham Way and S. Atlantic Street will be maintained during periods when downtown access is closed.
- Access to the waterfront piers and businesses will be maintained during construction.
- The Waterfront Streetcar will be removed for the duration of construction and will be replaced near the end of construction.

Although these are the working assumptions used to estimate construction costs and durations, it must be noted that additional lane restrictions or long-term lane closures may be necessary as the project is refined.

How would roadway capacity be affected during construction?

During construction, sections of the viaduct, Alaskan Way surface street, and neighboring streets will be closed for periods of time. Roadway closures during construction vary by alternative, location, and construction stage. The average loss of roadway capacity during construction is presented in Exhibit 10-12. The average percentage of roadway capacity lost in the downtown portion of the corridor ranges from 25 to 49 percent.

Exhibit 10-12
Summary of Lost Roadway Capacity During Major Construction Activities
(Excuding Stages 1 and 5)

	Rebuild	*Aerial*	*Tunnel*	*Bypass Tunnel*	*Surface*
Average Percentage of Corridor Roadway Capacity Lost	49%	29%	28%	25%	48%
Duration of Major Construction Activities*	6.5 years	9.5 years	8 years	7 years	7.5 years

* (Exclludes Site Preparation and Restoration stages)

Overall, the percentage of lost roadway capacity is the least for the Bypass Tunnel Alternative. The Aerial Alternative has a similar lost roadway capacity as the tunnel alternatives, but construction would take an additional 1.5 to 2.5 years. The Rebuild and Surface Alternatives have the highest loss of capacity during construction, though the Rebuild Alternative is expected to require more night and weekend closures of SR 99 than all of the other alternatives.

The Rebuild Alternative will require more closures of SR 99 than the other alternatives because SR 99 traffic would continue to use the viaduct during construction. There are no planned detours, so late night and weekend closures of SR 99 would be required, reducing roadway capacity during construction. Construction is not planned in or north of the Battery Street Tunnel, so this alternative will not change traffic conditions north of the Battery Street Tunnel or on Broad Street.

The Aerial Alternative will take the longest time to construct, and it is expected to reduce roadway capacity by about 29 percent. This alternative proposes to route southbound SR 99 traffic down Broad Street, which will increase traffic on Broad Street and in the

Broad Street Detour Simulation
at Clay Street

Exhibit 10-10

Battery Street Flyover Detour Simulation
at North Waterfront

Exhibit 10-11

north end of the project area. This detour will increase the amount of time it takes for southbound trips coming from Aurora Avenue/SR 99 since drivers will be forced to travel on surface streets instead of a free-flowing highway. If the Battery Street Flyover Detour option is used, impacts to Broad Street would be avoided and travel time increases for southbound SR 99 traffic would be minimized. However, this would affect additional buildings and views in the corridor.

The Tunnel Alternative is expected to affect traffic slightly more than the Bypass Tunnel Alternative because the tunnel is wider than the bypass tunnel and it will take longer to build. Detour routes have similar tradeoffs to those discussed for the Aerial Alternative.

The Bypass Tunnel Alternative is expected to have the least overall effect on traffic operations throughout the corridor. The same detour routes are proposed with this alternative as with the Aerial Alternative, and its effects will be similar to those described above.

The Surface Alternative will reduce roadway capacity more than the Aerial, Tunnel, and Bypass Tunnel Alternatives because the viaduct would be removed earlier in construction phasing. The Broad Street Detour will be used for this alternative, and its effects will be similar to those described for the Aerial Alternative.

It is likely that some drivers may shift to other routes such as I-5 or local city streets during construction. During construction, travel times through the corridor will increase, overall roadway capacity will decrease, and travel speeds will also decrease. Congestion at intersections in downtown will also increase during periods of construction. Additional information describing how SR 99 and the Alaskan Way surface street will operate during construction will be presented in the Final EIS.

How would construction materials be transported?

For all alternatives and options, trucks will most likely be the primary mode for transporting materials either into or out of the project area, though rail cars or barges may also be used.

All of the alternatives would increase the number of trucks in the area, since equipment, soil, and materials would be trucked in and out of the area. The Tunnel Alternative would require the most truck trips of all of the alternatives. The Bypass Tunnel Alternative would require fewer trips than the Tunnel Alternative, but more than the Rebuild, Aerial, and Surface Alternatives. The tunnel alternatives require more trucks because a large volume of soil would need to be excavated. Truck traffic volumes would be highest during the 2- to 4-year period when the tunnel was being constructed. Specific truck routes will be developed to help minimize possible effects to traffic in the area. Possible truck haul routes are described below.

- South end haul routes - Trucks in the south will use existing established truck routes at E. Marginal Way, SR 99, Michigan Street, S. Spokane Street, and I-5. SR 519 at S. Atlantic Street will also provide access to this section of the project area.
- Central and north waterfront haul routes - Truck access will be provided by routes described for the south and north.
- North end haul routes - Project haul routes for construction in the north end have not yet been identified; however, established truck routes between I-5 and Elliott Avenue/15th Avenue will be used. Trucks will predominantly use Elliott Avenue for deliveries in the north end.

How would transit be affected during construction?

For all of the alternatives, the Waterfront Streetcar would be removed for the entire construction period. It would be replaced at the end of construction. A shuttle service could be provided through the construction area to mitigate this loss. Other transit service would be affected by route changes, and travel times may increase due to additional congestion in the area. Transit currently uses the corridor by reaching downtown via the Columbia/Seneca ramps and the Denny Way ramps. During construction, these access points would be maintained or alternate routes would be provided. As part of the project, the lead agencies will work with transit providers to discuss construction activities that would affect transit routes and work on finding acceptable alternate routes as needed. In addition, the lead agencies will provide funds to enhance transit during construction, and transit priority measures may also be provided as part of the overall project mitigation strategy and flexible transportation package.

How would ferry traffic be accommodated during construction?

In the early phase of project construction, a new roadway will be built that provides access to and from Colman Dock. This roadway will help to separate ferry traffic from traffic on the Alaskan Way surface street, which will help to minimize effects to operations at Colman Dock. During construction, access to and from Colman Dock will be maintained at all times.

How would freight be affected during construction?

Since capacity will be reduced in the corridor, it is expected that there will be increased travel times for all vehicles, including freight. FHWA, WSDOT, and the City will work to keep the freight community informed of detours throughout the project so that drivers can make adjustments as needed.

How would rail yard operations be affected during construction?

For all alternatives except the Aerial Alternative, the Whatcom Rail Yard would be relocated into the BNSF Seattle International Gateway (SIG) Rail Yard. The Whatcom Rail Yard would be closed while it was being relocated, and the BNSF SIG Rail Yard would remain open while it is being reconfigured. For these alternatives, the tail track would also be moved. The existing tail track would be maintained during construction of the new tail track.

For the Aerial Alternative, the Whatcom Rail Yard located at the south end of the project area would be closed for the entire construction period. The BNSF

SIG Rail Yard and tail track would not need to be reconfigured.

In the central and north waterfront areas, potential effects to the BNSF mainline will be less than those described in the south end. There will be times when construction would occur over the existing BNSF tracks; however, the rail line would remain open throughout the construction period.

The lead agencies will carefully coordinate construction activities with the BNSF and Union Pacific Railroads to maintain the functions of their tracks during project construction.

How would parking be affected during construction?

About 1,100 on-street parking stalls in the project area will be removed, including parking spaces under the existing Alaskan Way Viaduct and under the ramp on Railroad Avenue S. Farther away from the project zone, on-street parking spaces in other locations may need to be removed to make room for maintaining smooth traffic flow for diverted traffic. All of the alternatives propose to use the parking lot at Seattle Center as a staging or parking area during construction. This parking lot would still remain open to support Seattle Center events as a first priority.

Most of the stalls along the waterfront are for short-term parking, while the majority of stalls in the stadium area are long-term (free) parking spaces. Businesses along the central waterfront and Pioneer Square area rely on this short-term parking to provide people with access to their facilities. Therefore, some mitigation would be provided to mitigate for short-term losses.

Removal of short-term parking could be mitigated by a combination of increasing utilization of other existing parking facilities, leasing an existing parking facility and converting it to short-term parking, or purchasing property and building new short-term parking. A parking mitigation strategy will be included in the Final EIS that will mitigate losses of short-term parking during and after construction of the preferred alternative.

What would be done to minimize traffic impacts during construction?

The lead agencies will fund specific transportation improvements to decrease reliance on single-occu pancy vehicles and increase other modes of transportation during construction. These improvements are proposed for all the alternatives. The transportation improvements and management strategies will be implemented to minimize and manage traffic during construction. These management strategies are part of the project's proposed Flexible Transportation Package.

The proposed Flexible Transportation Package includes several different programs and tools to respond to varying needs in the corridor. The management strategies proposed as part of this project are identified briefly below. They are described in more detail in Appendix B, Section 3.1.8. A specific plan incorporating the strategies will be included in the Final EIS.

- Direct transit enhancements, including possible water taxi service
- Construction worker/commuter shuttle service
- Expansion of FlexPass program during construction
- Traveler information systems
- Conversion of long-term downtown commuter parking to short-term and carpool parking
- Implementation of truck/commercial vehicle restrictions and prioritizations
- Event management system
- Smart work zones
- Enhanced traffic signal systems and programs
- Incident management systems
- Expand vanpool/vanshare program
- Small employer market development
- Parking lot guidance systems
- Flexible transportation program management and monitoring/demonstration and research programs
- Transit priority systems
- Personalized transportation consultation

5 What properties would be required for construction, and would construction affect land use?

Construction staging areas will be needed throughout the corridor to provide adequate space for construction equipment, construction materials, materials stockpiling, and parking. In general, the number of properties affected by construction would be similar between the alternatives. The fewest sites are needed for the Rebuild Alternative because no improvements are planned north of the Battery Street Tunnel. Specific staging areas would be identified through further project planning and design.

Construction staging areas would be purchased or leased from their respective owners before construction begins. After construction, the properties could be leased to new tenants, redeveloped, or sold.

Construction is not expected to permanently change land uses in the corridor. However, construction activities will affect all of the different land uses in the corridor by introducing a multi-year, large-scale construction project to the area. This will affect properties and their uses in many ways. The specific effects are described in more detail below.

6 How would views be affected during construction?

For any of the alternatives, construction equipment and materials will clutter views in the corridor. Also, lights used for nighttime construction could affect people within one or two blocks of construction or staging areas. The Aerial Alternative would have the greatest effect on views because a new temporary aerial structure would stretch the entire length of the waterfront for up to 7 years during construction.

In general, the primary change to views with the Rebuild Alternative is that the viaduct will be braced during construction. Therefore, the structure will appear to have more bulk, and it will be difficult to see through open areas in the viaduct where there currently is no concrete.

Additional details about tools proposed for the Flexible Transportation Package are contained in Appendix B, in Section 3.1.8.

The Land Use and Shorelines Technical Memorandum (Appendix G) discusses this topic more extensively and looks at the alternatives with an eye toward their consistency with current local land use plans and policies.

Appendices D and E contain more information on visual changes.

For the Aerial Alternative, a single-level aerial structure would be built over the Alaskan Way surface street beginning on the south end near S. Royal Brougham Way up to near Pike Street. From Pike Street to Lenora Street, the aerial structure would descend to meet the Alaskan Way surface street. In the south end of the corridor, the temporary structure would have minimal effects on the industrial landscape. Along the waterfront, the temporary aerial structure would tower above the pedestrian corridor, shadow the area, and overwhelm views from the historic waterfront piers. It would also obstruct views from buildings located in the space between Alaskan Way surface street and the viaduct. The temporary viaduct for the Aerial Alternative would be in place for about 7 years with the Broad Street Detour. If the Battery Street Flyover Detour option were built, the structure would remain in place about 4 years.

As part of the Broad Street Detour proposed for all alternatives except the Rebuild Alternative, a trestle would be built over Broad Street beginning near Vine Street and continuing to Western Avenue. The trestle would obstruct views from Pier 70, the proposed Olympic Sculpture Park, and the Old Spaghetti Factory restaurant.

If the Battery Street Flyover Detour option were constructed instead of the Broad Street Detour, it would require building the temporary aerial structure up to Battery Street. Near Battery Street, an aerial flyover structure would rise and curve to match into the Battery Street Tunnel. This detour option would obstruct views along the waterfront between Pike Street and Battery Street. This detour would affect views from nearby buildings, including the Belltown Lofts, the Austin Bell Building, and the Barnes Building. Views from the Seattle Art Institute, Marriott Hotel, Waterfront Landings, and Pier 66 would also be affected by the Battery Street Flyover Detour.

7 What would noise be like during construction?

Noise during the construction period would be bothersome and annoying to nearby residents, visitors, tourists, and businesses, particularly since construction activities will occur 24 hours per day.

All of the alternatives would generate similar types of noise that would occur sporadically in different locations throughout the 7.5- to 11-year construction period. The most common noise source in construction areas would be from engine-powered machinery such as earth-moving equipment (bulldozers), material handling equipment (cranes), and stationary equipment (generators). Mobile equipment (like trucks and excavators) operates in a cyclic manner, while stationary equipment (generators and compressors) generates noise at fairly constant levels. The loudest and most disruptive construction activities would be pile driving (including driving sheet pile), followed by demolition work with jackhammers and hoe rams. The Rebuild Alternative is likely to generate the most overall construction noise heard by the public, since it would include more pile placement near businesses and residences than the other alternatives.

Typical noise levels from construction equipment range from 69 to 106 dBA at 50 feet from the source; however, the majority of typical construction activities fall within the 75 to 85 dBA range at 50 feet. Peak noise levels from pile driving are about 106 dBA at 50 feet. The use of drilled or vibrated piles could reduce peak noise levels by between 15 and 25 dBA.

To the human ear, noise at 65 dBA is intrusive and 80 dBA is disruptive. At 80 dBA, people must shout to be heard. Hearing protection is recommended at noise levels above 90 dBA. Noise levels between 110 and 120 dBA are typical of a rock concert. Exhibit 10-14 shows the range of noise levels that can be expected from different types of construction equipment. Exhibit 10-15 may be compared to Exhibit 10-14 to get a better sense of how construction equipment noise levels might compare with typical sounds.

Construction noise at locations farther away than 50 feet would decrease at a rate of 6 to 8 dBA per doubling of the distance from the source. For example, if the noise level is 90 dBA at 50 feet from a jackhammer, then it would reduce to approximately 83 dBA at 100 feet and 76 dBA at 200 feet. For all of the alternatives, construction noise from some activities, such as demolition of the existing viaduct, could exceed the City of Seattle's daytime noise regulations at some locations. A variance would be required for these activities. Also, a variance would be needed to allow nighttime construction. These permits would specify mitigation measures to minimize effects by limiting the time of day that certain activities could occur.

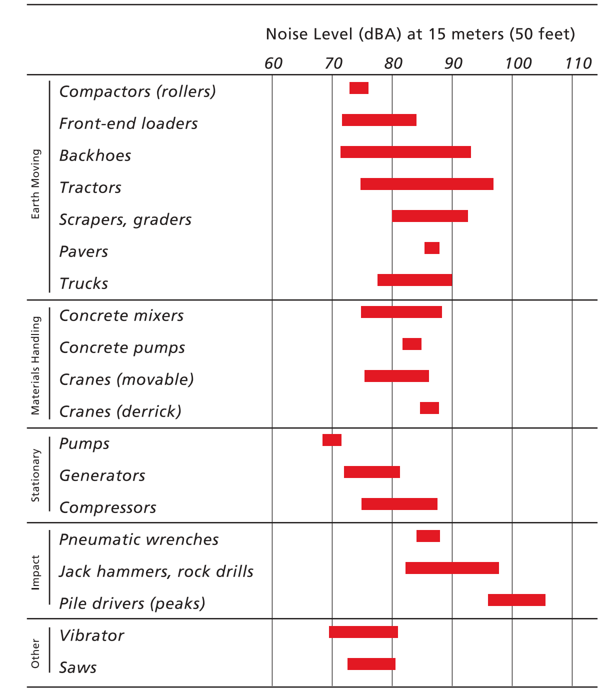
Mitigation requirements would be defined in contractor specifications and by the noise variance; they may include a management and monitoring plan that sets noise limits. Possible mitigation measures to reduce noise could include constructing temporary noise barriers or curtains around equipment or work areas and equipping construction equipment engines with adequate mufflers and intake silencers. Additional strategies for mitigation are described in Chapter 8 of Appendix F.

Temporary Aerial Viaduct Simulation
north of Union Street

Exhibit 10-13

Exhibit 10-14

Typical Construction Equipment Noise Levels



Source: EPA 1971 and WSDOT 1991

Exhibit 10-15

Typical Sound Levels

Source: FTA 1995, EPA 1971, EPA 1974

8 How would vibration affect the area during construction?

Demolishing the viaduct and pile driving would cause the highest vibration levels of the proposed construction activities. Older masonry buildings and areaways (spaces under sidewalks initially created when Pioneer Square streets were raised after the 1889 fire) could be affected by ground vibration during construction. During viaduct demolition, buildings 100 feet or more away from the demolition would be exposed to vibration levels less than the Federal Transit Administration's (FTA) criteria for extremely fragile historic structures. Extremely fragile buildings closer than 100 feet could be exposed to vibration levels that exceed FTA criteria.

The contractor would be required to use alternative construction methods near extremely fragile buildings to mitigate possible impacts during viaduct demolition. These buildings will be evaluated on a case-by-case basis during final project design to determine what specific mitigation measures would be needed. For pile driving, expected vibration levels at extremely fragile historic buildings that are more than 400 feet away would not exceed FTA's criteria. Pile driving activities more than 75 feet from newer, non-historic buildings would not exceed risk criterion for these buildings. Any buildings closer than these distances would require the contractor to mitigate for vibration levels during pile driving activities. The most appropriate method for reducing vibration from pile driving would be to use drilled shafts or auger cast piles in areas where vibration-sensitive buildings or utilities are located near the proposed foundation. Using cast-in-place or auger piles would eliminate impact driving and limit vibration to the lower levels generated by drilling.

The potential risk to underground and buried utilities from construction vibration would be less than the risk to buildings. The only construction activity proposed for this project that would generate vibration levels that could cause damage would be pile driving. Utilities that are less than 25 feet from pile driving locations may need to be further evaluated during final design to determine if mitigation is needed. Common sources and levels of vibration from construction and other activities are shown in Appendix F.

9 How would parks, recreation, and open space be affected during construction?

For some people, construction of a project of this scale will be interesting. For most people, increased traffic congestion, noise, vibration, and dust would make the project area, specifically the waterfront, a less desirable destination. Construction would make it harder for people to get to the project area because of traffic detours and the removal of parking. For many people, construction sites will seem like a barrier, even when temporary sidewalks or other routes are available. Even with provisions for access across construction sites, the perceived inconvenience will lead many people to avoid the waterfront.

The effects of construction activities on parks, recreation, and open space will vary throughout the construction period. When construction occurs directly adjacent to a park or recreational facility, such as the Seattle Aquarium, direct effects from noise and dust would be more intense. Once construction is completed in that area, these direct effects would lessen; however, other effects from traffic detours and congestion would continue.

For pedestrians and bicyclists, the Waterfront Trail beginning at S. Royal Brougham Way and continuing north to Bell Street would be removed during construction for all alternatives. Bicycle and pedestrian routes during construction will be proposed once a preferred alternative has been selected.

Prior to project construction, a new over-water pier with a ferry access road would be built near the end of S. Washington Street connecting to Colman Dock. The pier would remove Alaska Square, a small public access and shoreline viewing area. Alaska Square is currently closed because the bulkhead is failing, so this would only affect people if the bulkhead is fixed between now and the time construction would begin. The public access would be replaced on the new pier.

Noise and dust will affect open spaces at Waterfront Park, Pier 62/63, and Victor Steinbrueck Park. Also, for the Aerial, Tunnel, Bypass Tunnel, and Surface Alternatives, temporary trestles for the Broad Street Detour would temporarily alter views and increase noise and traffic, which would affect people visiting Myrtle Edwards Park and the proposed Olympic Sculpture Park. If the Battery Street Flyover Detour were constructed, views to these two parks would not be affected, but views between Pike and Battery Streets would be affected.

In addition, all of the alternatives would affect recreational facilities that depend on admission fees if people avoided the waterfront due to construction. This could affect the economic viability of the facilities listed below:

- Tillicum Village at Blake Island Park - Private ferry service to Blake Island State Park is provided from Pier 56.
- The Seattle Aquarium is primarily funded by admissions. If admissions drop during construc-

Appendix F contains additional information about noise and vibration during construction.

Appendices H and N contain additional information about parks and recreation.

tion, programs may be compromised and plans to upgrade the facility may be delayed. In addition, the animals at the Aquarium may be affected by construction due to noise.

- The summer concert series at the Pier 62/63 Park could be affected by construction noise.

In addition to the effects described above, the Aerial Alternative would increase proximity impacts such as increased noise to parks and recreational areas along the waterfront more than the other alternatives because a temporary aerial structure would be built directly adjacent to the waterfront between S. Royal Brougham Way and Pike Street.

Specific mitigation measures identifying possible pedestrian and bicycle routes and mitigation measures for parks and recreational facilities will be developed as part of the Final EIS.

10 How would neighborhoods be affected during construction?

For people working or living right next to the worksite, construction will sometimes be inconvenient and at other times will be quite disruptive. Construction noise, lights, and traffic changes could affect people within one to two blocks of the corridor or a staging area. The noise and visual effects of construction are discussed elsewhere in this chapter.

For many people, construction sites will seem like a barrier, even when temporary sidewalks or other routes are available. Because they are perceived as barriers, construction sites will temporarily increase separation between parts of each neighborhood. The Surface Alternative would have the least perceived separation. The Tunnel and Bypass Tunnel Alternatives have a lot of work below ground, which lessens some of the perceived separation, while the Rebuild and Aerial Alternatives, with a lot of temporary aboveground structures, would have the most perceived separation.

Because the construction zone will be closed, there will be many temporary road closures and detours. Some will be needed for only weeks or months, while others will be in place for years. The closures and detours will be inconvenient or disruptive to adjacent businesses and residents. The specific closure and detour routes will be developed for the preferred alternative and during detailed design. FHWA, WSDOT, and the City will work with local residents and businesses to keep disruption to a minimum.

11 Would the elderly, disabled, low-income, or minorities be affected during construction?

Construction impacts to disadvantaged communities include increased congestion, reduced mobility, increased response time for emergency services, and increased noise. For all alternatives, temporary congestion during construction would affect low-income, homeless, elderly, or disabled people and the organizations that strive to serve them. These people are heavily dependent on transit, whose service will be hampered by overall congestion. As part of the project mitigation strategy, funding will be provided to enhance transit operations during construction as described in Question 4 of this chapter. Congestion would also make deliveries to service providers more difficult. Construction activities may bring additional effects to portions of the homeless community. Traffic detours, barricades, and other temporary construction measures can present hurdles for all of these disadvantaged communities.

Although construction impacts to disadvantaged communities are probable, it appears they can be avoided, minimized, or mitigated. During discussions with service providers, the lead agencies have been able to identify potential solutions to offset construction impacts. At this point, it is too early to develop a specific construction mitigation strategy for disadvantaged communities; however, continued outreach with service providers will be critical to minimizing and avoiding effects, where feasible. This mitigation will be developed for the preferred alternative and included in the Final EIS.

12 How would construction affect historic resources?

Possible effects to historic resources from construction activities are similar to potential effects to other buildings and areas located along the corridor. Possible effects include increased vibration, increased congestion, loss of parking, increased noise and dust, and loss of business if people avoid the area during construction.

Construction effects will vary during the construction period. Direct effects will be more intense when construction is adjacent to an area and less intense when the activity moves elsewhere. During some parts of the demolition and construction period, Pioneer Square would be affected by increased traffic congestion, loss of parking, and changes to business access. Traffic barriers and detours may make it harder for people to get to the area. Those businesses and residents closest to the project would experience noise and dust. These impacts may lead to people avoiding the area, resulting in a decline in sales and a negative economic impact on the owners of historic buildings. Many of these effects could be mitigated or at least minimized, as described in Question 14 of this chapter.

Similar effects would occur along the waterfront, affecting businesses located on the historic piers. Congestion and lack of parking on the waterfront could also affect the Pike Place Market, which depends on its direct connection to waterfront parking and attractions. Both of these historic areas could see reduced sales. Many of these effects could be mitigated or reduced, as described in Question 14 of this chapter.

During demolition and construction, some historic buildings in Pioneer Square, on the waterfront, and in Belltown may be exposed to vibration levels high enough to cause damage. Before demolition begins, the closest buildings will be evaluated to determine their vulnerability to damage. Where necessary, the contractor will be required to use less-hazardous demolition and construction methods. The Rebuild Alternative is likely to generate the greatest vibration impacts. Refer to Question 8 of this chapter for further detail on potential effects due to increased vibration.

Some alternatives include temporary detour structures, which could have visual effects on buildings in Belltown and the central waterfront. These impacts are described in Question 6 of this chapter.

> Possible construction mitigation measures are identified in Appendix B, in Section 3.1.8.

> Appendices I and J contain additional information about neighborhoods and disadvantaged communities.

Finally, the historic Washington Street Boat Landing would be removed during construction. Once construction was completed, it would be relocated about 150 feet west of its existing location.

Mitigation measures will be described in a Memorandum of Agreement or a Programmatic Agreement among the City of Seattle, WSDOT, the WashingtonState Office of Archaeology and Historic Preservation, and FHWA. The agreement will be prepared after the preferred alternative is selected and prior to preparation of final construction designs. Mitigation measures could include monitoring buildings and areaways for vibration impacts and reinforcing them if needed; restrictions on construction methods to control noise and vibration; provision of alternative parking and access; and support for programs to assist in maintaining neighborhood business viability throughout construction.

13 How would utilities and public services be affected during construction?

An extensive network of utilities is located in the AWV Corridor. For all of the alternatives, many of these utilities will need to be moved at least once during construction. For any of the alternatives, relocating utilities is an engineering issue that must be carefully planned before and during construction. Some of the initial utility relocation will take place during an 18-month construction preparation period prior to the start of major roadway and seawall construction activities. Utilities will be relocated throughout the entire construction period.

Engineering for all of the alternatives is still preliminary, so effects to utilities from the alternatives can only be generalized. Engineering work will continue to refine construction details throughout the design process.

Among the alternatives, the Tunnel Alternative will require the most effort to relocate utilities, followed by the Bypass Tunnel Alternative.

During construction, unplanned interruptions or accidental disconnections associated with utility relocations could occur. Planned interruptions may be required to relocate some services. The interruption of the service could affect individual customers and businesses. In addition, when utilities are relocated, there are times when reliability of the utility systems may be reduced. These risks can be reduced through advanced planning and coordination.

One mitigation option to reduce unplanned interruptions could include requiring the contractor to develop a contingency plan and measures such as stand-by crews to minimize risks. Planned interruptions could be mitigated by developing customer service plans to minimize disruptions. Specific mitigation measures addressing interruptions would be developed upon selection of the preferred alternative.

Improving or excavating soil could affect utilities if the activity is not properly planned and performed. A mitigation strategy would be developed with utility providers on a case-by-case basis to make sure that utilities are not disturbed by these activities.

Public services, including emergency services, school buses, and garbage collections, would be affected by traffic delays and detours. Emergency service providers would be informed of planned detours ahead of time, so appropriate response plans could be developed. Other non-emergency services would also be informed of detours as needed.

Fire Station No. 5, located adjacent to Colman Dock on the waterfront, would be relocated prior to construction; however, the new location has not yet been determined. FHWA, WSDOT, and the City will work with the Fire Department to ensure that services are relocated in an adequate location.

14 How would the economy and local businesses be affected during construction?

Approximately 1,100 businesses have been identified within one block of the project area. These businesses include a mix of commercial, retail, industrial, and service-related enterprises that would be affected by construction in different ways. Some businesses in the construction area may be periodically inconvenienced by noise from the construction, while other businesses, such as those located along the waterfront, could be negatively affected by a decline in sales if people choose to avoid the area during construction. The number of buildings located within 50 feet of the project area is shown in Exhibit 10-16. Overall, the Rebuild Alternative is located near the fewest buildings in the area.

The intensity of construction activities will vary throughout the multi-year construction time period. At times, there may not be any work being done in front of a business; however, for all of the alternatives, construction will pass by properties located near the construction zone more than once.

Waterfront businesses, particularly retail, restaurants, and tourist-related businesses, would be most affected by construction activities. Waterfront businesses would be affected by traffic detours, congestion, noise, dust, changes to access, and removed parking. Also, while utilities are being relocated, it is likely that some businesses may have temporary utility connections. There could be temporary controlled outages when switching to and from the temporary utilities.

The combination of these construction effects could cause people to avoid the waterfront, which could reduce business revenues. Access to waterfront businesses would be maintained throughout construction, but additional mitigation measures will clearly be needed to help minimize construction effects.

The Pioneer Square Historic District would also be affected by construction. Noise and dust would affect businesses located in close proximity to the waterfront. However, effects to this area would mostly be due to increased congestion from traffic detours and removed parking. Effects to other areas located near the corridor, such as the Pike Place Market areas, would be similar to those described above.

In the south end of the project area, businesses would also be affected by noise, dust, detours, and congestion. Construction effects from congestion would be exacerbated when games or events take place at the stadiums.

Appendix L contains additional information about historic resources.

Possible construction mitigation measures are identified in Appendix B, in Section 3.1.8.

Appendix O contains additional information about utilities and public services.

A discussion of possible construction mitigation strategies for utility relocation and service interruptions is contained in Appendix B, in Section 3.1.8.

Appendix P contains additional information about economics.

Effects to the north end of the corridor would be mostly related to increased congestion. All alternatives except for the Rebuild Alternative would increase the volume of traffic using Broad Street if the Broad Street Detour is selected. If congestion was severe, potential customers could choose to avoid the area, causing reduced revenues.

Specific mitigation measures for affected businesses will be provided in the Final EIS. Business mitigation possibilities are presented in Appendix B and include the following measures:

- Conduct a public information campaign.
- Provide signage, lighting, or other information.
- Maintain vehicular and pedestrian access during important business seasons and minimize the duration of modified or lost access.
- Implement measures to reduce dust, noise, and vibration.
- Provide mitigation for losses to short-term parking.

Other sectors of the economy, such as contractors, construction materials providers, and concrete companies, would benefit from the infusion of dollars into the local economy over the course of many years of construction. Potentially billions of dollars will be placed into and circulated through the local and regional economy to build this project. This will add tax revenue, wages, and new economic activity in the area. An estimated 940 to 1,300 people[2] would be employed annually by the project for construction-related work. While this is a lot of workers, it is a small percentage of the regional workforce. Few people are expected to move here to find work on this project.

15 How would air quality be affected by construction?

Dust from construction and demolition activities would affect air quality directly adjacent to the construction area. However, dust would be minimized by watering down the construction site and containment areas and by incorporating other management practices as discussed in Section 9.2 of Appendix Q. Emissions from construction equipment would also affect air quality in localized areas. Equipment would be maintained with all appropriate air quality controls to minimize emissions. After selection of a preferred alternative, a detailed analysis of construction emissions and construction period traffic emissions will be completed. The analysis will provide information needed to develop specific, detailed mitigation strategies to limit effects from air pollutants. Because of the long duration and complexity of this project, traffic management and air pollution control plans will need to be coordinated with other planned construction projects in the region.

16 How would fish and wildlife be affected by construction?

For all the alternatives, construction of the over-water pier between S. Washington Street and Yesler Way and seawall construction near S. King Street up to Pike Street will require some in-water work. In-water construction would take place along about 3,350 linear feet of the shoreline. In-water construction activities such as placing piles for the over-water pier or removing the existing seawall would disturb sediments along the shoreline.

Any aquatic organisms in the immediate area where sediments are disturbed would be displaced, though they may recolonize quickly. Also, disturbed sediments would temporarily cause water to become turbid, or cloudy. If it's not adequately contained, increased turbidity can distress fish and aquatic organisms in the vicinity. Sediments in some of the project area may be contaminated, which could lead to toxic effects on fish and aquatic organisms. Along the waterfront, water currents have a low velocity and run parallel to the end of the piers, so any temporary increase in turbidity would likely stay in the work area and not affect off-site areas. Best Management Practices (BMPs) will be used to contain turbid water and reduce effects to aquatic resources.

All alternatives would strengthen soil with cement grout behind the sheet pile wall from S. King Street to near S. Washington Street. The sheet pile wall will be removed, which could require working in the water. Effects to fish and wildlife during sheet pile removal are similar to effects described above, and mitigation would also be similar.

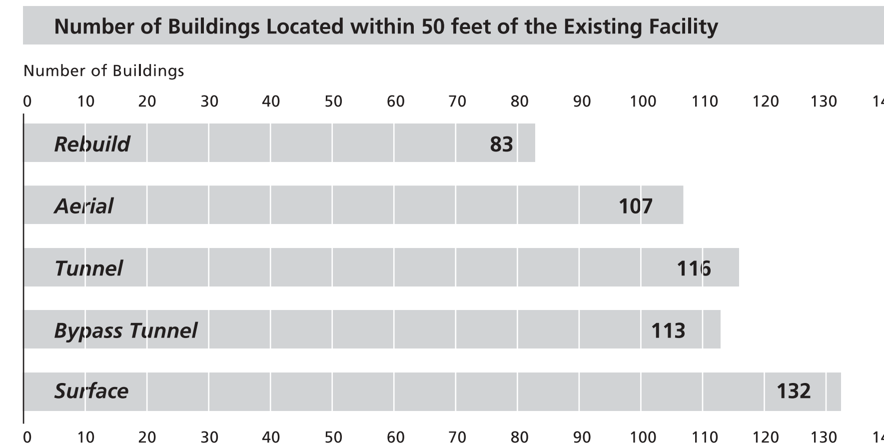


Exhibit 10-16

The Rebuild, Aerial, and Surface Alternatives would replace the seawall from S. Washington Street up to about Pike Street using soil improvements and drilled shafts. Possible effects are the same as previously described. Potential noise impacts to fish, wildlife, or bald eagles from pile placement may be avoided or minimized by using BMPs such as bubble curtains.

For the Tunnel and Bypass Tunnel Alternatives, the seawall would become the outer wall of the new tunnel, beginning at S. Washington Street and continuing to about Pike Street. A secant pile wall (similar to a row of continuous drilled shafts) would be constructed instead of soil improvements. In most places, the tunnel wall would be built behind the existing seawall, though between S. Washington Street and Yesler Way, the wall would extend between 21 and 58 feet out into Elliott Bay depending on which tunnel is constructed.

For all alternatives, from Pike Street to Myrtle Edwards Park, no in-water work is proposed. If the Seawall Frame option were built, in-water work would be required as described above from S. Washington Street up to Pike Street.

Specific mitigation measures for possible construction effects to fish and wildlife have not yet been determined. However, potential mitigation and enhancement opportunities are discussed in the Fisheries, Wildlife, and Habitat Discipline Report contained

Possible construction mitigation measures for businesses are identified in Appendix B, in Section 3.1.8.

Appendix Q contains additional information about air quality.

Appendix R contains additional information about fish and wildlife.

[2] Appendix P, Economic Technical Memorandum

in Appendix R. A mitigation strategy including possible enhancements will be developed and presented in the Final EIS once a preferred alternative has been identified.

17 How would water quality be affected by construction?

A variety of construction activities could affect water quality for all of the alternatives. Potential effects to water quality have been grouped into four main categories: (1) potential erosion in construction and staging areas; (2) seawall, in-water, and over-water work; (3) soil improvements; and (4) dewatering. These activities are discussed below.

Potential Erosion in Construction and Staging Areas

Water quality could be temporarily affected by erosion of disturbed soil areas or soil stockpiles. In addition, pH could be altered if runoff is in contact with concrete during the curing process or while demolition is underway. Soil erosion from stockpiles can increase turbidity and affect other water quality parameters, such as the level of dissolved oxygen in the water. Stormwater runoff may also carry other contaminants, such as fuel or oil from construction operations, particularly at staging areas. To avoid and minimize possible effects to water quality, a Temporary Erosion and Sediment Control plan will be developed for the project. This plan will include several BMPs that will be implemented during construction to avoid or minimize the overall water quality effects as required by regulators.

Seawall, In-Water, and Over-Water Work

Potential water quality effects and proposed actions to minimize these effects are described above in Question 16. In addition, for the Tunnel and Bypass Tunnel Alternatives, the 72-inch S. Washington Street stormwater outfall and the 24-inch combined sewer outfall would need to be extended further into Elliott Bay. This construction would be completed as part of the tunnel wall construction, and similar BMPs would be used.

Spoils From Soil Improvements, Drilled Shafts, and Slurry Walls

Soil improvements, drilled shafts, and slurry wall construction will mix existing soil with cement and/or a bentonite slurry. The mixing will create spoils, which would need to be dried on-site prior to being disposed of at an off-site location. The spoils will contain a high percentage of water that could have a pH approaching 10 (which is too high-a pH of 7 is considered to be normal). This water will be treated as needed to reduce pH, total suspended solids (soil particles), and other pollutants. The Aerial and Rebuild Alternatives will have the greatest volume of spoils from drilled shafts and soil improvements, with comparable volumes for the Tunnel, Bypass Tunnel, and Surface Alternatives.

The amount of spoil material anticipated for each alternative is shown below.

- Rebuild - 256,000 cubic yards
- Aerial - 286,000 cubic yards
- Tunnel - 241,000 cubic yards
- Bypass Tunnel - 201,000 cubic yards
- Surface - 178,000 cubic yards

Dewatering

Dewatering may be needed for all alternatives during construction at various locations within the entire corridor. In these cases, the water will be conveyed to a treatment system and treated prior to discharge. However, for both the Tunnel and Bypass Tunnel Alternatives, continuous dewatering of the cut-and-cover tunnel would be required. Based on preliminary calculations, if 1,500 feet of the area were being excavated:

- Dewatering flow rates south of University Street will average 0.7 gallons per minute per lineal foot of excavation, which is typical for these types of excavations in Seattle.
- Dewatering flow rates north of University Street will average 7.0 gallons per minute per lineal foot of excavation. This is higher than typical volumes, but treatment is feasible.

Based on preliminary monitoring data, potential contaminants of concern are total suspended solids, turbidity, and trace organic compounds.

Dewatering flow rates will vary over the excavation and dewatering period based on location and other factors normally affecting groundwater flow. Current estimates range from 1,050 to 6,090 gallons per minute[3]. The higher flow rates are primarily associated with work north of University Street. The Tunnel Alternative would require dewatering for a longer period of time than the Bypass Tunnel Alternative because it will take longer to build the larger tunnel. Additional information on dewatering can be found in Appendix S.

18 How would soil and contaminated materials be affected during construction?

All of the alternatives would expose and change soils found in the project area. Soil excavation and stockpiling increases the potential for erosion in the absence of BMPs. Stockpiling fill material or spoils could also cause erosion. Erosion can affect water quality, as discussed above in Question 17.

In areas where soils are excavated and dewatering occurs, it is possible that surrounding soils could settle (i.e., sink or shift). More detailed research will be conducted during project design to determine areas where soils could settle. If areas are prone to settlement, engineers will propose measures to minimize effects. In addition, soils supporting roads or other areas could settle because of heavy construction equipment. In this case, settlement damage would be repaired either during or after construction.

In addition, for all the alternatives, the strength of soils in the area will be improved by mixing them with cement grout. This would occur in the south end of the project area and along the seawall. In addition, where drilled shafts are proposed, the existing soils would be removed and replaced with concrete.

The total volume of soil that will likely be excavated for each alternative is shown below. It also includes the estimated volume of contaminated material and

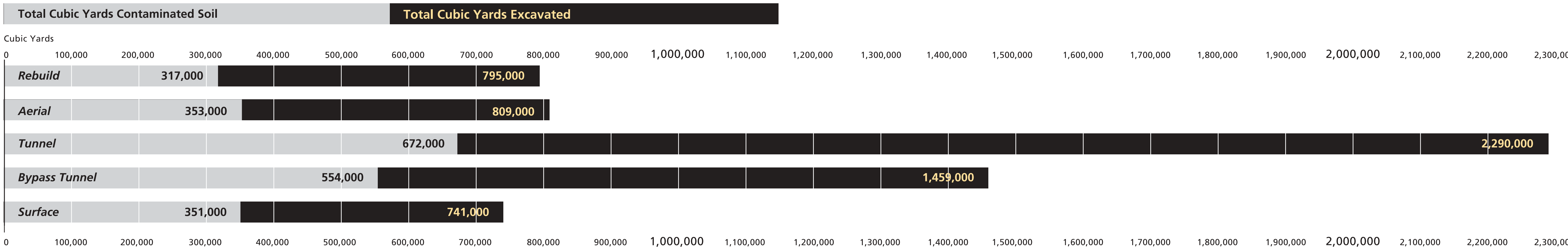
Appendix S contains additional information about water quality.

What is pH?

pH is a measurement of the acidity or alkalinity in a substance. A pH level of 7 is considered normal. If runoff becomes too basic (too alkaline) or too acidic, it can harm aquatic life when discharged.

What is turbidity?

Turbidity occurs when sediment is stirred up or suspended, causing water to be cloudy.



Estimated Volume of Excavated Soil

Exhibit 10-17

the amount of material that will be generated as spoil material from improving the soil and building drilled shafts. The Tunnel Alternative requires the most excavation of all of the alternatives, followed by the Bypass Tunnel Alternative. The amount of material that will be excavated for the Tunnel Alternative would nearly fill the old Kingdome from the floor to the top of the dome.

Soils will be tested during construction to determine if they are contaminated. If they are contaminated, they will be disposed of at an approved landfill.

19 Would potential cultural/archeological artifacts be affected by disturbing soils in the project area?

Soil excavation and soil improvement activities may affect unknown, important hunter-fisher-gatherer and ethnographic period archaeological deposits potentially located in the following areas:

- The former tideflats of Elliott Bay, on a former lagoon and peninsula in the S. King Street vicinity.
- The former beach of Elliott Bay, at the base of bluffs.
- Former bluff tops above Elliott Bay.
- In the east end of a former ravine or gulch near Bell Street.

Evidence of fish weirs, such as wood stakes, basketry, matting, or rock alignments, could be located in the project area. Shell and/or rock concentrations from shellfish gathering and processing could be present on old beaches and tideflats, from seasonal camps, villages, or processing localities. Archaeological materials could include food refuse, rock features, stone tools, bone tools, and debris from tool manufacturing, dating from 1,100 and 2,000 years ago. Areas at the base and top of early historic bluffs that fronted Elliott Bay could have archaeological deposits associated with seasonal camps dating within the past 1,100 years. Hunter-fisher-gatherer and ethnographic period burials may occur at the tops or bases of former bluffs on the east side of Elliott Bay.

Construction also may affect historic archaeological resources associated with industrial, commercial, and residential development of the Elliott Bay tideflats in the 1890s through early twentieth-century development.

In general, the fewest potential effects to archaeological deposits are expected with the Rebuild Alternative, followed closely by the Surface and Aerial Alternatives. The Bypass Tunnel and Tunnel Alternatives have the most potential to affect archeological deposits because a large volume of soils would be excavated for these alternatives.

Comparisons between alternatives were based on estimates of the number and locations of underground construction elements that could intersect unknown, intact archaeological deposits. Information regarding landform type, average depths of fill, depths of old beaches and shorelines, and density and location of structures on historic maps was compared to construction plans to estimate areas where construction excavation and soil improvements might intersect old, buried surfaces that could have unknown, intact archaeological deposits.

Mitigation measures will be outlined in a Programmatic Agreement among the City of Seattle, WSDOT, Washington State Office of Archaeology and Historic Preservation, and FHWA. The Programmatic Agreement will be presented in the Final EIS. Mitigation measures could include preparation of an Archaeological Monitoring Plan, preparation of an Archaeological Treatment Plan, and preparation of Supplemental Treatment Plans as necessary. Mitigation measures will also include provisions for archaeological monitoring of subsurface excavations and/or borings conducted for geotechnical studies prior to selection of a preferred alternative.

Appendix T contains additional information about geology and soils.

Appendix U contains additional information about contaminated materials

Appendix M contains additional information about archeological resources.

[3] Appendix S, Water Quality Discipline Report