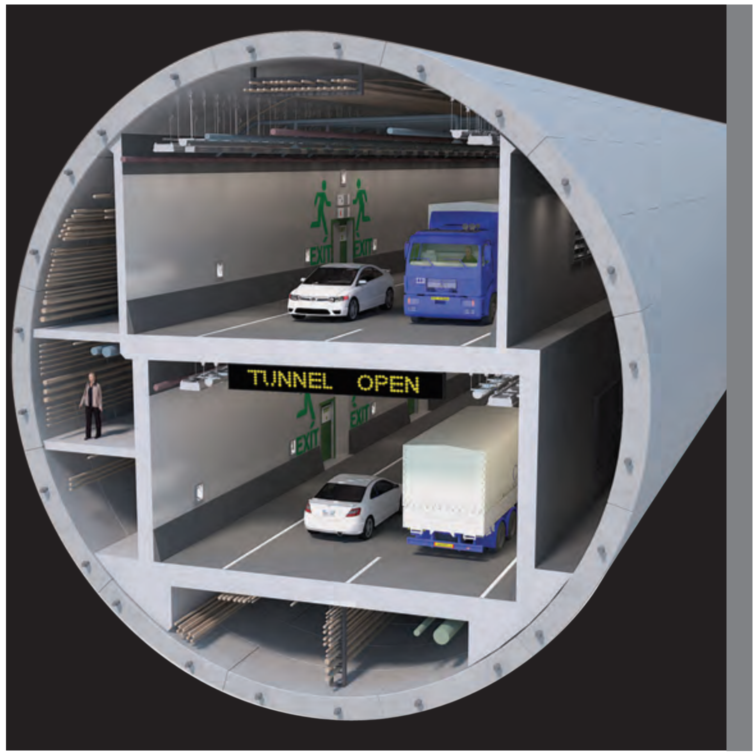
ALASKAN WAY VIADUCT REPLACEMENT PROJECT

2010 Supplemental Draft Environmental Impact Statement

APPENDIX B Alternatives Description & Construction Methods Discipline Report



Submitted by:
PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

Prepared by:
PARAMETRIX

U.S. Department of Transportation
Federal Highway Administration

Washington State Department of Transportation

City of Seattle

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Alaskan Way Viaduct Replacement Project

Supplemental Draft EIS
Alternatives Description and Construction Methods Discipline Report

The Alaskan Way Viaduct Replacement Project is a joint effort between the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and the City of Seattle. To conduct this project, WSDOT contracted with:

Parsons Brinckerhoff
999 Third Avenue, Suite 3200
Seattle, WA 98104

In association with:
Coughlin Porter Lundeen, Inc.
EnviroIssues, Inc.
GHD, Inc.
HDR Engineering, Inc.
Jacobs Engineering Group Inc.
Magnusson Klemencic Associates, Inc.
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Power Engineers, Inc.
Shannon & Wilson, Inc.
William P. Ott Construction Consultants

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LIST OF ATTACHMENTS

LIST OF EXHIBITS

Acronyms and Abbreviations

BINMIC	Ballard Interbay Northend Manufacturing and Industrial Center
BRT	bus rapid transit
City	City of Seattle
EIS	Environmental Impact Statement
EPB	earth pressure balance
FHWA	Federal Highway Administration
HOV	high-occupancy vehicle
I-5	Interstate 5
I-90	Interstate 90
I-405	Interstate 405
ITS	intelligent transportation systems
NEPA	National Environmental Policy Act
Program	Alaskan Way Viaduct and Seawall Replacement Program
project	Alaskan Way Viaduct Replacement Project
ROD	Record of Decision
SDOT	Seattle Department of Transportation
Sea-Tac	Seattle-Tacoma International (Airport)
SODO	South of Downtown
SPF	slurry pressure face
SR	State Route
TBM	tunnel boring machine
WOSCA	Washington-Oregon Shippers Cooperative Association
WSDOT	Washington State Department of Transportation

Chapter 1 INTRODUCTION AND SUMMARY

1.1 Introduction

This discipline report describes the Bored Tunnel Alternative, the new alternative under consideration for replacing the Alaskan Way Viaduct. This report and the Alaskan Way Viaduct Replacement Project Supplemental Draft Environmental Impact Statement (EIS) that it supports are intended to provide new information and updated analyses to those presented in the March 2004 Alaskan Way Viaduct and Seawall Replacement Project Draft EIS and the July 2006 Alaskan Way Viaduct and Seawall Replacement Project Supplemental Draft EIS. The discipline reports present the detailed technical analyses of existing conditions and predicted effects of the Bored Tunnel Alternative. The results of these analyses are presented in the main volume of the Supplemental Draft EIS.

The Federal Highway Administration (FHWA) is the lead federal agency for this project, primarily responsible for compliance with the National Environmental Policy Act (NEPA) and other federal regulations, as well as distributing federal funding. As part of the NEPA process, FHWA is also responsible for selecting the preferred alternative. FHWA will base their decision on the information evaluated during the environmental review process, including information contained within the Supplemental Draft EIS and the subsequent Final EIS. FHWA can then issue their NEPA decision, called the Record of Decision (ROD).

The 2004 Draft EIS (WSDOT et al. 2004) evaluated five Build Alternatives and a No Build Alternative. In December 2004, the project proponents identified the cut-and-cover Tunnel Alternative as the preferred alternative and carried the Rebuild Alternative forward for analysis as well. The 2006 Supplemental Draft EIS (WSDOT et al. 2006) analyzed two alternatives—a refined cut-and-cover Tunnel Alternative and a modified rebuild alternative called the Elevated Structure Alternative. After continued public and agency debate, Governor Gregoire called for an advisory vote to be held in the city of Seattle. The March 2007 ballot included an elevated alternative and a surface-tunnel hybrid alternative. The citizens voted down both alternatives.

Following this election, the lead agencies committed to a collaborative process to find a solution to replace the viaduct along Seattle's central waterfront. This Partnership Process is described in Appendix S, the Project History Report. In January 2009, Governor Gregoire, King County Executive Sims, and Seattle Mayor Nickels announced that the agencies had reached a consensus and recommended replacing the aging viaduct with a bored tunnel.

The environmental review process for the Alaskan Way Viaduct Replacement Project (the project) builds on the five Build Alternatives evaluated in the 2004 Draft EIS and the two Build Alternatives evaluated in the 2006 Supplemental Draft EIS. It also incorporates the work done during the Partnership Process. The bored tunnel was not studied as part of the previous environmental review process, and so it becomes the eighth alternative to be evaluated in detail.

The Bored Tunnel Alternative described in this discipline report and in the Supplemental Draft EIS has been evaluated both quantitatively and qualitatively. The Bored Tunnel Alternative includes replacing State Route (SR) 99 with a bored tunnel and associated improvements, such as relocating utilities located on or under the viaduct, removing the viaduct, decommissioning the Battery Street Tunnel, and making improvements to the surface streets in the tunnel's south and north portal areas.

Improvements at the south portal area include full northbound and southbound access to and from SR 99 between S. Royal Brougham Way and S. King Street. Alaskan Way S. would be reconfigured with three lanes in each direction. Two options are being considered for new cross streets that would intersect with Alaskan Way S.:

- New Dearborn Intersection – Alaskan Way S. would have one new intersection and cross street at S. Dearborn Street.
- New Dearborn and Charles Intersections – Alaskan Way S. would have two new intersections and cross streets at S. Charles Street and S. Dearborn Street.

Improvements at the north portal area would include restoring Aurora Avenue and providing full northbound and southbound access to and from SR 99 near Harrison and Republican Streets. Aurora Avenue would be restored to grade level between Denny Way and John Street, and John, Thomas, and Harrison Streets would be connected as cross streets. This rebuilt section of Aurora Avenue would connect to the new SR 99 alignment via the ramps at Harrison Street. Mercer Street would be widened for two-way operation from Fifth Avenue N. to Dexter Avenue N. Broad Street would be filled and closed between Ninth Avenue N. and Taylor Avenue N. Two options are being considered for Sixth Avenue N. and the southbound on-ramp:

- The Curved Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. in a curved formation between Harrison and Mercer Streets. The new roadway would have a signalized intersection at Republican Street.
- The Straight Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. from Harrison Street to Mercer Street in a

typical grid formation. The new roadway would have signalized intersections at Republican and Mercer Streets.

For these project elements, the analyses of effects and benefits have been quantified with supporting studies, and the resulting data are found in the discipline reports (Appendices A through R). These analyses focus on assessing the Bored Tunnel Alternative's potential effects for both construction and operation, and consider appropriate mitigation measures that could be employed. The Viaduct Closed (No Build Alternative) is also analyzed.

The Alaskan Way Viaduct Replacement Project is one of several independent projects intended to improve safety and mobility along SR 99 and the Seattle waterfront from the South of Downtown (SODO) area to Seattle Center. Collectively, these individual projects are often referred to as the Alaskan Way Viaduct and Seawall Replacement Program (the Program). This Supplemental Draft EIS evaluates the cumulative effects of all projects in the Program; however, direct and indirect environmental effects of these independent projects will be considered separately in independent environmental documents. This collection of independent projects is categorized into four groups: roadway elements, non-roadway elements, projects under construction, and completed projects.

Roadway Elements

- Alaskan Way Surface Street Improvements
- Elliott/Western Connector
- Mercer West Project (Mercer Street improvements from Fifth Avenue N. to Elliott Avenue)

Non-Roadway Elements

- First Avenue Streetcar Evaluation
- Transit Enhancements
- Elliott Bay Seawall Project
- Alaskan Way Promenade/Public Space

Projects Under Construction

- S. Holgate Street to S. King Street Viaduct Replacement
- Transportation Improvements to Minimize Traffic Effects During Construction

Completed Projects

- SR 99 Yesler Way Vicinity Foundation Stabilization (Column Safety Repairs)
- S. Massachusetts Street to Railroad Way S. Electrical Line Relocation Project (Electrical Line Relocation Along the Viaduct's South End)

1.2 Summary

Chapter 2 describes the Viaduct Closed (No Build Alternative), the Bored Tunnel Alternative, and other Program elements. The Bored Tunnel Alternative is described from south to north in terms of the proposed tunnel alignment, portals and surface street facilities, and associated features.

Chapter 3 describes the major construction elements and the construction methods most likely to be used to build the bored tunnel and complete the other elements of the project, including demolition of the viaduct. These descriptions are intended to provide general information on how the project could be built, allowing leeway through the design and contracting process for other methods and approaches or variations of these methods to be proposed.

Chapter 4 describes the construction activities and estimated durations for the Bored Tunnel Alternative, as well as the roadway restrictions or detours that would be needed. The overall construction plan has been broken down into construction traffic stages, and for each traffic stage, the estimated duration is reported and the traffic routing plan is described. (The proposed alternate routes for transit and other transportation modes during construction are described in greater detail in Chapter 6 of Appendix C, Transportation Discipline Report.)

Chapter 5 lists the references used to prepare this report.

Attachment A, at the end of this report, describes all of the projects that were analyzed for potential contributions to the Alaskan Way Viaduct Replacement Project and Program's cumulative effects.

1.2.1 Project Limits

As shown on Exhibit 1-1, the project limits are S. Atlantic Street in the south to Roy Street in the north. The east and west limits are more approximate; they are Alaskan Way to the west and Interstate 5 (I-5) to the east. The construction limits may extend beyond these project limits.

1.2.2 Viaduct Closed (No Build Alternative) Overview

The Viaduct Closed (No Build Alternative) assumes that one of two scenarios would occur, either of which would prevent the use of the SR 99 mainline for the approximately 110,000 vehicle trips it now carries daily:

- Scenario 1 – Sudden unplanned closure of the Alaskan Way Viaduct due to some structural damage from a smaller-scale earthquake or for other reasons relating to structural deficiencies that could lead to partial structural failures that would render the viaduct unsafe or unusable.

Project Limits

Exhibit 1-1

- Scenario 2 – Catastrophic failure and collapse of the viaduct. Any collapse, whether partial or total, would cause a sudden disruption to traffic flow, which would affect both individuals and commercial interests that rely on the viaduct for access and travel, either to or through downtown Seattle.

1.2.3 Bored Tunnel Alternative Overview

The Bored Tunnel Alternative would replace SR 99 between S. Royal Brougham Way and Roy Street. The bored tunnel would have two lanes in each direction. It would be approximately 1.7 miles long, with an inside diameter of 49 feet and an outside diameter of approximately 54 feet.

At this time, no decision has been made on whether the proposed build alternative should be a tolled facility. A decision on whether to toll vehicles on the replacement facility will likely be discussed in the Final EIS. Refer to the Supplemental Draft EIS, Chapter 9, for additional information on tolling.

Beginning at S. Royal Brougham Way, SR 99 would be a side-by-side surface roadway that would transition to a cut-and-cover tunnel. At approximately S. King Street, SR 99 would become a stacked bored tunnel, with two southbound travel lanes on the top and two northbound travel lanes on the bottom.

Passing under Alaskan Way S. and the existing viaduct to approximately S. Washington Street, the bored tunnel would curve slightly away from the waterfront and then travel under Western Avenue and continue diagonally under Seattle's Central Business District to First Avenue at approximately University Street. Near Stewart Street, the alignment would extend north under Belltown. The bored tunnel with the stacked roadway would end at Thomas Street. Between Thomas Street and Harrison Street, the roadway would transition from a stacked configuration to a side-by-side roadway in a cut-and-cover tunnel. From the tunnel portal at Harrison Street, the roadway would continue in a retained cut section until it matches the existing grade at Mercer Street.

The Bored Tunnel Alternative would remove the existing viaduct as well as close and fill the Battery Street Tunnel after the new bored tunnel is completed.

There are three primary components of the Bored Tunnel Alternative: the south portal area, the bored tunnel, and the north portal area. Each of these areas is discussed in more detail below.

South Portal Area

Full northbound and southbound access to and from SR 99 would be provided in the south portal area between S. Royal Brougham Way and S. King Street. The northbound on-ramp to and southbound off-ramp from SR 99 would be built near S. Royal Brougham Way and would intersect with the East Frontage Road.

The southbound on-ramp to and northbound off-ramp from SR 99 would feed directly into a reconfigured Alaskan Way S. with three lanes in each direction. The Port Side Pedestrian/Bike Trail (built as an element of the S. Holgate Street to S. King Street Viaduct Replacement Project) would run along the west side of the reconfigured Alaskan Way S. The City Side Trail would extend from S. Atlantic Street up to S. King Street. This multi-use path would replace the existing Waterfront Bicycle/Pedestrian Facility that currently runs along the east side of Alaskan Way S.

Two options are being considered for new cross streets that would be built to intersect with Alaskan Way S.:

- New Dearborn Intersection – Alaskan Way S. would have one new intersection and cross street at S. Dearborn Street. The cross street would have sidewalks on both sides.
- New Dearborn and Charles Intersections – Alaskan Way S. would have two new intersections and cross streets at S. Charles Street and S. Dearborn Street. The cross streets would have sidewalks on both sides.

The Bored Tunnel Alternative would also widen the frontage road east of SR 99 slightly at S. Atlantic Street to accommodate truck turning movements. Railroad Way S. would be replaced by a new one-lane roadway where traffic could travel northbound between S. Dearborn Street and Alaskan Way S.

A tunnel operations building would be constructed in the block bounded by S. Dearborn Street, Alaskan Way S., and the new Railroad Way S. access road. Part of the building would be constructed underground; the remaining portion is expected to be approximately 60 feet tall with vent stacks extending up to 30 feet above the roof.

Amenities such as landscaping, pedestrian facility improvements, and transit priority features would be incorporated into the reconstructed surface streets in the area of Alaskan Way S. between S. Royal Brougham Way and S. King Street.

Bored Tunnel Alignment – S. King Street to Harrison Street

Beginning in the south end of the project area, the SR 99 bored tunnel would connect to SR 99 just south of S. King Street (see Exhibit 1-1). The bored tunnel would continue under Alaskan Way S. to approximately S. Washington Street, where it would curve slightly away from the waterfront and then travel under First Avenue beginning at approximately University Street. At Stewart Street, it would extend north under Belltown. At Denny Way, the bored tunnel would travel under Sixth Avenue N., where it would transition to a side-by-side surface roadway at about Harrison Street.

North Portal Area

Full northbound and southbound access to and from SR 99 would be provided near Harrison and Republican Streets. The existing on- and off-ramps at Denny Way would be closed and replaced with downtown access ramps to and from SR 99 that drivers would access via a new surface connection between Denny Way and Harrison Street.

Northbound access from SR 99 and southbound access to SR 99 would be provided via new ramps at Republican Street. The northbound off-ramp to Republican Street would be provided on the east side of SR 99 and routed to an intersection at Dexter Avenue N. Drivers would access the southbound on-ramp via a new connection with Sixth Avenue N. at Republican Street on the west side of SR 99.

The surface streets in the north portal area would be reconfigured and improved. The street grid between Denny Way and Harrison Street would be connected by restoring Aurora Avenue over the top of SR 99 and connecting John, Thomas, and Harrison Streets as cross streets. The surface Aurora Avenue roadway would have two general-purpose lanes in each direction, a transit-only lane, and turn pockets between Denny Way and Harrison Street. Signalized intersections would be located at Denny Way and John, Thomas, and Harrison Streets.

Mercer Street would become a two-way street and would be widened from Dexter Avenue N. to Fifth Avenue N. The rebuilt Mercer Street would have three lanes in each direction, with left-hand turn pockets. Broad Street would be filled and closed between Ninth Avenue N. and Taylor Avenue N.

Two options are being considered for Sixth Avenue N. and the southbound on-ramp, as discussed in Chapter 2 (see Exhibit 2-3):

- The Curved Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. in a curved formation between Harrison and Mercer Streets. The new roadway would have two lanes in each direction and a signalized intersection at Republican Street and would connect to the southbound on-ramp to the tunnel.
- The Straight Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. from Harrison Street to Mercer Street in a typical grid formation. The new roadway would have two lanes in each direction with signalized intersections at Republican and Mercer Streets. The Sixth Avenue N. and Republican Street signalized intersection would connect to the southbound on-ramp to the tunnel.

As part of the north portal, a tunnel operations building would be constructed between Thomas and Harrison Streets on the east side of Sixth Avenue N. Part of the building would be constructed underground; the remaining portion is expected to be approximately 65 feet tall with vent stacks extending up to 30 feet above the roof.

Viaduct Removal

The demolition of the existing Alaskan Way Viaduct, from S. King Street to Battery Street, would take approximately 9 months. The demolition would take place after the bored tunnel is completed and operational. The existing Marion Street pedestrian bridge from First Avenue to the Seattle Ferry Terminal would also be demolished and replaced as part of this alternative.

In the north, the Lenora Street pedestrian bridge is expected to remain as it is today. Where the bridge terminates on its east side, modifications would be made to provide an at-grade pedestrian crossing on Elliott Avenue. The southbound on-ramp and the northbound off-ramp to Western Avenue would be removed along with the viaduct structure.

Battery Street Tunnel Decommissioning

The Battery Street Tunnel would be closed after the bored tunnel is opened to traffic. During or after the demolition of the viaduct, the Battery Street Tunnel would be filled in, likely using the concrete rubble left from the demolition of the viaduct structure. The cross streets above the tunnel and the utilities would be maintained.

Utility Relocations

Before the construction of the south and north portals, some utility relocations would be required. Other relocations may occur during the initial stages of construction, and then again in the end stages before the surface street restoration. Utility relocation would require the temporary closure of some streets and sidewalk areas, potentially affecting both pedestrian and vehicle movements (including transit) in the construction area, although detour routes would be established and maintained.

Prior to street restoration toward the end of project construction, some of the utility services would need to be integrated into the existing utility network. This would likely require tying into areas beyond the most adjacent properties, and sometimes beyond the immediate project boundaries.

1.2.4 Program Elements Overview

Other Roadway Elements

Alaskan Way Surface Street Improvements – S. King to Pike Streets

The new Alaskan Way surface street would be six lanes wide between S. King and Columbia Streets, transitioning to four lanes between Marion and Pike

Streets. Generally, the new Alaskan Way would be located on the east side of the right-of-way, where the viaduct is located today, and it would provide new sidewalks, bicycle lanes, parking/loading zones, and signalized pedestrian crossings at cross streets.

Elliott/Western Connector – Pike Street to Battery Street

A new four-lane, at-grade roadway would connect Alaskan Way to Elliott and Western Avenues; it would include bicycle and pedestrian facilities. This connector would cross over the BNSF tunnel and the mainline railroad tracks. The Lenora Street pedestrian bridge is expected to remain as it is today, except that where the bridge terminates on its east side, modifications would be made to provide an at-grade pedestrian crossing on Elliott Avenue.

Mercer West Project – Fifth Avenue N. to Elliott Avenue

Mercer Street would be restriped and resignalized between Fifth Avenue N. and Second Avenue W. to create a two-way street with turn pockets. These improvements also include restriping and modifying the signals on Roy Street between Fifth Avenue N. and Queen Anne Avenue N. to create a two-way street.

Non-Roadway Elements

Elliott Bay Seawall Project

The Elliott Bay Seawall needs to be replaced to protect the shoreline along Elliott Bay, including Alaskan Way. It is at risk of failure due to seismic and storm events. The seawall currently extends from S. Washington Street in the south to Bay Street in the north, a distance of about 8,000 feet. The Elliott Bay Seawall Project limits extend from S. Washington Street in the south to Pine Street in the north (also known as the central seawall).

Alaskan Way Promenade/Public Space

A new expanded waterfront promenade and public space would be provided to the west of the new Alaskan Way surface street between S. King Street and Pike Street. Between Marion and Pike Streets, this public space would be approximately 70 to 80 feet wide. The Alaskan Way public space will be designed at a later date as part of an overall design for the waterfront. Access to the piers would be provided by service driveways. Other potential open space sites include a triangular space north of Pike Street and east of Alaskan Way, and parcels created by the removal of the viaduct between Lenora and Battery Streets.

First Avenue Streetcar Evaluation

This project will evaluate a new streetcar line along First Avenue between Pioneer Square and Seattle Center in the City's transit plan.

Transit Enhancements

A variety of transit enhancements would be provided to support planned transportation improvements associated with the Program and to accommodate future demand. Development of the specific improvements is underway.

King County Metro's RapidRide program would provide additional routes and service from the West Seattle and Ballard areas to and from downtown Seattle.

1.2.5 Construction Plans, Durations, and Sequencing

As part of the development of construction sequencing for the Bored Tunnel Alternative, the construction plan was broken down into a series of traffic stages that represent significant changes to traffic flow and routes within the project area, such as detours or lane or roadway closures. Each traffic stage includes a set of construction activities that must be substantially completed before the next traffic stage and the subsequent construction activities can begin.

The construction phasing and sequencing described in Chapter 4 is based on current planning and knowledge that the project team has acquired through numerous studies and analyses (including a cost estimate validation process and a value engineering study) that have been completed thus far. Durations for the construction activities and traffic stages have been developed based on certain assumptions of overall risk. These estimates will likely be further refined as the project design evolves and new information becomes available.

For the Bored Tunnel Alternative, construction would require approximately 66 months. This construction period includes the removal of the viaduct once the bored tunnel is finished and ready for use.

1.3 List of Supplemental Draft EIS Appendices

A. Public Involvement Discipline Report

B. Alternatives Description and Construction Methods Discipline Report

C. Transportation Discipline Report

D. Visual Quality Discipline Report

E. Visual Simulations

F. Noise Discipline Report

G. Land Use Discipline Report

H. Social Discipline Report

I. Section 106: Historic, Cultural, and Archaeological Resources Discipline Report

J. Section 4(f) Supplemental Materials

K. Public Services and Utilities Discipline Report

L. Economics Discipline Report

M. Air Discipline Report

N. Wildlife, Fish, and Vegetation Discipline Report

O. Surface Water Discipline Report

P. Earth Discipline Report

Q. Hazardous Materials Discipline Report

R. Energy Discipline Report

S. Project History Report

T. Supplemental Draft EIS Annotated Outline

Chapter 2 ALTERNATIVES DESCRIPTION

2.1 Viaduct Closed (No Build Alternative)

Both federal and Washington State environmental regulations require agencies to evaluate a No Build Alternative to provide baseline information about existing conditions in the project area. For this project, the No Build Alternative is not a viable alternative since the existing viaduct is vulnerable to earthquakes and structural failure due to ongoing deterioration. Multiple studies of the viaduct's current structural conditions, including its foundations in liquefiable soils, have determined that retrofitting or rebuilding the existing viaduct is not a reasonable alternative. At some point in the future, the roadway will need to be closed.

The Viaduct Closed (No Build Alternative) describes what would happen if the Bored Tunnel Alternative or one of the other build alternatives is not implemented. If the existing viaduct is not replaced, it will be closed, but it is unknown when that would happen. However, it is highly unlikely that the existing structure could still be in use in 2030. For these reasons, this Supplemental Draft EIS compares the effects of the proposed build alternatives to a 2015 Existing Viaduct.

The Viaduct Closed (No Build Alternative) describes the consequences of suddenly losing the function of SR 99 along the central waterfront based on the two scenarios described below. These consequences would be short-term and would last until transportation and other agencies could develop and implement a new, permanent solution. The planning and development of the new solution would have its own environmental review.

Viaduct Closed (No Build Alternative) Scenario 1: Sudden Unplanned Loss of SR 99

Under this scenario, there would be a sudden, unplanned closure of SR 99 between S. King Street and Denny Way due to structural deficiencies, other types of deterioration, or a smaller earthquake event. Under this scenario, SR 99 would be closed for an unknown period of time until a viaduct replacement could be built. This would eliminate the use of the SR 99 mainline for the approximately 110,000 vehicle trips it now carries per day, and severe travel delays and congestion would be experienced.

Viaduct Closed (No Build Alternative) Scenario 2: Catastrophic Failure and Collapse of SR 99

This scenario considers the effects of a catastrophic failure and collapse of SR 99. Under this scenario, a seismic event of similar or greater magnitude than the February 2001 Nisqually earthquake could trigger failure of portions of the viaduct. This scenario would have the greatest effect on people and the surrounding environment. Failure of the viaduct could cause injuries and death to people traveling on or near the structure at the time of the seismic event. This type of event could cause buildings to be damaged or collapse and would likely cause extensive damage to utilities. Severe travel delays would occur. The environmental effects and length of time it would take to repair the SR 99 corridor are unknown, but the effects would be substantial.

2015 Existing Viaduct

The 2015 Existing Viaduct assumes that the existing viaduct will continue to be part of the transportation network between S. King Street and Denny Way in the year 2015. It also assumes construction of the new south end ramps as part of the separate S. Holgate Street to S. King Street Viaduct Replacement Project. For the environmental analysis in this Supplemental Draft EIS, traffic conditions are compared to the 2015 Existing Viaduct to describe how traffic operations are expected to change in the future. The focus is on comparing the proposed Bored Tunnel Alternative with the 2015 Existing Viaduct; however, we also make comparisons to the post-earthquake condition to understand what could happen at some unknown time in the future.

2.2 Bored Tunnel Alternative

The Bored Tunnel Alternative would replace SR 99 between S. Royal Brougham Way and Roy Street. The bored tunnel would have two lanes in each direction. At this time, no decision has been made on whether this build alternative should be a tolled facility. A decision on whether to toll the replacement facility will likely be discussed in the Final EIS. Refer to the Supplemental Draft EIS, Chapter 9, for additional information on tolling.

Beginning at S. Royal Brougham Way, SR 99 would be a side-by-side surface roadway that would transition to a cut-and-cover tunnel. At approximately S. King Street, SR 99 would become a stacked bored tunnel, with two southbound travel lanes on the top and two northbound travel lanes on the bottom.

The bored tunnel would continue under Alaskan Way S. to approximately S. Washington Street, where it would curve slightly away from the waterfront and then travel under First Avenue beginning at approximately University Street. At Stewart Street, it would extend north under Belltown. At Denny Way, the bored tunnel would travel under Sixth Avenue N., where it would transition to a side-by-side surface roadway at about Harrison Street.

The Bored Tunnel Alternative would also include some intelligent transportation systems (ITS) components, such as electronic sign boards, signage, and related fixtures. Improvements in the south and north portal areas could include the following ITS components:

- Variable message signs
- Overheight vehicle warning signs with flashing beacons
- Portal traffic signal
- Tunnel closure gate
- Tunnel closure sign
- Detection loops
- Surveillance cameras
- Ramp meters
- Tolling system equipment (if needed)

In the tunnel itself, the following ITS fixtures are likely to be installed:

- Variable message signs
- Detection loops
- Emergency telephones
- Incident detection cameras
- Surveillance cameras
- Maintenance telephones

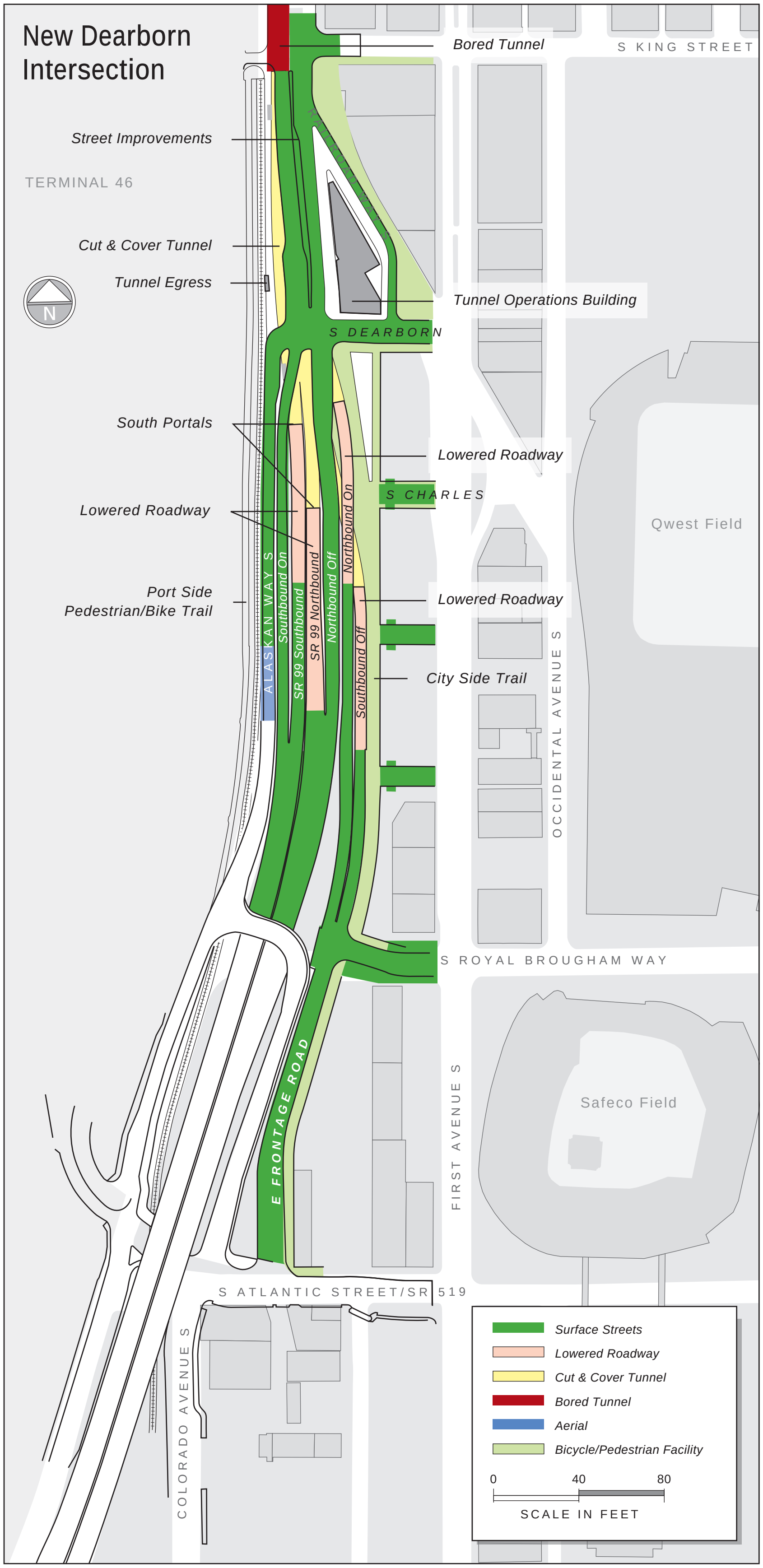
The Bored Tunnel Alternative would also include the removal of the existing viaduct after the completion of the bored tunnel. The Battery Street Tunnel would be closed after the new bored tunnel is completed. The current proposal is to use crushed rubble from the demolition of the existing viaduct to fill the tunnel approximately two-thirds full.

There are three primary components of the Bored Tunnel Alternative: the south portal area, the bored tunnel, and the north portal area. Each of these elements is discussed in more detail below. Some of the specific design features are likely to change as the design continues to evolve.

2.2.1 South Portal Area

Full northbound and southbound access to and from SR 99 would be provided in the south portal area between S. Royal Brougham Way and S. King Street. The northbound on-ramp to and southbound off-ramp from SR 99 would be built near S. Royal Brougham Way and would intersect with the East Frontage Road, as shown in Exhibits 2-1a and 2-1b.

At the south tunnel portal near the intersection of S. King Street and Alaskan Way S., the double-level roadway would extend to the south of the tunnel and unbraid as it becomes shallower. About the first thousand feet of roadway south of the portal would be built as a cut-and-cover structure. At the south end of the


New Dearborn Intersection
Bored Tunnel
S KING STREET
Street Improvements
TERMINAL 46
Cut & Cover Tunnel
Tunnel Egress
N
Tunnel Operations Building
S DEARBORN
South Portals
Lowered Roadway
S CHARLES
Lowered Roadway
Qwest Field
Port Side Pedestrian/Bike Trail
ALASKAN WAY S
Southbound On
SR 99 Southbound
SR 99 Northbound
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FIRST AVENUE S
Safeco Field
S ATLANTIC STREET/SR 519
COLORADO AVENUE S
Surface Streets
Lowered Roadway
Cut & Cover Tunnel
Bored Tunnel
Aerial
Bicycle/Pedestrian Facility
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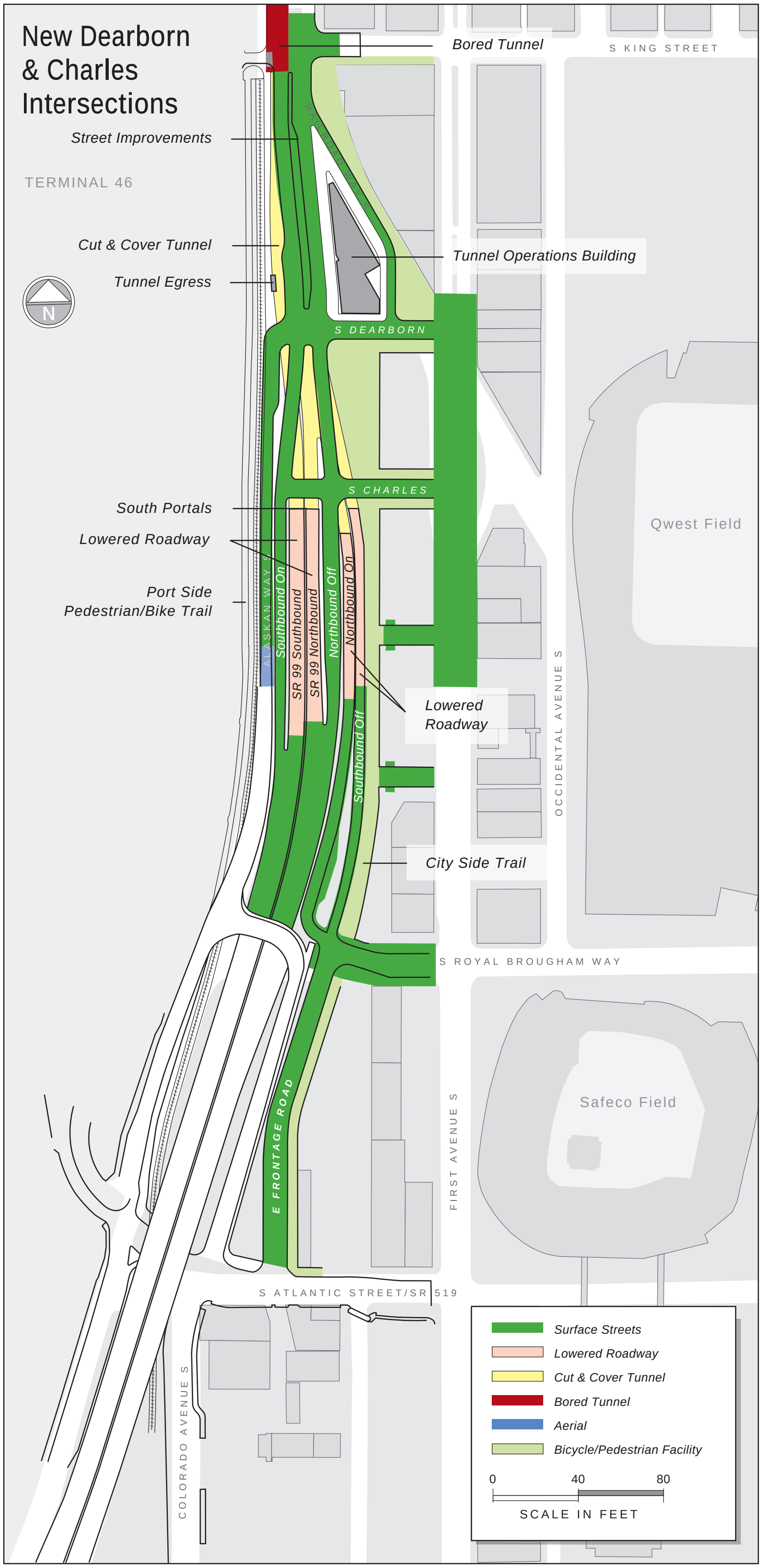
40
80
SCALE IN FEET

Exhibit 2-1a


New Dearborn & Charles Intersections
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Street Improvements
TERMINAL 46
Cut & Cover Tunnel
Tunnel Operations Building
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S DEARBORN
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South Portals
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SR 99 Northbound
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Surface Streets
Lowered Roadway
Cut & Cover Tunnel
Bored Tunnel
Aerial
Bicycle/Pedestrian Facility
0
40
80
SCALE IN FEET

Exhibit 2-1b

cut-and-cover structure, the southbound and northbound lanes of the roadway would be side-by-side, and they would extend about 15 to 25 feet below the ground surface, respectively. The side-by-side roadway would extend approximately 550 feet farther in a retained cut before reaching existing grade just north of S. Royal Brougham Way.

The southbound on-ramp to and northbound off-ramp from SR 99 would be built in retained cuts and feed directly into a reconfigured Alaskan Way S. The retained cuts and cut-and-cover sections of the roadway and ramps would likely be supported by diaphragm walls, such as secant pile walls or slurry walls. The northbound off-ramp would have a general-purpose lane and a peak-hour transit-only lane to accommodate transit coming from south Seattle or West Seattle. The reconfigured Alaskan Way S. would have three lanes in each direction.

On the west side of the reconfigured Alaskan Way S., there would be a pedestrian and bicycle trail, called the Port Side Pedestrian/Bike Trail. This trail would be approximately 15 feet wide. On the east side of Alaskan Way S., another pedestrian and bicycle trail, called the City Side Trail, would be built over the cut-and-cover section of the new SR 99 roadway from S. Atlantic Street to S. King Street. This multi-use path would replace the existing 15-foot-wide Waterfront Bicycle/Pedestrian Facility currently located on the east side of Alaskan Way S. The width of the City Side Trail south of S. Royal Brougham Way is not yet determined.

In the south portal area, two options are being considered for new east-west cross streets that would be built to intersect with Alaskan Way S.:

- New Dearborn Intersection – Alaskan Way S. would have one new intersection and cross street at S. Dearborn Street, as shown in Exhibit 2-1a. The cross street would have sidewalks on both sides.
- New Dearborn and Charles Intersections – Alaskan Way S. would have two new intersections and cross streets at S. Charles Street and S. Dearborn Street, as shown in Exhibit 2-1b. The cross streets would have sidewalks on both sides.

The Bored Tunnel Alternative also includes reconstruction of a portion of the east-west S. King Street and widening of the East Frontage Road from S. Atlantic Street to S. Royal Brougham Way to accommodate truck turning movements. Railroad Way S. would be replaced by a new one-lane roadway on which traffic could travel northbound between S. Dearborn Street and Alaskan Way S.

A tunnel operations building would be constructed in the block bounded by S. Dearborn Street, Alaskan Way S., and the new Railroad Way S. access road. One story would be constructed underground. The remaining portion of the building is expected to be approximately 60 feet tall, with vent stacks extending up to 30 feet above the building.

2.2.2 Bored Tunnel Alignment – S. King Street to Harrison Street

Beginning at S. Royal Brougham Way, SR 99 would be a side-by-side surface roadway that would transition to a cut-and-cover tunnel. At approximately S. King Street, SR 99 would become a stacked bored tunnel, as shown in Exhibit 2-2. The bored tunnel would continue under Alaskan Way S. to approximately S. Washington Street, where it would curve slightly away from the waterfront and then travel under First Avenue beginning at approximately University Street. At Stewart Street, it would travel north under Belltown. At Denny Way, the bored tunnel would travel under Sixth Avenue N., where it would transition to a side-by-side surface roadway at about Harrison Street.

The bored tunnel would be approximately 1.7 miles long with an inside diameter of 49 feet and an outside diameter of approximately 54 feet. The bored tunnel would have two lanes in each direction, which are expected to carry approximately 85,000 vehicles per day. Southbound lanes would be located on the top level of the tunnel, and the northbound lanes would be located on the bottom level. The travel lanes would be 11 feet wide, with a 2-foot-wide shoulder on one side and a 6-foot-wide shoulder on the other side. The wider shoulder would provide access for emergency vehicles and space for disabled vehicles to stop safely.

The wider shoulder would also provide access to emergency tunnel exits, which would be provided at least every 650 feet. Signs would direct travelers to the nearest exit. In an emergency, travelers would walk along the shoulders to reach a doorway into a secure waiting area, called a refuge area, located between the tunnel levels. Emergency telephones would be available in the refuge areas. A staircase inside the refuge area would provide access between the tunnel levels, allowing travelers to either wait in the refuge area for assistance or walk out of the tunnel.

The tunnel would be equipped with ventilation, a fire detection and suppression system, and drainage. Video cameras would provide real-time information to the operators at the Washington State Department of Transportation's (WSDOT's) 24-hour tunnel control center and allow them to respond quickly to changing conditions and emergencies. The tunnel control center would be incorporated into one of the tunnel operations buildings at either the south or north tunnel portal.

2.2.3 North Portal Area

At the north portal, the bored tunnel would transition to a side-by-side cut-and-cover section between Thomas and Harrison Streets. At Harrison Street, the roadway would continue in a retained cut and transition to existing grade at Mercer Street. In this transition to existing grade at Mercer Street, the alignment would move from Sixth Avenue N. to Aurora Avenue. Broad Street would be closed and filled in between Taylor Avenue N. and Ninth Avenue N. as part of the Bored Tunnel Alternative.

Bored Tunnel Cross-Section

Exhibit 2-2

Full northbound and southbound access to and from SR 99 would be provided near Harrison and Republican Streets. The existing on- and off-ramps at Denny Way would be closed and replaced with downtown access ramps to and from SR 99 that drivers would access via Aurora Avenue between Denny Way and Harrison Street.

Northbound access from SR 99 and southbound access to SR 99 would be provided via new ramps at Republican Street. The northbound off-ramp to Republican Street would be provided on the east side of SR 99 and routed to an intersection at Dexter Avenue N. Drivers would access the southbound on-ramp via a new connection with Sixth Avenue N. at Republican Street on the west side of SR 99.

Surface streets would be reconfigured and improved in the north portal area. The street grid between Denny Way and Harrison Street would be connected by restoring a section of Aurora Avenue at grade prior to reconnecting with SR 99 via the Harrison Street ramps. John, Thomas, and Harrison Streets would be connected as cross streets.

The new at-grade section of Aurora Avenue would have two general-purpose lanes in each direction and turn pockets between Denny Way and Harrison Street. Signalized intersections would be located at Denny Way and John, Thomas, and Harrison Streets. A northbound transit lane would extend from Denny Way to John Street, with a transit queue bypass at the John Street signal. A southbound transit lane would extend from Denny Way to Harrison Street.

John Street would be built with one lane in each direction, a center turn lane, and bicycle lanes and sidewalks on each side of the roadway. Thomas Street would be built with one lane in each direction, a center turn lane, and sidewalks. Harrison Street would be built with two lanes in each direction and sidewalks.

Mercer Street would become a two-way street, and the retained cut roadway along Mercer Street from Fifth Avenue N. to Dexter Avenue N. would be widened from four lanes to six lanes, requiring construction of new retaining walls along Mercer Street. The rebuilt Mercer Street would have three lanes in each direction with left-hand turn pockets. The mainline profile of SR 99 would be raised approximately 2 to 3 feet to allow for a 16.5-foot minimum clearance over Mercer Street below.

A connection from Mercer Street to the surface street grid would be built along Sixth Avenue N. Two design configuration options are being considered for Sixth Avenue N. and the southbound on-ramp, as shown in Exhibit 2-3:

- The Sixth Avenue Curved option proposes to build a new roadway that would extend Sixth Avenue N. in a curved formation between Harrison and Mercer Streets. The new roadway would have a signalized intersection at Republican Street and would connect to the southbound on-ramp to the tunnel.

- The Sixth Avenue Straight option proposes to build a new roadway that would extend Sixth Avenue N. from Harrison Street to Mercer Street in a typical grid formation. The new roadway would have signalized intersections at Republican and Mercer Streets. The Sixth Avenue N. and Republican Street signalized intersection would connect to the southbound on-ramp to the tunnel.

As part of the north portal, a tunnel operations building would be built between Thomas and Harrison Streets on the east side of Sixth Avenue N. Part of the building would be constructed underground to match the tunnel grade in this area (up to about 80 feet below ground surface). The remaining portion of the building is expected to be approximately 65 feet tall, with vent stacks extending another 10 feet or so above the roof.

Roadway signage and pavement marking revisions would also be implemented approximately 1 mile north of the north portal area to provide direction to drivers using the new roadway and tunnel facilities.

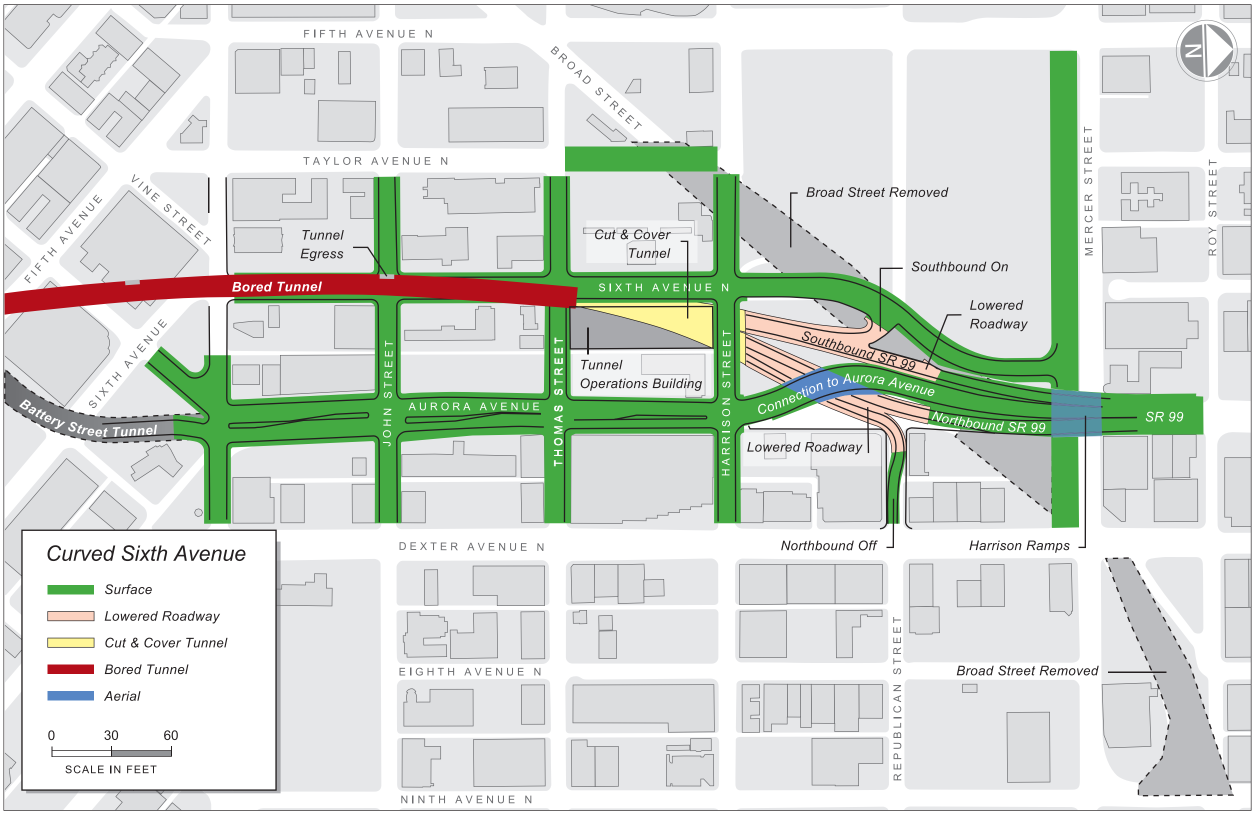
2.2.4 Decommissioning the Battery Street Tunnel

The Battery Street Tunnel would be closed after the bored tunnel is opened to traffic. The cross streets above the tunnel and the utilities would be maintained. The current proposal is to use crushed rubble recycled from the existing viaduct to fill the tunnel approximately two-thirds full, and then pump in a low-strength concrete slurry to fill the remaining clearance space and solidify the rubble. Trucks would be the likely method of transporting the fill material to the Battery Street Tunnel site.

The concrete slurry mix used to top the crushed rubble fill would be poured from openings adjacent to the street above (Battery Street). The concrete mix would need to be poured from approximately seven locations along the Battery Street Tunnel.

Before the Battery Street Tunnel is filled, materials associated with the tunnel system components and other elements, such as asbestos transite conduit, lead-based paint, light fixtures, and light tubes containing heavy metals, would be removed. The sewer piping and inlets would be maintained for drainage purposes. Other utilities would be disconnected and separated from the serving utility.

Bored Tunnel North Portal Options



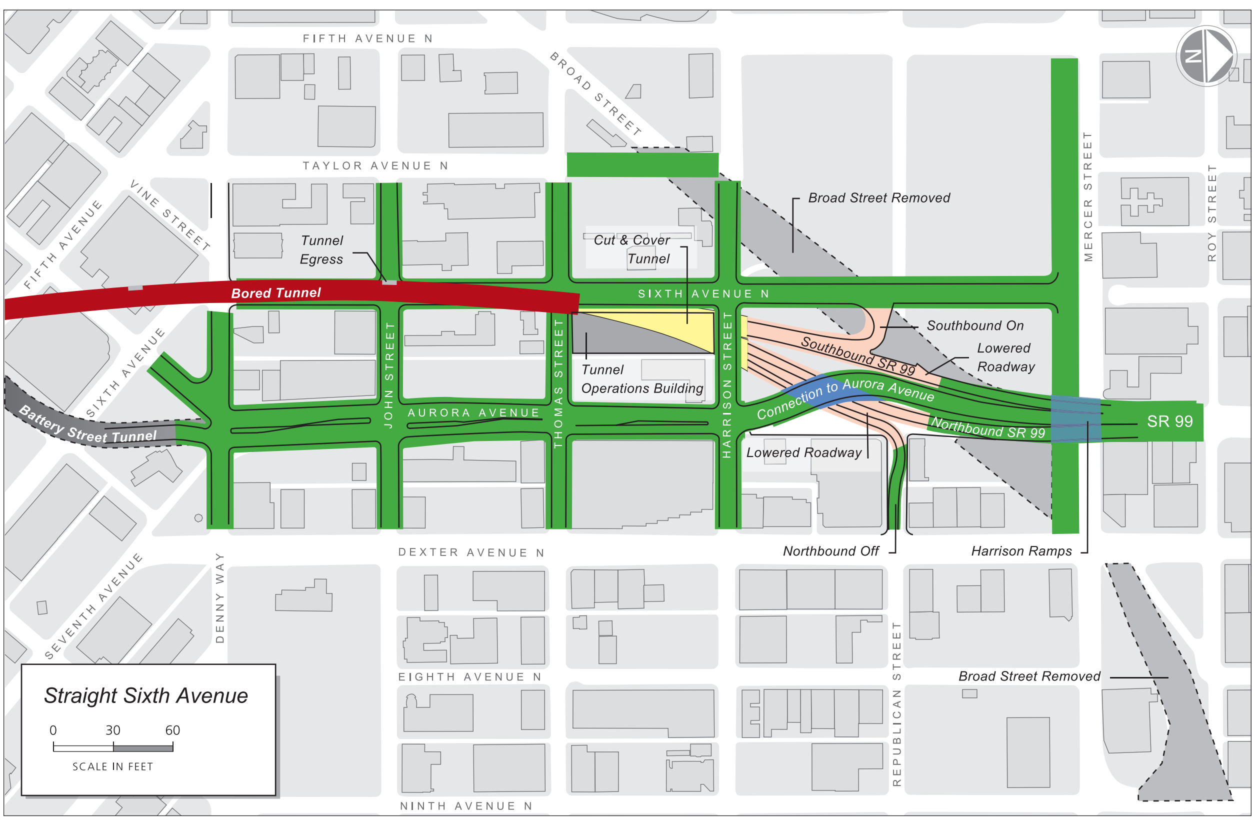


Exhibit 2-3

The ends of the tunnel would be sealed with concrete, and barricades would be placed so that there would be no means of entering the tunnel. This is the general design approach being considered at this time. Measures will be taken to ensure that access will be maintained to provide for adequate maintenance of utilities in and around the tunnel.

2.2.5 Utility Relocations

Construction of both the south and north portals would involve excavation from the street level down. This would affect all utilities within the footprint of both the retained cut and cut-and-cover sections. Utility services connecting to adjacent properties would need to be temporarily relocated to maintain services during construction, and then relocated after construction, if necessary. Integrating these utility lines into the existing utility network may require tying into areas beyond the most adjacent properties, and sometimes beyond the immediate project boundaries. Refer to Appendix K, Public Services and Utilities Discipline Report, for greater detail regarding the construction effects to utilities.

Depending on the depth of the bored tunnel, utilities would need to be replaced, protected, or repaired along the bored tunnel alignment.

2.2.6 Viaduct Removal

The viaduct structure from approximately S. King Street to the Battery Street Tunnel would be demolished and removed once the bored tunnel construction is completed and the tunnel is operational. Demolition would require approximately 9 months. Demolition is currently proposed to occur concurrently in two locations along the viaduct alignment. Each of the two demolition crews would work in about two-block segments at a time. This means that up to four blocks along the viaduct alignment could be under demolition at a given time.

The utilities buried beneath the viaduct may require replacement because it would be difficult to ensure that they can be adequately protected in place.

2.3 Program Elements

2.3.1 Other Roadway Elements

Alaskan Way Surface Street Improvements – S. King to Pike Streets

The Alaskan Way surface street would be six lanes wide between S. King and Columbia Streets (not including turn lanes), transitioning to four lanes between Marion and Pike Streets. Generally the new Alaskan Way surface street would be located on the east side of the right-of-way where the viaduct is located today. The new street would include new sidewalks, bicycle lanes, parking and loading zones, and signalized pedestrian crossings at cross streets.

Elliott/Western Connector – Pike Street to Battery Street

The new roadway connecting Alaskan Way to Elliott and Western Avenues in the area between Pike and Battery Streets would be four lanes wide and would be at grade, except for the grade-separated crossing of the BNSF mainline railroad tracks. The new roadway would include bicycle and pedestrian facilities. The Lenora Street pedestrian bridge across the BNSF tracks would become an at-grade pedestrian crossing of this new connector arterial. Where the bridge terminates on its east side, modifications would be made to provide an at-grade pedestrian crossing on Elliott Avenue.

Mercer West Project – Fifth Avenue N. to Elliott Avenue

Mercer Street would be restriped and signalized between Fifth Avenue N. and Second Avenue W. to create a two-way street with turn pockets. These improvements also include the restriping and resignalization necessary to convert Roy Street to two-way operations from Fifth Avenue N. to Queen Anne Avenue N.

2.3.2 Non-Roadway Elements

Elliott Bay Seawall Project

The Elliott Bay Seawall needs to be replaced to protect the shoreline along Elliott Bay, including Alaskan Way. It is at risk of failure due to seismic and storm events. The seawall currently extends from S. Washington Street in the south to Bay Street in the north, a distance of about 8,000 feet. The Elliott Bay Seawall Project limits extend from S. Washington Street in the south to Pine Street in the north (also known as the central seawall). The southern one-third of the central seawall was built in 1916 and rebuilt in 1987. The northern two-thirds of the central seawall were constructed between 1934 and 1936. Eventually, the seawall replacement will extend farther north, from Pine Street to Broad Street.

Alaskan Way Promenade/Public Space

A new expanded waterfront promenade and public space would be provided to the west of the new Alaskan Way surface street between S. King Street and Pike Street. Between Marion and Pike Streets, this public space would be approximately 70 to 80 feet wide. This public space will be designed at a later date. Access to the piers would be provided by service driveways. Other potential open space sites include a triangular space north of Pike Street and east of Alaskan Way, and parcels created by the removal of the viaduct between Lenora and Battery Streets.

First Avenue Streetcar Evaluation

This project will evaluate a new streetcar line along First Avenue between Pioneer Square and Seattle Center in the City’s transit plan.

Transit Enhancements

A variety of transit enhancements would be provided to support planned transportation improvements associated with the Program and accommodate future demand. These transit enhancements include (1) the Delridge RapidRide line, (2) additional service hours on the West Seattle and Ballard RapidRide lines, (3) peak-hour express routes added to the South Lake Union and Uptown neighborhoods, (4) local bus changes (such as realignments and a few additions) to several West Seattle and northwest Seattle routes, (5) implementation of transit signal priority on S. Main and/or S. Washington Streets between Alaskan Way and Third Avenue, and (6) simplification of the electric trolley system. RapidRide transit along the Aurora Avenue corridor would also be provided.

Chapter 3 CONSTRUCTION METHODS

This chapter describes the construction process, including the anticipated methods and equipment needed to build the Bored Tunnel Alternative. This is intended to be a general description of the current thinking on how this alternative might be built, while allowing leeway for new considerations that may result as the design-build process proceeds. As a result of this evolving process, additional methods and approaches to the construction process may be considered.

3.1 Construction Elements

3.1.1 Construction Staging Areas

The following construction staging areas (shown on Exhibit 3-1) are proposed for tunnel construction and excavation activities and other project-related construction:

1. Terminal 106 – Terminal 106 is south of the S. Spokane Street Viaduct and may be used as a construction staging, materials fabrication, and laydown area.
2. Terminal 25 – Terminal 25 is north of S. Spokane Street near the Whatcom Railyard. This site could be used for some materials fabrication, but this activity would occur outside the 200-foot shoreline boundary.
3. Washington-Oregon Shippers Cooperative Association (WOSCA) Site – The WOSCA site lies to the west of First Avenue S., between S. Royal Brougham Way and S. King Street. Part of the site would be used for a slurry separation plant, if needed. This site is the likely location of a temporary concrete batch plant for construction work in the south portal area, if one is deemed necessary. This site would also be used for the assembly of the tunnel boring machine (TBM) power substation, as well as for storage and laydown of construction materials.
4. Pier 48, Uplands Only – Located along Alaskan Way S. between S. Jackson and S. Washington Streets, this property is owned by the State of Washington. This property may be used for construction parking.
5. Pier 46 – Pier 46 (on the northern edge of Terminal 46) is a possible location to accommodate the barging of excavated materials for off-site disposal. (One possible location for off-site disposal would be at Mats Mats Quarry near Port Ludlow, Washington.) This would include the construction of a conveyor and hoppers for transfer of materials to the barge. Container activity on Terminal 46 would not be affected.

Bored Tunnel Construction Staging Areas

Exhibit 3-1

6. Interstate 90 (I-90) High-Occupancy Vehicle (HOV) Ramp Site – This site lies between the E-3 Busway and Sixth Avenue. On the south, this parcel is bounded by S. Royal Brougham Way. It would be used primarily for storage.
7. Alaskan Way S., S. King Street to S. Jackson Street – The Alaskan Way S. right-of-way between S. King Street and S. Jackson Street would be used to construct the south portal and launch the TBM.
8. Railroad Way S. Right-of-Way – During much of the construction period, the right-of-way along Railroad Way S. under the First Avenue S. ramps would be used to accommodate south portal construction activities and construction of the tunnel operations building. During the last year of construction, the area would be used to demolish the ramps.
9. Alaskan Way S., S. Royal Brougham Way to S. King Street – This project work zone and construction staging area (6-acre site) would also in part become the location of the permanent roadway connecting the bored tunnel to the new SR 99.
10. First Avenue S. Bridge Site – This site is a triangle-shaped property bordered by W. Marginal Way, Second Avenue S.W., and S.W. Michigan Street. It would be used primarily for storage.
11. Fischer Site (Fourth Avenue S., formerly an SR 519 project staging site) – This site lies between Third and Fourth Avenues S. On the south and north, it lies between S. Massachusetts Street and S. Atlantic Street, respectively. It would be used primarily for storage but could possibly be used for materials fabrication.
12. I-90 Ramp Site – This site is located between Fourth Avenue S. and the BNSF railroad tracks. The southern portion of this site is bounded by S. Royal Brougham Way. It would be used primarily for storage.
13. Broad Street Right-of-Way – Once Broad Street is closed, it could be used for construction staging and storage.
14. Construction Zone Within City Right-of-Way – This strip of right-of-way along the existing viaduct would be used for demolition and removal of the viaduct structure.
15. Seattle City Light Parking Lot South of the Battery Street Tunnel – This site is currently a triangle-shaped property just west of SR 99, near the intersection of Battery Street and Western Avenue. It would be used primarily for storage.

16. North Portal Construction Staging Area – The north portal staging area is bounded by Thomas Street on the south and Broad Street on the north, between Aurora Avenue and Sixth Avenue N. This area includes the City of Seattle (City) Maintenance Yard, which is bounded by Harrison and Republican Streets and Sixth Avenue N. and SR 99. This area would be used for construction staging, closing and backfilling Broad Street, and TBM retrieval.
17. BNSF/Lenora Street Construction Zone – This site is WSDOT right-of-way. It would be used for material storage for viaduct demolition and resurfacing of Alaskan Way in the last phases of construction.

3.1.2 Construction Haul Routes

During construction of the Bored Tunnel Alternative, City-designated truck routes would be used for transporting construction materials, over-sized equipment, and spoils into and out of the construction zones. In the south portal area, the primary construction access to the work area (on the WOSCA site) would be from S. Atlantic Street. Construction vehicles would enter the work area via a temporary construction road that would cross the southbound off-ramp from SR 99. A temporary traffic signal would facilitate crossing the off-ramp. Trucks leaving the construction zone would merge with traffic on the southbound off-ramp from SR 99 and turn eastbound on S. Atlantic Street. Inbound and outbound trucks would use Edgar Martinez Drive S. (the east extension of S. Atlantic Street) to access I-5 north and south and I-90 east and west. Over-legal loads could use First Avenue S. to Railroad Way S. to Alaskan Way S.

For haulers of construction materials and spoils, the potential routes being considered for the north portal area are I-5 to Fairview Avenue N. to Denny Way to Sixth Avenue N. to the construction zones, or I-5 to Mercer Street to the construction zones. SR 99 to and from the north is also available as a potential haul route.

In the south portal area, some restrictions on construction haul traffic may be needed to maintain traffic operations on the temporary SR 99 off-ramp as well as along the S. Atlantic Street corridor between E. Marginal Way S. and I-90.

3.1.3 Construction Equipment

A wide variety of construction equipment, including specialized and custom-made machinery, would be needed to build the Bored Tunnel Alternative and demolish the existing viaduct structure. Throughout construction, materials and equipment would be stored primarily within the project area and existing road right-of-way.

Throughout construction, crews would use the following types of equipment:

- A TBM
- Extended-arm trackhoes with concrete-pulverizing attachment (concrete muncher)
- Cranes
- Trucks and dump trucks
- Air compressors
- Bulldozers
- Backhoe loaders
- Front loaders
- Excavators
- Drilling rigs (including oscillator drills)
- Vibratory pile driving equipment
- Loaders
- Forklifts and manlifts
- Jackhammers
- Various pumps, including slurry separation pumps
- Grading and paving equipment
- Compressors
- Generators
- Welding equipment

For viaduct demolition activities, crews would most likely use crunching/shearing attachments, concrete saws, concrete splitters, and cutting torches. For soil improvements, work crews would need specialty equipment such as drilling rigs for tunnel wall work, drilling rigs with mixing augers, and slurry processing equipment.

Construction may also require additional equipment such as barges, conveyor belts, and hoppers. Other equipment would be needed for dewatering processes, such as settlement and pretreatment storage tanks. Whether a concrete batch plant is needed would be determined by the contractor. Depending on the type of TBM used, a slurry separation plant may be needed. If so, this would likely be located on the WOSCA site in the south end.

3.1.4 Utility Relocations

Utilities attached to the viaduct and expected to remain in service would need to be relocated prior to viaduct demolition. It is anticipated that for the viaduct removal, replacement may be necessary for the utilities buried beneath the viaduct. Some of these relocations or replacements may require excavation. Mitigation measures would be employed to ensure that utilities buried beneath the viaduct are not damaged during demolition. The surface features of existing utilities located beneath the viaduct may need to be adjusted to be flush with the new surface.

Some of the other construction activities that would probably require utility relocations (temporary or permanent) are the construction of support walls for tunnel portals, fill embankments, foundations, or soils improvements. The project will attempt to protect in place any utilities that feasibly can be protected adequately. Other utilities that may face a greater risk of damage due to the construction methods in or near the work area are likely to be relocated, and in some cases, replaced.

3.2 Construction Methods for Major Project Elements

3.2.1 Construction Risks and Ground Improvement Methods

Tunneling is planned to be undertaken with best-available tunneling technology to minimize ground settlement. A combination of the ground improvement methods discussed below would be used prior to and during the tunneling activities to protect existing structures and underground utilities from potential ground subsidence as well as to strengthen the ground mass so that it can better accommodate the construction of the tunnel structure.

Ground improvements would be needed more extensively for the construction of the south portal and along the south portion of the tunnel alignment where the predominant soils are fill material. The area south of University Street, primarily between Yesler Way and Seneca Street, is more vulnerable to ground settlement because of the soil types found in that area and the relatively shallow depth of the tunnel. See Exhibit 3-2 for a map showing the area in the south end where compensation grouting is likely to be needed. This exhibit also presents conceptually the area around each grouting shaft that would undergo the grouting process. There may be a few small locations in the north portal area where settlement mitigation measures using ground improvement may also be needed.

Ground improvement would likely be performed along the tunnel alignment to stabilize soft soils around the tunnel and mitigate potential ground loss. The minimization of ground settlement risks posed by the tunnel work, such as

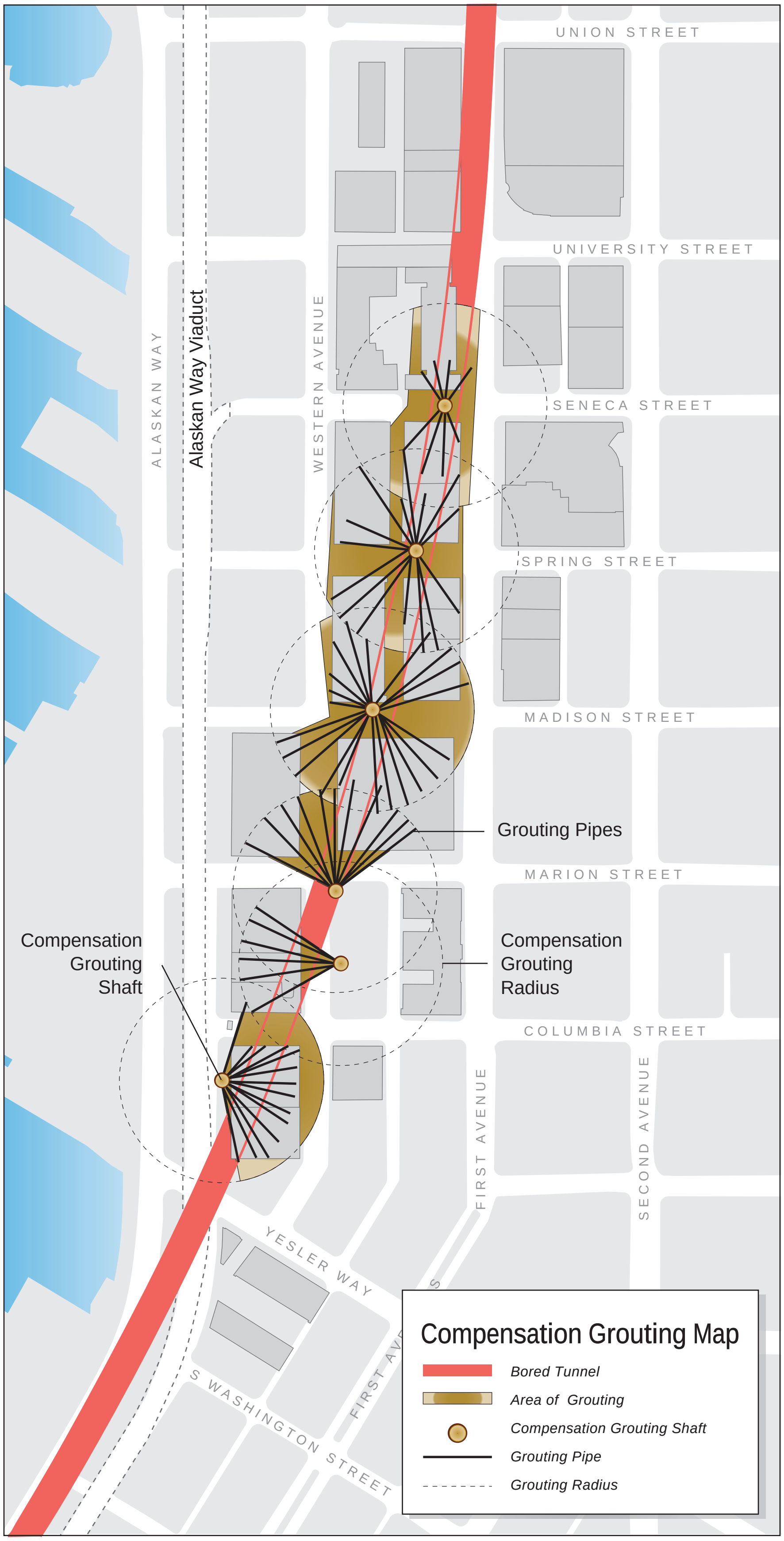

UNION STREET
UNIVERSITY STREET
SENECA STREET
SPRING STREET
MADISON STREET
MARION STREET
COLUMBIA STREET
ALASKAN WAY
Alaskan Way Viaduct
WESTERN AVENUE
FIRST AVENUE
SECOND AVENUE
YESLER WAY
S WASHINGTON STREET
FIRST AVE
Grouting Pipes
Compensation Grouting Shaft
Compensation Grouting Radius
Compensation Grouting Map
Bored Tunnel
Area of Grouting
Compensation Grouting Shaft
Grouting Pipe
Grouting Radius

Exhibit 3-2

sinkholes in streets or damage to utilities, is a primary goal of design for the tunnel construction. Ground improvements, such as those described in the following sections (e.g., compensation grouting, compaction grouting), would also be used as advance mitigation to prevent damage to utilities from ground settlement prior to tunnel boring. Among other potential methods for ground improvements that may be used additionally are ground anchors to be placed in intervals to provide uplift resistance from the water table below in the south portion of the tunnel where the water table depth is nearer the tunnel alignment. Refer to Appendix P, Earth Discipline Report, for a more detailed discussion of ground improvements and potential effects.

Although extensive planning and design measures are being undertaken to prevent ground subsidence, some unanticipated settlement events could occur. If unanticipated settlement occurs, emergency measures would be necessary to repair damage or to minimize further settlement. These measures could include lane and/or sidewalk closures or access to basements of adjacent buildings.

Permeation Grouting

Permeation grouting is a ground improvement process in which a grout fluid is injected (by permeation) into the soil to displace the air and/or water occupying natural pore spaces. The fluid can be either a cement grout or a chemical grout, depending upon project requirements and restrictions, soil permeability, material availability, and the availability of specialized equipment and skilled local labor.

The permeation grouting process is limited to granular soils with a sufficiently high permeability to allow the fluid to penetrate the soil pore spaces. These permeability restrictions vary depending upon the type of grout used, with ordinary Portland cement grout used for coarser materials and micro-fine cement used for finer-grained sands with a lower permeability. For high-permeability materials, it may be necessary to adjust the cement grout fluid's viscosity, injection pressure, or setting time to limit the penetration distance. For finer-grained sands and coarse silts, chemical grouts such as sodium silicate are normally used because they have a lower viscosity than cement grouts and can penetrate smaller voids. In clay-type soils, both cement grout and chemical grout have limited application, because soil permeability is too low to allow fluid penetration into the pore spaces without fracturing the ground and forming isolated lenses of grout.

Grout is placed through small-diameter pipes inserted from the surface and from pits or shafts adjacent to the grouted area or, in certain instances, from the tunnel face. In the latter scenario, the TBM must be appropriately equipped with drills and valves, and the tunnel drive must stop long enough to drill and insert the grout placement pipes, inject the grout, and allow time for the grout to set. This method has been used successfully in situations where tunnels have passed under potentially sensitive or important structures.

Compaction Grouting

Compaction grouting is a process that injects a highly viscous grout into the soil mass. It does not penetrate the pores as with permeation grouting, but instead forms a grouted "bulb" within the soil mass, displacing the natural soil and consolidating and condensing it in the process. Due to the non-penetration of the grout into the soil mass, a single bulb has a limited volume and area of soil improvement. However, multiple bulbs can be placed adjacent to one another to achieve the desired results. It is especially useful in loose, granular soils that densify or compact easily and quickly.

Compaction grouting would involve injection of grout above the tunnel crown as the tunnel bore advances forward longitudinally. The grout densifies the soil profile overlying the tunnel's crown and replaces some of the lost ground, thereby preventing potential settlement (or sinkholes) from propagating upward to the surface.

Compensation Grouting

Ground improvement along the bored tunnel is expected to consist of compensation grouting, a type of jet grouting. Compensation grouting would be performed to mitigate ground loss during tunneling beneath the structures where settlement is anticipated or detected during construction of the bored tunnel. Grout is injected into the ground beneath the foundations of existing structures, and a grout bulb is formed. The grout displaces the soil and has the potential for uplifting the foundation and restoring ground support. For sensitive structures where settlement is anticipated, grout injection pipes could be installed prior to construction. Settlement monitoring could be performed as construction progresses, and then, if ground settlement is detected, the pre-installed pipes could be used to inject the grout and maintain the structural alignment. If the grout is not installed in time, settlement of the structure could occur. Also, if the grout injection pressure is not carefully controlled, excessive uplift or lateral pressure against the foundations could cause damage to the structure.

Compensation grouting is generally performed using large-diameter drilled shafts below ground. See Exhibit 3-3 for a representative example of what the compensation grouting equipment would look like.

The current proposal for the grouting procedures in the south end would use three to five large-diameter (approximately 15-foot) access shafts. The shafts would be drilled into the ground to facilitate the installation of an array of grout tubes under the existing building foundations. These shafts would extend to the base of the existing pile foundations, about 40 feet below grade. Grouting operations (mixers, pumps, and power units) would be located at the surface to service the drilling of the grout tubes. The access shafts are planned for the south project area (largely south of Seneca Street), where the soils are weaker and less dense.

The key to effective compensation grouting is to carefully monitor both the structure and any ground movements to optimize the timing and quantities of grout to be injected. Through reuse of pre-installed grout placement pipes, grout can be injected before, during, and after the tunnel drive.

Ground Freezing

Artificial ground freezing is a process by which heat is extracted from a water-saturated soil mass, temporarily converting the interstitial pore water to ice, resulting in a consolidated soil mass as long as it remains frozen. The heat extraction is accomplished by installing freeze pipes into the soil mass to be frozen and then circulating a refrigerant fluid to extract the heat. Under normal conditions, a saline solution with a freezing point below that of pure water is used. Liquid nitrogen can be used for saline groundwater conditions, where groundwater is moving under a slight hydraulic gradient, or where a "quick freeze" is desired. This expedites the freezing process but substantially increases the cost. The freeze can be maintained as long as the temporary foundation support is required.

Ground freezing is applicable to all soil types, but is potentially problematic in some soils. Since water expands as it freezes, free water must be allowed to escape from the pore space as the ice forms; otherwise, ice lenses will form and result in ground heave. In coarse- to fine-grained granular soils, this is usually not an issue, because soil permeability is high enough to allow free water to escape. As soils become finer grained (in the silt sizes), the permeability is low enough that free water cannot easily escape; in some cases, capillary action can attract free water to the ice crystals. Either phenomenon results in the formation of ice lenses that result in ground heave. In clays, free water cannot escape, but capillary action is reduced. Depending upon the natural water content of the clay, some heave potential still exists due to ice formation and expansion. There is a slight risk that any water-carrying buried utilities (such as water and sewer lines) could also freeze if they are within the zone of formation of the frozen ground block. Although ground freezing has not been ruled out as a ground improvement method, it is not among the most likely methods to be used. If it is used, it would be used in very limited areas.

Underpinning

Underpinning is a traditional structural modification process by which the foundations of an existing structure are temporarily (sometimes permanently) structurally supported by alternative support elements. The objective is to maintain the structural integrity and vertical position of the existing structure while excavating for a new structure.

Compensation Grouting

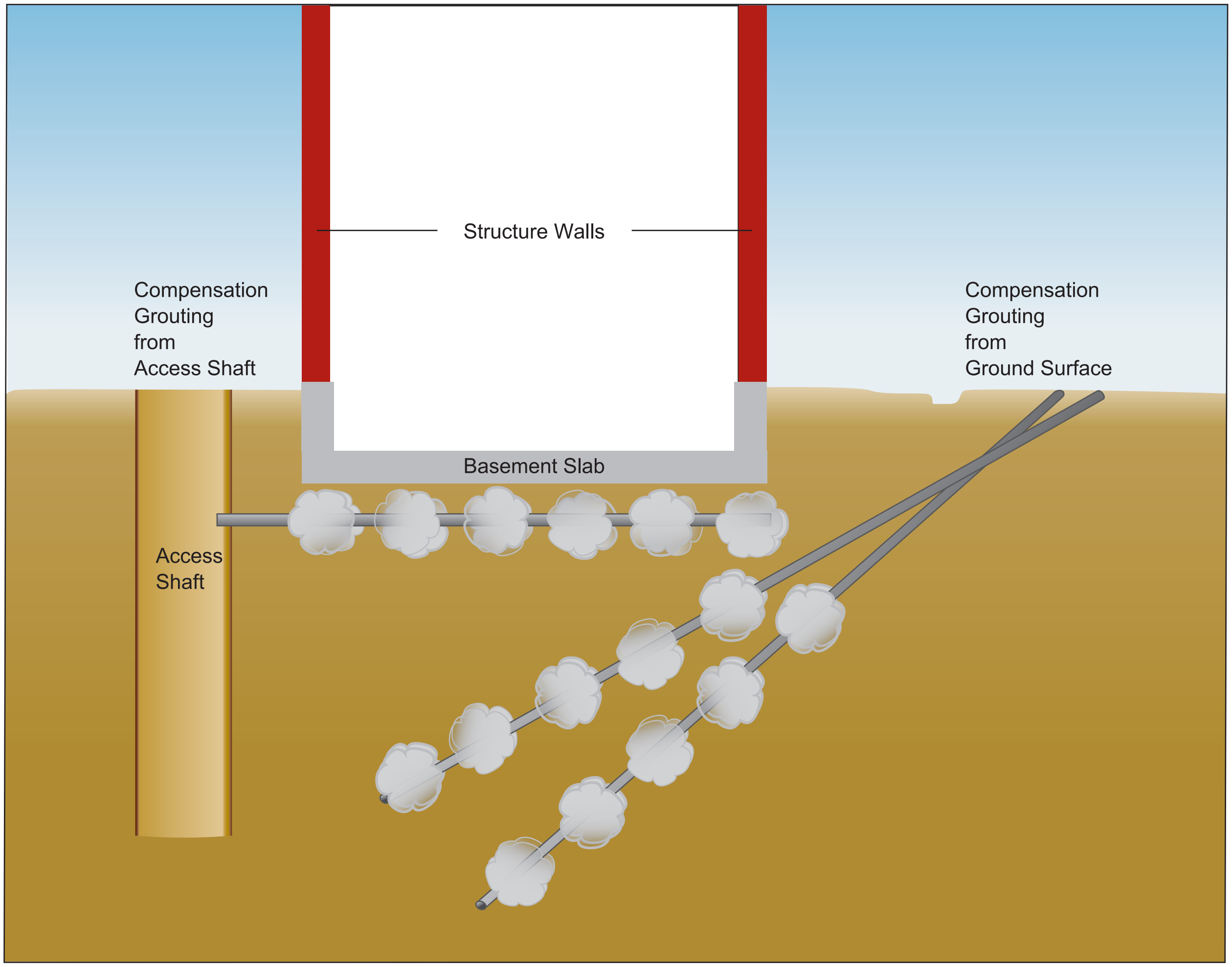


Exhibit 3-3

Typical underpinning methods include temporary timber cribbing beneath existing foundations, ground improvement with grout or ground freezing beneath the existing foundations, or new structural elements such as pin piles (or micropiling) beneath the existing foundations. The selection of an appropriate underpinning solution is a function of the size (weight) and geometry of the structure to be temporarily supported, the work space available, the site-specific ground and groundwater conditions, the availability of specialty equipment and labor locally, the duration for which supplemental foundation support is required, and the cost and schedule to construct the underpinning scheme.

3.2.2 South Portal Area Construction

Secant piles with a diameter of approximately 4 or 5 feet would be used for support. These secant pile walls would be installed along both sides of the proposed tunnel alignment from S. King Street to just north of S. Royal Brougham Way. The total length of these secant pile walls would be approximately 900 linear feet. Once the secant piles are installed, the excavation operation would begin along Alaskan Way and the WOSCA property, to varying depths of approximately 12 feet to a maximum of 90 feet. Temporary tiebacks would also be installed for additional support.

The current plan is to support and protect in place as many of the utilities in the construction area as possible. However, it would be necessary to temporarily relocate some utilities and replace them in their current location or permanently relocate them.

The south portal design includes the construction of a tunnel operations building and ramps providing northbound on, northbound off, southbound on, and southbound off movements to and from SR 99. Construction durations for this activity are based on the assumption of two 8-hour shifts, each working 5 days per week, but the shifts could occur up to 24 hours per day, 7 days per week if necessary to maintain schedule.

Other work in the south portal area includes construction of foundations for structures, grading for roadways, trenching for utilities, ground improvement, placement and compaction of fill, and removal of existing subsurface structures. In shallow excavation areas, such as utility trenches, temporary shoring may be used to provide excavation support. Construction dewatering would likely be required during construction to control groundwater flow into the excavations that extend below the water table.

Concurrent with ground improvement and settlement mitigation operations in the south end, work would be conducted within the WOSCA property extending from south of Railroad Way S. to the intersection of S. Royal Brougham Way. This work would include the construction of a secant pile wall with tiebacks to support an open-cut excavation. This excavation would allow for construction of the ramps and mainline roadways that would connect the bored tunnel to SR 99. See Section 3.2.1 for a discussion of potential ground improvement methods that could be used to strengthen existing soils, as required for portal and tunnel construction activities and long-term operation. Some of the early soil improvement work would be undertaken to reduce the risks of settlement of existing buildings in the areas where the soil types warrant additional strengthening. This is discussed in the paragraphs below, and greater detail regarding the geology and soils in the project area can be found in Appendix P, Earth Discipline Report.

Just north of the WOSCA property, a 9-foot-thick reinforced-concrete slab approximately 400 feet long would be constructed to support the concrete cradle that will support the TBM. This area is also where the assembly and launching of the TBM would take place. The WOSCA site would be used to facilitate tunnel boring operations. Upon completion of the bored tunnel construction, the structures to connect the tunnel to SR 99 and the surrounding surface streets would be completed.

A number of ground replacement and ground improvement methods are being discussed to strengthen soils sufficiently to accommodate the construction of the proposed structures, particularly in the south portal area where the soil is mostly fill material. To initiate tunneling, it would be necessary to construct a deep, long braced excavation with a vertical headwall where the tunneling would start, with a back slope to grade. A minimum cover of at least 25 feet of stiff ground (roughly half the tunnel diameter) is required above the TBM to safely begin tunneling. Ground investigations at this location indicate the presence of about 30 feet of poor ground consisting of loose sand, fill, timber, and other manmade materials overlying very dense silty sand to gravel.

To alleviate disruption and shorten the duration of planned utility outages and street closures in the area, utilities would be protected in place where possible. However, some may need to be relocated if they cannot be protected in place.

Temporary excavation support walls (shoring) must be installed before beginning any excavation. Shoring walls must be laterally supported (using either internal struts or tiebacks) as the excavation is progressively deepened to avoid instability and control settlement at the sides of the cut. The method of shoring would depend on the depth of excavation and corresponding ground conditions.

The construction approach that offers the least disruption to the Pioneer Square and stadium area is the bored tunnel alignment that allows most of the construction to occur to the south on the WOSCA property. Several approaches to construction will be considered with the objective of minimizing utility relocations, decreasing the duration of traffic disruption, and reducing risks relating to poor soil conditions to facilitate a safer start for the tunneling process.

As the project develops and construction methods become more established, strategies will be developed to ensure local connectivity and access to buildings and businesses by pedestrians, bicyclists, motorists, and movers of freight. In addition, methods to ensure access to public facilities and utilities would be developed for those not relocated prior to construction.

3.2.3 Portal Entry Construction

The cut-and-cover portions to be built for the portal entry points at both ends of the tunnel would involve construction of a box structure placed within a trench excavation. The excavation would subsequently be backfilled, followed by restoration of disturbed surface features, such as streets, utilities, and amenities (e.g., sidewalks and street furniture).

As both portals would be built in a dense urban setting, underground work using the cut-and-cover method would entail the following activities:

- Relocating utilities and rerouting traffic
- Mitigating construction-generated effects (e.g., noise, dust, and traffic congestion)
- Modifying access for commercial businesses and nearby residential uses
- Localized disruption of some transit routing

Within the WOSCA site, the south portal structure would transition from cut-and-cover into a retained cut that would accommodate the braiding and unbraiding of the roadway structures. Construction of the retained cut sections (no roof) would essentially be the same as for the cut-and-cover sections, except there would be no roof slab or restoration of surface features immediately above the tunnel section.

3.2.4 Bored Tunnel Construction

The current plan is to initiate tunnel construction from the south portal just south of S. King Street, excavate northward under Alaskan Way, crossing under the existing viaduct to follow a large curve beginning just south of S. Washington Street, then pass under Western Avenue parallel with First Avenue. The tunnel would be about 215 feet below the existing ground level at its deepest point near Virginia Street. The tunnel would then rise as it continues north under First Avenue to near Stewart Street, follow another large curve to the north, and cross under the Belltown neighborhood at a diagonal. After a few hundred feet, the tunnel would transition back to a cut-and-cover section north of Thomas Street. This section would unbraid from the stacked configuration to a side-by-side roadway to match the existing grade of Aurora Avenue near Mercer Street. The bored tunnel would emerge at Thomas Street.

The bored tunnel would contain two roadway decks, with the southbound roadway above and the northbound roadway below. Each roadway deck would convey two lanes of traffic.

Construction durations for this activity are based on the assumption of three 8-hour shifts, each working 6 days per week, with a TBM maintenance day needed on the seventh day.

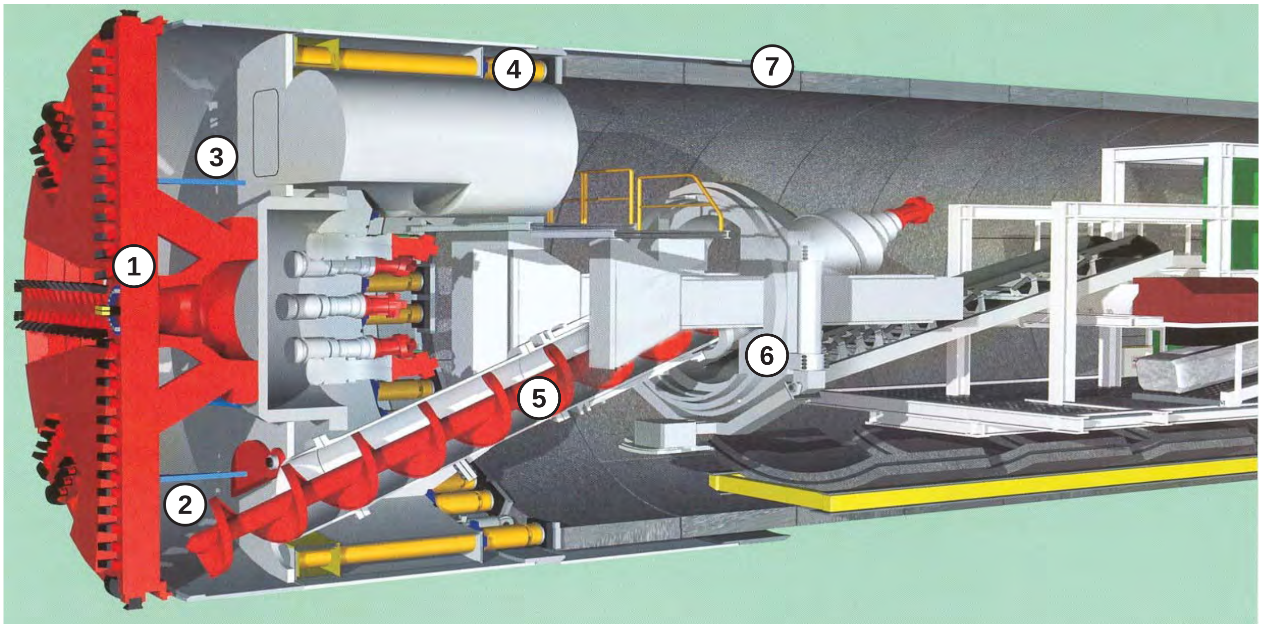
Tunnel Boring Machines

For deep bore tunnel construction, three types of pressurized-face TBMs are in use today: the earth pressure balance (EPB) machine, the slurry pressure face (SPF) machine, and a hybrid EPB-slurry TBM. These machines can mine below the groundwater table and stabilize the tunnel face, as well as minimize surrounding ground movements and ground subsidence above the tunnel. This is accomplished by maintaining pressure on the tunnel face to balance ground and water pressures. Both technologies have been used on large-diameter tunnels, and both have been used in the geologic conditions existing in the Seattle area. Current technology is moving towards a hybrid of the EPB and SPF TBMs to enable excavation of tunnels in the most challenging of soft ground conditions.

Pressurized-face TBMs are used with a precast concrete segmented lining that provides both water-tightness and ground support. These linings are usually developed with a slight taper to the ring that provides the ability to negotiate both vertical and horizontal curves and to make alignment corrections during the tunnel excavation. The precast concrete segmented liners may be used for both initial and final tunnel support.

A TBM is fitted with an automated grout injection system to fill any voids behind the completed tunnel lining ring and the cut ground; this controls surface settlement in soil and maintains ring shape and position within the tunnel bore.

In an EPB system, an example of which is shown conceptually in Exhibit 3-4, the cutting wheel operates within a chamber filled entirely with excavated ground. Face pressure is controlled by balancing the rate of advance of the shield with the rate of discharge of the excavated material through the screw conveyor. The material from the screw conveyor is emptied into muck cars (or a conveyor) for transport. Typical practice for EPB tunneling also includes the addition of bentonite, foams, polymers, or other conditioners into the pressure chamber and within the screw conveyor. This conditioning improves the workability of the excavated material in the working chamber and within the screw conveyor, modifies permeability, improves the plasticity of flow, and reduces friction.



EPB machines loosen the soil at the tunnel face by means of the tools on the rotating **cutting wheel (1)**. The soil then passes through the cutting wheel openings into the **excavation chamber (2)**, where it is mixed with the existing plastic soil. The force of the **thrust cylinders (4)** is transferred to the plastic soil via the **pressure bulkhead (3)**, thus controlling the movement of soil from the tunnel face into the excavation chamber. The excavated material is conveyed from the pressurized excavation chamber to the tunnel, which is under atmospheric pressure, by the **screw conveyor (5)**. Directly behind the shield, the **tunnel (7)** is lined with segments by means of an **erector (6)**.

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Exhibit 3-4
Typical Earth Pressure Balance Tunnel Boring Machine

Source: Sivalingam and Klados 2006.

EPB machines are generally considered more appropriate in fine-grained material (clay, silt, and fine sand). However, various types of soil conditioners that provide an artificial cohesion to granular materials are continually being developed and improved. These soil conditioners allow EPB machines to be used in more granular soil types, although sometimes at a significant cost. EPB TBMs are commonly fitted with cutting disks to excavate through rock materials, including cobbles and boulders.

Generally, the tunneling contractor would choose the method most advantageous for removing the excavated spoil materials generated during the tunneling work. Spoils would be removed through the south portal area using hoppers and conveyors and transported to a staging area for stockpiling before being transported by truck or barge to a disposal site.

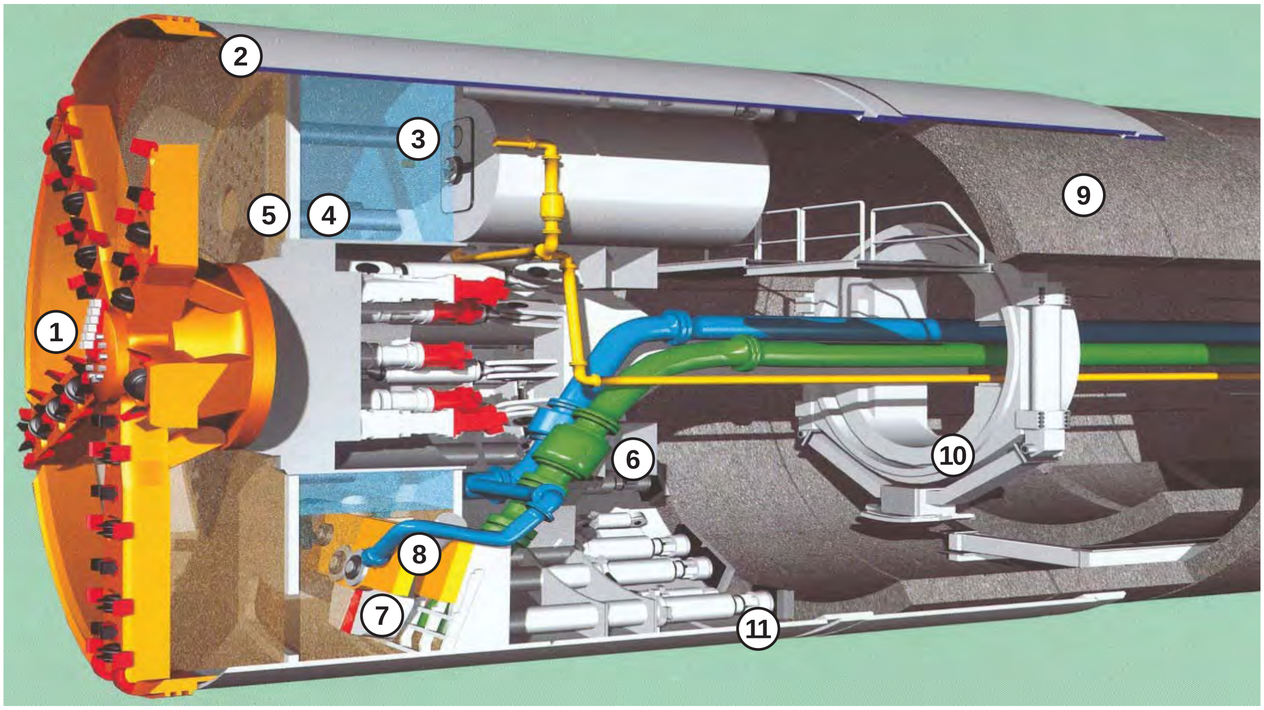
A slurry TBM is shown schematically in Exhibit 3-5. The principle of the slurry TBM is to fill the excavation chamber with a mixture of soil cuttings and bentonite slurry fluid. This mixture provides the necessary ground support. Using the slurry return pipeline, the mixture of excavated material and slurry is taken to a separation plant on the surface, where solids are removed and the treated slurry is returned to the heading. With the slurry system, face support and ground movements into and around the tunnel shield are controlled by maintaining a hydraulic pressure in the slurry to counter-balance the prevailing earth (soil and water) pressure.

During normal tunneling, the slurry is forced into the excavated face by the pressure in the cutting chamber. The slurry forms a bentonite cake on exposed ground at the front of the machine, and this cake acts as a membrane-type barrier against uncontrolled flow of water and soil. Slurry TBMs are generally considered more appropriate in coarse-grained soil because coarse-grained material is more easily separated at the slurry treatment plant.

Spoils would be pumped via the slurry pipeline in the tunnel from the TBM to the surface in the south portal area. A special processing plant would likely be necessary to separate the bentonite from the slurry, return the slurry to the TBM, and stockpile the clean spoils until they are transported by truck or barge to the off-site disposal area.

Bored Tunnel Construction Activities

The proposed bored tunnel would have an outside diameter of approximately 54 feet and would be excavated by a pressurized-face TBM. The TBM with trailing gear would likely measure at least 400 feet in length and approximately 54 feet in height. The tunnel would be lined with precast concrete segments as the tunnel is excavated. Two levels of deck would be installed in the tunnel to support two lanes of traffic in each direction.



Behind the **cutting wheel (1)** with muck bucket lips and cutter tools is a steel cylinder, the **shield (2)**. It is within the protection of this shield that the tunnel is excavated. The space in front of the **pressure bulkhead (3)** is filled with a bentonite suspension that seals the existing soil. The pressure necessary to support the tunnel face is produced by means of a compressed air cushion in the **excavation chamber (4)**, which is divided by a **submerged wall (5)**. The excavated soil is pumped into the **slurry line (6)** together with the suspension. Large rocks are broken down by a **stone crusher (7)**. The suspension is supplied via the **feed line (8)**. Protected by the shield, the **reinforced concrete segments (9)** are installed by an **erector (10)**. To continue the advance, the machine presses against each previously installed segmental ring with **hydraulic thrust cylinders (11)**. The annular gap between the segmental ring and the ground is continuously grouted with mortar as the machine advances. All operations are controlled from the control panel.

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Exhibit 3-5
Typical Slurry
Tunnel Boring Machine

Source: Sivalingam and Klados 2006.

A project work site would be established on the WOSCA property to support TBM excavation and road deck construction. These facilities would include laydown areas for materials, possibly a bentonite slurry separation plant (if needed), maintenance workshops, storage areas for excavated spoils and precast concrete segments, along with parking and field offices for contractors' and owner's on-site personnel. If a slurry separation plant is needed, it would have a fairly large footprint on the site—approximately 200 feet by 130 feet.

A temporary electrical substation would be built at this location, and electrical systems in the area would be extended to this substation to provide power to the TBM. The footprint for the TBM electrical substation would be approximately 75 feet by 125 feet, and the structure would be no more than two stories high.

During the tunnel excavation, access into and out of the tunnel would be facilitated from the WOSCA site.

Bored tunnel construction would likely occur in the following activity sequences:

1. Procure TBM.
2. Set up staging areas to support tunnel excavation and internal construction.
3. Excavate tunnel; install permanent lining system for ground support as excavation proceeds.
4. Construct internal structure and configuration of roadways, egress passages, and ventilation ducts.
5. Install embedded components for tunnel systems, including fire and life safety and directional information signage. Fire and life safety systems for the tunnel include power, lighting, ventilation, fire alarm, sprinkler system, traffic signals, and communications.

The TBM and its trailing gear would be assembled at the bottom of the cut-and-cover excavation. Driving the TBM through the proposed tunnel alignment is estimated to take approximately 1 year, assuming an average rate of advancement of approximately 30 feet per day. This assumes three 8-hour shifts per day, 6 days per week. Excavating a 54-foot-diameter bore at 30 feet per day would produce an average of approximately 2,600 cubic yards of material per day, which would fill approximately six trucks per hour, assuming 18 cubic yards per truck. At the completion of the tunnel drive, the TBM and associated trailing gear would be dismantled and removed from the north end of the tunnel. The current plan is to complete the bored tunnel excavation and remove the TBM before starting construction of the internal roadway structure and emergency escape facilities.

One possible method for constructing the tunnel's internal walls and roadway decks would be to use a combination of cast-in-place concrete and precast components fabricated off site and brought in from both ends, with assembly staged from a specially fabricated moving rig and working platform called a "jumbo." After the TBM is removed from an extraction pit at the north end of the tunnel, precast panels for the lower roadway deck would be installed. The panels would be concurrently loaded from the north and south ends, and work would proceed toward the middle of the tunnel. Both cast-in-place and precast components would then be installed for the tunnel's side walls, emergency stair enclosures, and the upper roadway deck. After these internal structures have been completely installed, components relating to the mechanical, electrical, and control/instrumentation systems would be installed throughout the bored tunnel and portals.

3.2.5 North Portal Area Construction

Tunnel boring operations would end just north of Thomas Street. An open cut extraction pit would be excavated to remove the TBM, and the machine would be dismantled and extracted at this location. At the end of the bored tunnel, SR 99 would begin to unbraid and transition into a cut-and-cover structure between Thomas and Harrison Streets. The new SR 99 would become a side-by-side roadway at Harrison Street connecting back to the existing SR 99 just north of Mercer Street.

Construction of the north portal would begin with retaining walls (slurry walls) constructed along the eastern and western boundaries of the project area. The interior structures housing the northbound and southbound roadway decks and connections to the tunnel ventilation structures would be built within the excavation.

3.2.6 Tunnel Operations Buildings at the South and North Portals

One tunnel operations building would be located near each tunnel portal. The tunnel operations buildings are required to provide life-safety ventilation to the tunnel by means of multiple large exhaust fans, which could also be used to supply air when required. The building at the south portal would be approximately 60 feet in height above street level, with ventilation stacks extending up to 30 feet above the roof. The building at the north portal would be approximately 65 feet in height above street level, with ventilation stacks extending up to 30 feet above the roof. These buildings would also serve as distribution points for electrical and fire-suppression utilities serving the tunnel, the retained cut roadway connecting to the tunnel, and the fans in the tunnel operations buildings. A vertical fan arrangement would be used to conserve valuable urban real estate and minimize noise and exhaust at street level. The design of the fan arrangement depends on calculations to determine the size adequate to accommodate fire emergency ventilation requirements of the tunnel. To facilitate this arrangement, structures, or major portions of structures, may need to be several stories high. Height restrictions and the urban context will be considered as the building designs are developed.

The north portal tunnel operations building would include a tunnel operations center where staff would be stationed to monitor traffic and maintain tunnel operations, as well as monitor any emergency events. The south portal tunnel operations building would have a limited tunnel maintenance operations area for tunnel monitoring staff. The south tunnel operations building could also be used as a backup tunnel operations center in case of an emergency.

A number of secondary elements, such as emergency generators and fuel tanks, would be incorporated into the buildings to support basic functions. Structures would require truck access with loading docks to facilitate the occasional movement of large equipment. A few small ancillary rooms that support other functional requirements of tunnel operation may be included within each ventilation structure. Given the constrained site areas available, both of the tunnel operations buildings would be multiple stories, with at least one story underground.

3.2.7 Viaduct Demolition

The Bored Tunnel Alternative includes demolition and removal of the existing viaduct. The viaduct columns and footings would be removed to an estimated depth of 5 feet below existing grade. Activities associated with viaduct demolition and removal are assumed to require two 8-hour shifts per day, 6 days per week.

All utilities attached to the viaduct and expected to remain in service would need to be relocated prior to viaduct demolition, as described in Section 3.1.4. It is anticipated that for the viaduct's removal, replacement may be necessary for the utilities buried beneath the viaduct. Some of these relocations or replacements may require excavation. Mitigation measures would be employed to ensure that utilities buried beneath the viaduct are not damaged during demolition.

For the demolition and removal of the viaduct structure between S. King Street and the Battery Street Tunnel, concrete munchers would be used exclusively in locations adjacent to existing businesses or any residential uses, to control the size and dispersion of concrete debris. To protect any live underground utilities within the footprint of the existing viaduct, either timber mats or gravel bedding would be used. Water would be used to control fugitive dust created during demolition. Signs, fences, traffic control flaggers, and possibly uniformed police officers may be used to separate pedestrians and vehicles from the construction work zone. Materials resulting from viaduct demolition would be broken concrete and severed reinforcing steel. A smaller concrete-breaking hammer would be used to further separate the concrete from the reinforcing steel, and these materials would be placed in separate stockpiles.

Some of the concrete rubble may be recycled and used to fill the Battery Street Tunnel during the decommissioning process. The remaining demolition debris would likely be trucked to local disposal sites or recycled for use on other projects, although some portion of the debris could be transferred to an active quarry site at Mats Mats in Jefferson County, Washington, as one possible location.

The fleet of demolition equipment to be used in the removal of the viaduct would consist of two extended-arm trackhoes with a concrete-pulverizing attachment (concrete muncher), two trackhoes with a concrete-breaking hammer attachment, a 60-foot-reach manlift, a 60-ton-capacity support crane, a 10-ton-capacity forklift, two track-mounted backhoes, and several pickup trucks and dump trucks.

3.2.8 Battery Street Tunnel Decommissioning

The decommissioning of the Battery Street Tunnel would require disconnecting the power, water, and drainage lines; filling the void space with suitable material (potentially recycling the concrete rubble from the demolition of the viaduct); closing all of the street access vents; and blocking the portals at both ends of the tunnel. The necessary utilities would be reconnected as required.

Small utility equipment such as excavators and loaders would be used during the decommissioning and restoration of any of the utilities. Some concrete pavement breaking would be required, and some evening or weekend street closures may be necessary to support this operation. The filling of the majority of the void space would use suitable material (either import fill or rubble debris generated from the viaduct demolition) compacted to a designated value. The remaining space would be capped with a fluid material such as controlled-density fill. Earth-moving equipment such as loaders, graders, compactors, and haul trucks would transport, spread, and compact the backfill material into the Battery Street Tunnel. The fluid cap would be placed by concrete pump trucks that would stage either at the portal ends or along the surface street of Battery Street from above.

3.2.9 Surface Street Improvements and Restoration of Utilities

Improvements in the South Portal Area

Two options are being considered for new cross streets that would be built to intersect with Alaskan Way S.:

- New Dearborn Intersection – Alaskan Way S. would have one new intersection and cross street at S. Dearborn Street. The cross street would have sidewalks on both sides.
- New Dearborn and Charles Intersections – Alaskan Way S. would have two new intersections and cross streets at S. Charles Street and S. Dearborn Street. The cross streets would have sidewalks on both sides.

Landscaping, trails, and sidewalk improvements would be incorporated into the reconstruction of surface roadways and the intersections between First Avenue S. and Alaskan Way S., and S. Royal Brougham Way and S. King Street.

Aboveground utilities would be replaced, and other utilities would be relocated prior to street restoration. Any underground utilities would also be installed prior to surface street restoration. Seattle City Light's transmission lines would be affected by construction, as well as water lines and mains, sanitary sewer and storm drains, and natural gas lines. Please refer to Appendix K, Public Services and Utilities Discipline Report, Section 6.1.3 for greater detail regarding the construction effects to these utilities.

Improvements in the North Portal Area

At the north end of the project area, SR 99 would be within a four-lane cut-and-cover tunnel between Thomas and Harrison Streets and a retained cut between Harrison and Mercer Streets. The bored tunnel would pass under John and Thomas Streets, and Harrison Street would be connected over the cut-and-cover section of the SR 99 tunnel. New intersections at John, Thomas, and Harrison Streets would cross the Aurora Avenue surface street. Mercer Street would also be widened between Fifth Avenue N. and Dexter Avenue N., and SR 99 would be raised to provide vertical clearance for the Mercer Street crossing.

The existing ramps at Denny Way would be replaced by ramps at Harrison Street. The new northbound SR 99 off-ramp would exit onto a rebuilt Republican Street that would connect with Dexter Avenue N. The new southbound on-ramp to SR 99 would be located at the intersection of Sixth Avenue N. and Republican Street. The northbound on-ramp and southbound off-ramp would connect with SR 99 at the intersection of Aurora Avenue and Harrison Street.

In the north portal area, the aboveground utilities would be replaced, and other utilities would be relocated prior to street restoration. Any underground utilities would also be installed prior to surface street restoration. The affected utilities would include electrical power facilities, water lines, sanitary sewer and storm drains, natural gas facilities, and telecommunications systems. For greater detail on the effects to these utilities, see Appendix K, Public Services and Utilities Discipline Report, Section 6.1.5.

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Chapter 4 CONSTRUCTION ACTIVITIES, DURATIONS, AND ROADWAY RESTRICTIONS

In this chapter, the construction of the Bored Tunnel Alternative is broken down into construction activities and the possible sequencing for these activities. Because of the densely developed and congested urban character of the project area, maintaining traffic flow and routing during the construction period is a major factor in determining the construction sequencing. To maintain traffic flow in the corridor, certain construction traffic stages must precede others to preserve traffic movements to the maximum degree possible, while still accommodating the necessary construction activities and work zones. The activity durations are current estimates developed for each activity within each traffic stage, and they may change somewhat prior to the start of construction as more information becomes available.

4.1 Construction Assumptions for the Bored Tunnel Alternative

The following assumptions were used to develop the construction schedule and traffic staging for the Bored Tunnel Alternative:

- Funding will be available to build this project as proposed.
- The NEPA ROD will be issued by July 2011, and construction will begin immediately after the ROD is issued.
- The existing viaduct will carry SR 99 traffic during the construction of the bored tunnel.
- Construction may occur up to 24 hours per day, 7 days per week, for the entire construction period, within permitting requirements.
- Parking under the viaduct will be removed prior to the removal and demolition of the viaduct.
- Access to the Seattle Ferry Terminal and the ferries will be maintained. Access will also be maintained to Terminal 46 and its cargo operations.
- Transit access and capacity will be maintained in the downtown area to the extent feasible during construction.
- All utilities will be relocated from Denny Way, Sixth Avenue, Taylor Avenue, and Broad Street for the north portal cut-and-cover structure.
- The major electrical transmission line under the existing viaduct will be relocated prior to viaduct demolition activities.
- Service to utility customers will be maintained during construction to the greatest extent possible. Priority will be given in particular to

maintaining service to businesses and residences in the construction area. Although temporary disruptions may be necessary, they will be minimized to the extent possible.

- All of the necessary right-of-way, easements, permits, and construction staging areas will be acquired prior to construction.

4.2 Bored Tunnel Alternative Construction Stages and Durations

The construction activities for the Bored Tunnel Alternative would require a total of 66 months. The construction period can be broken down into eight traffic stages, starting with some utility work and early construction activities prior to the construction of the south portal.

During construction, at least one northbound lane and one southbound lane would be maintained along First Avenue. In addition, both south and north pedestrian connections along First Avenue S. between S. Royal Brougham Way and S. King Street would be maintained to the maximum extent possible. However, during key construction activities, there may be short periods when some of the connections are detoured. At the end of the bored tunnel construction, up to a 3-week closure would be needed to connect SR 99 to the bored tunnel at the end of Traffic Stage 7.

The following text describes a likely construction sequence for elements of the Bored Tunnel Alternative, along with the approximate construction durations. These durations have been developed as estimates based on what is known about the Bored Tunnel Alternative design at this early stage.

4.2.1 Bored Tunnel Traffic Stage 1

Traffic Stage 1 would last approximately 4.5 months, as shown in Exhibit 4-1. In Traffic Stage 1, the SR 99 mainline would remain open with two lanes in each direction, although these lanes would be shifted to the east for the construction of the Mercer Street overcrossing. Along with the mainline, the midtown Seneca and Columbia Street ramps would remain in use until the bored tunnel is operational and the demolition of the viaduct begins in early 2016.

In the south portal area, a temporary northbound on-ramp and southbound off-ramp would be in place on the WOSCA property as a result of the S. Holgate Street to S. King Street Viaduct Replacement Project and would continue to be used during the construction associated with the Bored Tunnel Alternative. Alaskan Way S. would be closed between S. King and S. Atlantic Streets to accommodate portal construction activities. Traffic on Alaskan Way S. would be routed to First Avenue S., between S. Royal Brougham Way and S. King Street. First Avenue S. would carry two lanes of traffic in each direction.

In the north portal area, Sixth Avenue, Broad Street, and Taylor Avenue would be subject to lane closures and periodic evening closures due to utility relocations. Denny Way would remain open, but road widening activities would require the closure of two lanes of Mercer Street between Fifth and Ninth Avenues N.

Exhibit 4-1. Traffic Stage 1 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (4.5 months)
Support or replace utilities along tunnel corridor	4.5 months (continues in Stages 2 and 3)
Widen Mercer Street: Construct overcrossing and widen Mercer Street from Fifth to Ninth Avenues N.	4.5 months (continues in Stages 2, 3 and 4)
Initiate design and procurement of the TBM	4.5 months (continues in Stages 2 and 3)
Construct secant pile shoring walls and excavate at Alaskan Way, install secant pile wall around staging area, and establish staging yard at WOSCA site	4.5 months (continues in Stages 2 and 3)
Conduct soil improvements in the south along tunnel alignment up to Madison Street in the north	4.5 months (continues in Stages 2 and 3)
North end: Relocate utilities along Sixth Avenue N., Taylor Avenue N., Republican Street, and Denny Way	4.5 months (continues in Stage 2

TBM = tunnel boring machine
WOSCA = Washington-Oregon Shippers Cooperative Association

4.2.2 Bored Tunnel Traffic Stage 2

Traffic Stage 2 would last approximately 5 months, as shown in Exhibit 4-2. In Traffic Stage 2, northbound SR 99 traffic would remain on the viaduct, while southbound traffic would be routed off of the viaduct and on to the Railroad Way S. ramp to connect to the WOSCA detour (Exhibit 4-3). Southbound SR 99 traffic would connect back to the new SR 99 structure near S. Royal Brougham Way. First Avenue S. would remain open, with two lanes in each direction. Near the south portal, soil improvements for potential settlement would occur.

Exhibit 4-2. Traffic Stage 2 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (5 months)
Support or replace utilities along tunnel corridor	5 months (continues in Stage 3)
Widen Mercer Street: Construct overcrossing and widen Mercer Street from Fifth to Ninth Avenues N.	5 months (continues in Stage 3 and 4)
Construct secant pile shoring walls and excavate at Alaskan Way, install secant pile wall around staging area, and establish staging yard at WOSCA site	5 months (continues in Stage 3)
Initiate design and procurement of the TBM	5 months (continues in Stage 3)
Conduct soil improvements in the south along tunnel alignment north to Madison Street	4.5 months (continues in Stage 3)
North end: Relocate utilities along Sixth Avenue N., Taylor Avenue N., Republican Street, and Denny Way	5 months

TBM = tunnel boring machine
WOSCA = Washington-Oregon Shippers Cooperative Association

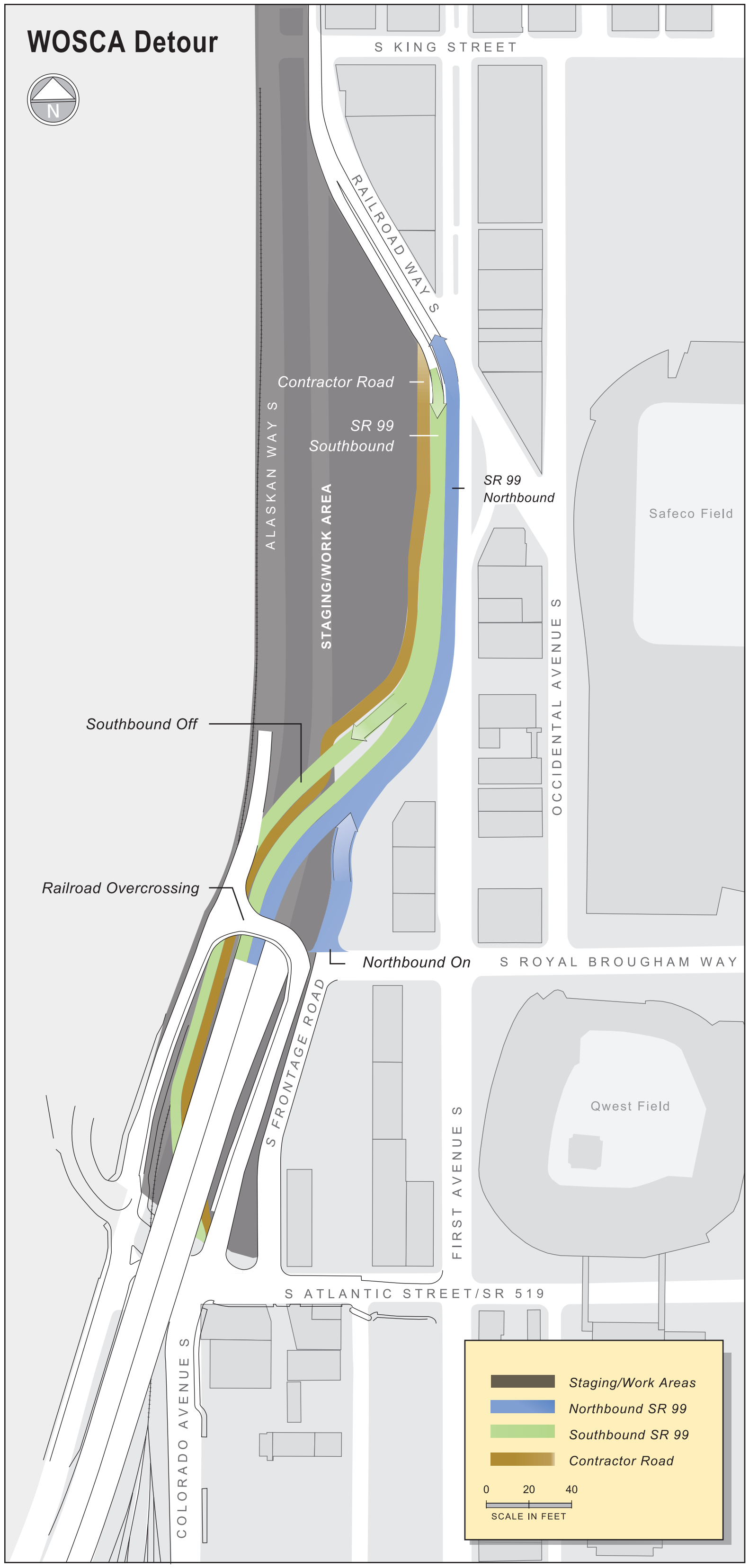
WOSCA Detour
N
S KING STREET
RAILROAD WAY S
ALASKAN WAY S
STAGING/WORK AREA
Contractor Road
SR 99
Southbound
SR 99
Northbound
Safeco Field
OCCIDENTAL AVENUE S
Southbound Off
Railroad Overcrossing
Northbound On
S ROYAL BROUGHAM WAY
S FRONTAGE ROAD
FIRST AVENUE S
Qwest Field
S ATLANTIC STREET/SR 519
COLORADO AVENUE S
Staging/Work Areas
Northbound SR 99
Southbound SR 99
Contractor Road
0
20
40
SCALE IN FEET

Exhibit 4-3

4.2.3 Bored Tunnel Traffic Stage 3

Traffic Stage 3 would last approximately 7 months, as shown in Exhibit 4-4. Demolition of the viaduct section between S. Royal Brougham Way and S. King Street would take approximately 1 month at the beginning of this stage.

Exhibit 4-4. Traffic Stage 3 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (7 months)
Support or replace utilities along tunnel corridor	7 months
Demolish viaduct between S. Royal Brougham Way and S. King Street[1]	1 month
Widen Mercer Street: Construct overcrossing and widen Mercer Street from Fifth to Ninth Avenues N.	7 months (continues in Stage 4)
Continue installation of secant pile wall around staging area and establish staging yard at WOSCA site	7 months
Initiate design and procurement of the TBM	6 months
Assemble the TBM	1 month (continues in Stage 4)
Conduct soil improvements in the south along tunnel alignment north to Madison Street	4.5 months
North end: Construct support walls for north portal and TBM retrieval pit	6 months

TBM = tunnel boring machine
WOSCA = Washington-Oregon Shippers Cooperative Association
[1] Part of the S. Holgate Street to S. King Street Viaduct Replacement Project.

In the south end, the S. Holgate Street to S. King Street Viaduct Replacement Project would demolish a section of the viaduct just north of S. Royal Brougham Way that would require the closure of SR 99 to all traffic for 1 week. Once this demolition is completed, both northbound and southbound SR 99 traffic would travel on the WOSCA detour at about S. Royal Brougham Way and connect back to SR 99 using the existing ramp along Railroad Way S. The northbound on-ramp and southbound off-ramp would remain on the temporary ramps. First Avenue S. would still carry two lanes of traffic in each direction between S. King Street and S. Royal Brougham Way. In the north end, Sixth Avenue N. would remain closed from Thomas Street to Broad Street. Harrison Street would also be closed from Sixth Avenue N. to SR 99. The eastbound lanes of Broad Street and the two right lanes of Mercer Street would remain closed for road-widening activities. Toward the end of Traffic Stage 3, the SR 99 lanes would be shifted to the west as the construction of the Mercer Street overcrossing continues.

4.2.4 Bored Tunnel Traffic Stage 4

Traffic Stage 4 would last approximately 3 to 4 months, as shown in Exhibit 4-5. In the south end, both northbound and southbound SR 99 traffic would use the WOSCA detour and the temporary northbound and southbound ramps. First Avenue S. would continue to carry two lanes of traffic in each direction.

Exhibit 4-5. Traffic Stage 4 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (3 to 4 months)
Assemble TBM and start tunnel drive	3 to 4 months (continues in Stage 5)
Complete Mercer Street overcrossing	3 to 4 months
North end: Construct tunnel operations building	3 to 4 months (continues in Stages 5 and 6)

TBM = tunnel boring machine

In the north, Sixth Avenue N. would remain closed during this stage from Thomas Street to Broad Street. Harrison Street would be closed from Sixth Avenue N. to SR 99. The westbound lanes of Broad Street would be closed, and Mercer Street would have two lanes open in each direction as part of the widening activities performed by the City. During Traffic Stage 4, the SR 99 lanes would remain shifted to the west as the construction of the Mercer Street overcrossing continues.

4.2.5 Bored Tunnel Traffic Stage 5

Traffic Stage 5 would last approximately 16 months, as shown in Exhibit 4-6. In the south end, northbound and southbound SR 99 traffic would continue to travel on the WOSCA detour. First Avenue S. would continue to carry two lanes of traffic in each direction.

Exhibit 4-6. Traffic Stage 5 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (16 months)
Bored tunnel: Drive TBM	10 months
Bored tunnel: Install interior tunnel structures and systems	7 months (continues in Stages 6 and 7)
Extract TBM	1 month
North end: Close Broad Street	Permanent condition
North end: Construct west half of Harrison/Aurora ramps	8 months
North end: Construct cut-and-cover tunnel	8 months (continues in Stage 6)
North end: Construct tunnel operations building	10 months (continues in Stage 6)
South end: Construct tunnel operations building	12 months (continues in Stage 6)

TBM = tunnel boring machine

In the north, Sixth Avenue N. would remain closed from Thomas Street to Broad Street. Harrison Street would be closed from Sixth Avenue N. to SR 99. Approximately 3 months into Traffic Stage 5, Broad Street would be closed permanently, and Mercer Street would carry two lanes of traffic in each direction. The SR 99 southbound lanes would undergo temporary lane closures.

4.2.6 Bored Tunnel Traffic Stage 6

Traffic Stage 6 would last approximately 9 months, as shown in Exhibit 4-7. In the south end, northbound and southbound SR 99 traffic would continue to travel on the WOSCA detour. First Avenue S. would continue to carry two lanes of traffic in each direction.

The southbound SR 99 lanes would be shifted onto the west half of the Harrison/Aurora ramps. Later in this traffic stage, the east half of the Harrison/Aurora ramps would be built after the traffic has shifted over to use the west half. Sixth Avenue N. would remain closed from Thomas Street to Broad Street. Harrison Street would also be closed from Sixth Avenue N. to SR 99. Broad Street would remain closed. Mercer Street would be opened to three lanes in each direction from Fifth Avenue N. to I-5.

Exhibit 4-7. Traffic Stage 6 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (9 months)
Bored tunnel: Install interior tunnel structures and systems	9 months (continues in Stage 7)
South portal: Construct tunnel operations building	9 months
South portal: Construct cut-and-cover and retained cut tunnel connection	9 months
North portal: Construct shoring, excavate, and build east half of Harrison Street ramp structure	6 months
North portal: Construct southbound SR 99 from tunnel portal at Harrison Street to meet existing grade	1 month (continues in Stage 7)
North portal: Construct tunnel operations building	9 months
North portal: Construct cut-and-cover tunnel	9 months

SR = State Route

4.2.7 Bored Tunnel Traffic Stage 7

Traffic Stage 7 would last approximately 8 months, as shown in Exhibit 4-8. In the south end, the northbound and southbound traffic would continue to travel on the WOSCA detour. First Avenue S. would continue to carry two lanes of traffic in each direction.

Exhibit 4-8. Traffic Stage 7 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (8 months)
Bored tunnel: Install interior tunnel structures and systems	4 months
Bored tunnel: Commission interior systems	5 months
South portal: Construct cut-and-cover and retained cut tunnel connection	8 months
North portal: Construct shoring for northbound SR 99; excavate and build northbound SR 99	7 months
North portal: Construct Republican Street and Sixth Avenue N. ramp structures	8 months
North portal: Construct both southbound and northbound SR 99 from tunnel portal at Harrison Street to meet existing grade	4 months
Connect SR 99 to the bored tunnel	3 weeks

SR = State Route

Sixth Avenue N. would remain closed from Thomas Street to Broad Street, and Harrison Street would remain closed from Sixth Avenue N. to SR 99. Broad Street would remain closed.

At the end of Stage 7, there would be up to a 3-week closure to connect SR 99 to the bored tunnel.

4.2.8 Bored Tunnel Traffic Stage 8

Traffic Stage 8 would last approximately 13 months, as shown in Exhibit 4-9. When this stage starts, SR 99 traffic would begin using the newly constructed bored tunnel. In the south end, Alaskan Way would be reduced in width between S. King and Pike Streets to allow for the demolition and removal of the viaduct structure. Drivers on First Avenue S. would experience lane closures necessary for street restoration. Between Railroad Way S. and S. Royal Brougham Way, traffic would be reduced to one lane in each direction. First Avenue S. would experience periodic lane closures for street restoration activities. Various streets between S. King Street and Battery Street would experience periodic street closures to facilitate the viaduct demolition.

Exhibit 4-9. Traffic Stage 8 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (13 months)
Demolish and remove existing viaduct	9 months
Decommission Battery Street Tunnel	9 months
South portal area: Remove WOSCA detour	1 month
South portal area: Restore surface streets	13 months
North portal area: Restore surface streets	13 months

WOSCA = Washington-Oregon Shippers Cooperative Association

In the north end, Denny Way, Harrison Street, Sixth Avenue N., Taylor Avenue N., and Broad Street lanes would be restricted to support utility relocation and surface street restoration activities. The reconstruction of Aurora Avenue between Harrison Street and Denny Way would include filling the currently depressed Aurora Avenue roadway to grade at the Battery Street Tunnel's north portal, and the existing Denny Way ramps would be closed. Traffic would use the new intersection and on- and off-ramps to and from SR 99 at the intersection of Harrison Street.

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ATTACHMENT A

Cumulative Effects Analysis

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CUMULATIVE EFFECTS ANALYSIS

The Alaskan Way Viaduct Replacement Project proposes to replace SR 99 from approximately S. Royal Brougham Way to Roy Street and remove the existing viaduct, which extends from approximately S. King Street to the Battery Street Tunnel. The Alaskan Way Viaduct Replacement Project complements a number of other independent projects that improve safety and mobility along SR 99 and Seattle waterfront from the South of Downtown (SODO) area to Seattle Center. Collectively, these projects are referred to as the Alaskan Way Viaduct and Seawall Replacement Program. The individual projects referred to as "the Program" include the Moving Forward projects identified in 2007 and improvements recommended as part of the Partnership Process.

The Moving Forward projects are the following:

- SR 99 Yesler Way Vicinity Foundation Stabilization (Column Safety Repairs)
- S. Massachusetts Street to Railroad Way S. Electrical Line Relocation Project (Electrical Line Relocation Along the Viaduct's South End)
- Battery Street Tunnel Maintenance and Repairs
- S. Holgate Street and S. King Street Viaduct Replacement
- Transit Enhancements and other improvements

Improvements recommended as part of the Partnership Process include the following:

- Alaskan Way Surface Street Improvements
- Elliott/Western Connector
- Mercer West Project (corridor improvements from Fifth Avenue N. to Elliott Avenue
- Elliott Bay Seawall Project
- Alaskan Way Promenade/Public Space
- Transit Enhancements
- First Avenue Streetcar Evaluation

All of these projects have been categorized into four groups of Program elements: roadway elements, non-roadway elements, projects under construction, and completed projects.

Roadway Elements

Alaskan Way Surface Street Improvement

The Alaskan Way surface street would be rebuilt and improved between S. King Street and Pine Street. The new surface street would be six lanes wide between King and Columbia Streets (not including turn lanes), transitioning to four lanes between Marion and Pike Streets. Generally, the new street would be located east of the existing street where the viaduct is located today. The new street would include sidewalks, bicycle lanes, parking/loading zones, and signalized pedestrian crossings at cross streets. The existing waterfront streetcar would be replaced by a new streetcar line running on First Avenue. The new surface street would provide a regional truck route for freight traveling between the Duwamish/Harbor Island/SR 519 area and the Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC).

Elliott/Western Connector

The Elliott/Western Connector would provide a connection from the Alaskan Way surface street to the Elliott/Western corridor that provides access to and from BINMIC and neighborhoods north of Seattle (including Ballard, Fremont, and Magnolia). The connector would be four lanes wide and would provide a grade-separated crossing of the BNSF mainline railroad tracks. In addition, it would provide local street access to Pike Street and Lenora Street and be reintegrated with the street grid at Bell Street, which would improve local street connections in Belltown. The new roadway would include bicycle and pedestrian facilities.

Mercer West Project – Corridor Improvements From Fifth Avenue N. to Elliott Avenue

The Mercer Street west corridor improvements include reconfiguring Mercer Street between Fifth Avenue N. and Elliott Avenue to accommodate two-way traffic. The route would be redesignated by the City as a regional truck route to provide vital freight connections to Ballard/Interbay. These improvements would provide access to Ballard/Interbay freight and a route for drivers coming from Ballard and Magnolia.

Battery Street Tunnel Maintenance and Repairs

Battery Street Tunnel maintenance work was identified as one of the Moving Forward projects. However, the need for maintenance and repairs to the Battery Street Tunnel depends on how the tunnel might be used in the future. The Battery Street Tunnel would be used as part of the alternatives studied in the 2004 Draft Environmental Impact Statement (EIS) and 2006 Supplemental Draft EIS. With the Bored Tunnel Alternative, the Battery Street Tunnel would not be needed and would be decommissioned. The Washington State Department of Transportation

(WSDOT) and the City of Seattle remain committed to maintaining the Battery Street Tunnel to ensure that it remains safe for as long as it is in use.

Non-Roadway Elements

Elliott Bay Seawall Project

The Elliott Bay Seawall needs to be replaced to protect the shoreline along Elliott Bay, including Alaskan Way. It is at risk of failure due to seismic and storm events. The seawall currently extends from S. Washington Street in the south to Bay Street in the north, a distance of about 8,000 feet. The Elliott Bay Seawall Project limits extend from S. Washington Street in the south to Broad Street in the north (also known as the central seawall).

Alaskan Way Promenade/Public Space

A new expanded promenade and public space would be provided to the west of the new surface Alaskan Way between King Street and Pike Street. The promenade would vary in width and would serve Piers 48 through 59, which have various uses such as cruise ship and ferry terminals, restaurants, retail shops, hotels, and regional entertainment like the Seattle Aquarium. Access to the piers would be provided by service driveways.

Between Marion and Pike Streets, the promenade would be approximately 70 to 80 feet wide. This public space will be designed at later date. Other potential open-space sites include a triangular space north of Pike Street and east of Alaskan Way and parcels created by the removal of the viaduct between Lenora and Battery Streets.

Transit Enhancements

A variety of transit enhancements will be provided to support planned transportation improvements associated with the Alaskan Way Viaduct and Seawall Replacement Program. Development of these specific improvements is underway: (1) the Delridge RapidRide line, (2) additional service hours on the West Seattle and Ballard RapidRide lines, (3) peak-hour express routes added to the South Lake Union and Uptown neighborhoods, (4) local bus changes (such as realignments and a few additions) to several West Seattle and northwest Seattle routes, (5) implementation of transit signal priority on S. Main and/or S. Washington Streets between Alaskan Way and Third Avenue, and (6) simplification of the electric trolley system.

In addition, northbound and southbound right-side transit lanes on SR 99 are assumed from just south of the Aurora Bridge to north of Aloha Street.

First Avenue Streetcar Evaluation

The First Avenue streetcar would circulate between S. Jackson Street and Republican Street and function as a local connector. This alignment would extend through several of Seattle's densest neighborhoods, including Pioneer Square, the Central Business District, Pike Place Market, Belltown, and Lower Queen Anne.

Projects Under Construction

S. Holgate Street to S. King Street Viaduct Replacement Project

(Construction/implementation: mid-2009 to spring 2014)

The S. Holgate Street to S. King Street Viaduct Replacement Project will replace this seismically vulnerable portion of SR 99 with a seismically sound structure that is designed to current roadway and safety standards. An Environmental Assessment for this project was completed in June 2008, and the Finding of No Significant Impact was published in February 2009. Early utility relocations began in mid-2009, and construction followed in 2010. The project is expected to be completed by March 2014.

Transportation Improvements to Minimize Traffic Effects During Construction

(construction/implementation: 2011–2017)

Several transportation improvements are underway to help offset traffic effects during construction of projects included in the Alaskan Way Viaduct and Seawall Replacement Program. Construction or implementation of the following improvements are underway:

- Adding variable speed signs and travel time signs on Interstate 5 (I-5) to help maximize safety and traffic flow
- Providing funding for the Spokane Street Viaduct Widening Project, which includes a new Fourth Avenue S. off-ramp for West Seattle commuters
- Adding buses and bus service in the West Seattle, Ballard/Uptown, and Aurora Avenue corridors during construction, as well as a bus travel time monitoring system
- Upgrading traffic signals and driver information signs for the Denny Way, Elliott Avenue W./15th Avenue W., SODO, and West Seattle corridors to support transit and traffic flow
- Providing information about travel alternatives and incentives to encourage use of transit, carpool, and vanpool programs

Completed Projects

SR 99 Yesler Way Vicinity Foundation Stabilization (Column Safety Repairs)

(construction/implementation: completed April 2008)

Construction to strengthen four column footings between Columbia Street and Yesler Way was completed in April 2008. To prevent the columns from sinking further, crews drilled a series of steel rods surrounded by concrete into stable soil and added a layer of reinforced concrete to tie the new supports to the existing column footings.

S. Massachusetts Street to Railroad Way S. Electrical Line Relocation Project (Electrical Line Relocation Along the Viaduct's South End)

(construction/implementation: completed fall 2009)

Construction to relocate electrical lines began in September 2008 and was completed in fall 2009. WSDOT and Seattle City Light relocated electrical lines from the viaduct to underground locations east of the viaduct between S. Massachusetts Street and Railroad Way S.

Seattle Planned Urban Development

Gull Industries on First Avenue S. (Also Known as the Home Plate Development)

(construction/implementation: 2010–2013)

This project site is located west of First Avenue S., between S. Atlantic Street and S. Massachusetts Street. The project would redevelop the entire site to include a mix of office, retail, and restaurant uses. The development would include approximately 300 parking spaces designated for events, which is the same number of event parking spaces that exist today, and 500 spaces for the development's occupants.

North Parking Lot Development at Qwest Field

(construction/implementation: 20012–2025)

Planned development of Qwest Field's north parking lot includes a 20-story office tower and three residential towers of 10, 20, and 25 stories on a 3.85-acre site. The project would potentially create 645 new housing units, 19,000 square feet of retail space, 480,000 square feet of office space, and about 950 above-grade parking stalls. In addition, the Stadium Lofts, an 80-unit mixed-use residential development, is proposed for construction on Occidental Avenue S. The permitting and construction timeframe for this component of the project has not yet been determined.

Seattle Center Master Plan (EIS) (Century 21 Master Plan)

(construction/implementation: 2010–2030)

Seattle Center's *Century 21 Master Plan* lays out a vision for the future of the campus over a 20-year period. The focus of the plan is to unify the open space at the heart of the campus and create connections between the buildings on the periphery, the open spaces at Seattle Center, and the growing neighborhoods on the center's edges. The *Century 21 Master Plan* calls for increasing the modes and frequency of transit, improving pedestrian connections to and through the campus, and making it easier and safer to access Seattle Center by vehicle, by bicycle, or on foot. Future transportation-related projects called for in the plan include the following:

- A new underground multimodal transportation center and parking garage, located at the Memorial Stadium site, providing direct bus and truck loading to campus venues and patron parking.
- Improved access with new emphasis on pedestrian safety and better connections to and through the site, especially from transit stops.
- A proposed bus rapid transit (BRT) stop on the west side of Seattle Center on First Avenue N. and Republican Street as part of the new BRT route from north downtown to Ballard.
- Expansion of the South Lake Union streetcar line to Seattle Center along the Central line route.

In a scoping letter, the management of Seattle Center expressed particular concern about construction impacts during Seattle Center's 50th anniversary celebration, from April to October 2012.

Bill and Melinda Gates Foundation Campus Master Plan

(construction/implementation: 2008–2014)

In July 2008, the Bill and Melinda Gates Foundation (the world's largest charitable foundation) broke ground on its new $500 million headquarters, which it hopes to occupy in late 2010 or spring 2011. Other elements of the plan will be implemented over a 15-year period.

The foundation's campus, which is located east of Seattle Center, covers a city block and will be large enough to house 1,200 employees and host large meetings and events. The campus will also have its own interactive museum, a 15,000-square-foot center describing the work of the Bill and Melinda Gates Foundation. In all, the headquarters buildings will encompass some 900,000 square feet.

South Lake Union Redevelopment

(construction/implementation: 2003–2013)

The first set of projects in the South Lake Union area (the boundary of the area starts at the intersection of I-5 and Denny Way, follows Denny Way to Aurora Avenue, Aurora Avenue to Galer Street, Galer Street to Lake Union, around Lake Union to E. Nelson Place, and E. Nelson Place to I-5) announced by the property owners (Phase I) is providing space for University of Washington research laboratories, other research institutions desiring expansion space, commercial biotechnology companies, an architectural design company, an international retailer, office space for other tenants, restaurants and other retail businesses, and a number of residential units. Some of the buildings were completed and entered service in 2007. Others were completed as early as 2004. More than 3 million square feet of commercial, retail, and residential space are expected to be added to the South Lake Union area.

The second phase of development in the South Lake Union area (Phase II) is projected to result in a net increase (with the existing Phase I buildings) of 7.2 million square feet of commercial space, 35 percent of which is assumed to be designed for biotechnology research and development uses, with the remainder in a mix of commercial office (55 percent) and retail uses (10 percent).

In addition to the commercial development, 10,000 residential units are projected to be constructed in the South Lake Union area through the development of 7.7 million square feet of new housing units during Phases I and II. Estimates for both commercial and residential development are clearly speculative for Phase II, but they are based on the best information currently available, in *Potential Economic and Fiscal Impacts of South Lake Union Development* (Sommers 2003).

U.S. Coast Guard Integrated Support Command

(construction/implementation: unknown)

The U.S. Coast Guard is proposing changes to its facility on Alaskan Way S. The schedule for this work is unknown.

Seattle Aquarium and Waterfront Park

(construction/implementation: 2006–2018)

The central portion of the waterfront is at the nexus of several potential development projects to create a new civic space for Seattle. These projects are discussed in *Mayor's Recommendations: Seattle's Central Waterfront Concept Plan* (Seattle 2006). The development is proposed to include a reconfigured shoreline consisting of Piers 62/63 and the Seattle Aquarium site, and a triangle of land between them offers the potential to create a public space and pedestrian corridor descending from Victor Steinbrueck Park and the Pike Place Market down to the waterfront.

Mayor's Recommendations: Seattle's Central Waterfront Concept Plan recommends creating a new civic space at the central waterfront by integrating the renovation of Piers 62/63 with the development of a highway lid and the aquarium expansion that would consist of a mix of uses, including retail space, public space, public art, performance space, and other features.

<u>Seattle Combined Sewer System Upgrades</u>

(construction/implementation: 2010–2015)

The City of Seattle intends to construct a new combined sewer overflow storage facility and conveyance system along the central waterfront. This project is not part of the Alaskan Way Viaduct and Sewall Replacement Program.

Local Roadway Improvements

<u>Bridging the Gap Projects</u>

(construction/implementation: 2007–2015)

Construction associated with projects that are part of this Seattle levy began in 2007 and is expected through 2015. Considerable road work is expected on downtown streets and First Avenue S. in 2008. In 2010, Airport Way S. and Fourth Avenue S. north of S. Royal Brougham Way would have partial closures for roadway resurfacing. In 2011, additional resurfacing work is planned for Airport Way S. north of S. Massachusetts Street and on S. Dearborn Street east of Fifth Avenue S.

<u>S. Spokane Street Viaduct Widening</u>

(construction/implementation: 2009–2012)

The Seattle Department of Transportation (SDOT) is significantly improving the S. Spokane Street Viaduct, the 60-year-old elevated roadway that connects I-5 to the West Seattle Bridge. Components of the project are described in the following list.

- A new eastbound, two-lane off-ramp will be added to the Spokane Street upper roadway. The ramp will touch down at Fourth Avenue S., where vehicles may head either northbound or southbound on Fourth Avenue S.
- The upper roadway between Sixth Avenue S. and E. Marginal Way will be widened to the north by 41 feet.
- The existing ramp at Fourth Avenue S. for westbound traffic will be replaced by a new ramp at First Avenue S., built to current design standards.

- The existing upper roadway deck will be repaved and variable message signs will be installed.
- The lower roadway will be rebuilt with curbs and gutters, and a new 10-foot-wide sidewalk with landscaping will be installed along the north side of the lower roadway.

The construction dates provided below are current projections; they may change as the work progresses.

- 4th quarter 2010 – Reopening of eastbound lower roadway
- 4th quarter 2010 – Opening of temporary lanes on new upper structure
- 4th quarter 2010 – Opening of new eastbound Fourth Avenue off-ramp
- 3rd quarter 2011 – Opening of new First Avenue on- and off-ramp
- 3rd quarter 2011 – Temporary closure of eastbound Fourth Avenue off-ramp
- 4th quarter 2011 – Reopening of westbound lower roadway, substantial completion

<u>SR 99/East Marginal Way Grade Separation</u>

(construction/implementation: 2009–2011)

This project will provide a northbound and southbound grade separation on Duwamish Avenue S., relocating E. Marginal Way through this corridor to improve access among the Port of Seattle terminals, the Union Pacific Railroad and BNSF railyards, and local manufacturers' and distribution warehouses. The lead track that will be grade-separated connects on-dock rail at the Port of Seattle's Terminal 5 (where containers are loaded directly onto trains instead of shuttled to a railyard by truck) to the mainline. It also supports industrial users in West Seattle and on Harbor Island. Construction began in 2007 and is expected to be completed near the end of 2010.

<u>Mercer East Project – Corridor Improvements From Dexter Avenue N. to I-5</u>

(construction/implementation: summer 2010 to summer 2012)

The Mercer East Project will widen Mercer Street between I-5 and Dexter Avenue N. to accommodate three lanes of traffic in each direction, parking, sidewalks, and a median with left-turn lanes. Valley Street will be narrowed to a two-lane, two-way street.

Regional Roadway Improvements

I-5 Improvements

(construction/implementation: see below)

To extend the life of the freeway, WSDOT will replace about 440 deteriorating concrete panels and grind down the worst areas of uneven pavement on northbound and southbound I-5 between the Boeing Access Road in South Seattle and the King/Snohomish County line and in the I-5 express lanes. Crews also will repave the N.E. 50th Street on-ramp and replace signs, guardrails, and impact attenuators.

The implementation timeline is as follows:

- 2004 to 2008 – Identify and prioritize the list of pavement replacement projects that may include operational improvements.
- 2008 to 2009 – Select the top two pavement replacement projects and traffic operations improvements.
- 2009 – Begin the I-5 pavement repairs project from Tukwila to Shoreline. This project will addresses the most urgent pavement repairs until the pavement can be replaced.
- 2009 to 2015 – Advance the top two reconstruction options forward for preliminary design and environmental documentation.
- 2017 and beyond – Implement pavement replacement and operational improvements (assuming that funds are available).

SR 520 Bridge Replacement and HOV Program

(construction/implementation: 2010–2014)

The SR 520 Bridge Replacement and HOV Program includes four projects:

- SR 520 Bridge Replacement and HOV Project – The SR 520 bridges are vulnerable to earthquakes and windstorms and must be replaced. As part of the Bridge Replacement and HOV Project, crews will replace the SR 520 bridges and make other transit, HOV, and community enhancements.
- Medina to SR 202: Eastside Transit and HOV Project – Population, employment, and transit use are growing on the Eastside, and this growth will continue through the next 20 years. The Eastside Transit and HOV Project will respond to the needs of the rapidly growing Eastside and enhance the SR 520 corridor by completing the HOV system, improving transit time and reliability, enhancing public safety, and providing other environmental and community benefits.

- SR 520 Pontoon Construction Project – WSDOT is advancing pontoon construction to restore the SR 520 floating bridge in the event of a catastrophic failure. If the SR 520 bridge fails, it could take several years to construct pontoons and restore the bridge. Crews would construct and store pontoons until they are needed for a recovery effort. If the pontoons are not needed for emergency use, they would be used for the planned replacement of the SR 520 bridge. WSDOT is currently evaluating two Pacific coast sites to build a pontoon construction site.
- Lake Washington Congestion Management – The Lake Washington Congestion Management Program is a series of projects to develop "smart roadways" on Interstate 405 (I-405), SR 520, and I-90. The work is federally funded and part of The Lake Washington Urban Partnership, a cooperative agreement to use innovative traffic management tools for improving traffic flow on the major corridors surrounding Lake Washington. The agreement also calls for a new variable tolling system that could improve traffic flow on the SR 520 corridor and provide up to $500 million to replace the aging SR 520 Lake Washington floating bridge.

I-405 Corridor Program

(construction/implementation: 2005–2020)

In October 2002, the federal government released a Record of Decision approving the I-405 Corridor Program EIS, which is a master plan for regional transportation improvements on the Eastside. This corridor-wide programmatic planning document was the result of unprecedented cooperation between all the cities, legislative leaders, and agencies in the I-405 corridor.

Major pieces of the master plan include:

- Adding up to two new lanes in each direction for the entire 30-mile length of I-405
- Developing a BRT line with stations along I-405 and expanded transit centers
- Improving key arterial streets
- Creating 1,700 new vanpools, a doubling of the region's current fleet
- Building 5,000 new park-and-ride spaces
- Building eight new pedestrian/bicycle crossings over the freeway
- Increasing local transit service by up to 50 percent

Construction of elements of the corridor program began in 2005 and are expected to be completed in 10 to 15 years.

I-90 Two-Way Transit and HOV Operations, Stages 1 and 2

(construction/implementation: 2007–2014)

The I-90 Two-Way Transit and HOV Operations project will improve regional mobility by providing safe and reliable two-way transit on I-90 between Bellevue and Seattle. The project will provide full-time HOV lanes for eastbound and westbound traffic on the outer I-90 roadways and will retain the existing reversible lane operations in the center roadway.

Because of funding limitations, the project will be implemented in stages. Each stage of the project provides viable and independent transit and transportation benefits that can be funded and constructed as financing becomes available. Three stages have been identified for the project:

- **Stage 1**, which is funded and approved, provides a new HOV lane in the westbound outer roadway and a new HOV direct access ramp at 80th Avenue S.E. It also includes modifications to the Bellevue Way HOV direct access ramp.
- **Stage 2**, with future funding, will include improvements to eastbound I-90 between 80th Avenue S.E. on Mercer Island and Bellevue Way.
- **Stage 3** will provide improvements to eastbound and westbound I-90 between Seattle and 80th Avenue S.E. on Mercer Island.

Transit Improvements

First Hill Streetcar

(construction/implementation: dates not available)

The First Hill Streetcar project is a proposed 2-mile streetcar connector serving Seattle's Capitol Hill, First Hill, and International District areas with connections to Link light rail and Sounder commuter rail. It was included in the mass transit system expansion ballot that voters approved in November 2008.

http://www.seattlestreetcar.org

Sound Transit University Link Light Rail Project

(construction/implementation: 2009–2016)

University Link (U-Link) is the 3.15-mile extension of light rail from downtown Seattle to the University of Washington. U-Link includes twin-bore tunnels and two stations, one at Capitol Hill (Broadway and E. John Street) and the other on the University of Washington campus at Husky Stadium. U-Link is projected to add 70,000 daily riders to the Link system, bringing total daily ridership to 114,000 in 2030. Construction of U-Link began in early 2009 and will continue over the next 7 years. Passenger service is scheduled to begin in 2016.

RapidRide

(construction/implementation: 2010–2013)

The King County Metro Transit Now Service Changes and RapidRide Corridors program includes King County Metro's planned service improvements that will substantially improve transit's ability to accommodate increased ridership. The plan includes RapidRide services that provide high-frequency service and bus priority improvements to highly traveled routes within King County Metro's service area. The plan also includes improved service on high-ridership routes and new peak and midday service in newly developing residential areas, and creates service partnerships with major employers throughout the region.

RapidRide is King County Metro's new, streamlined bus service that will provide frequent, all-day service in the following six corridors:

- **A Line** – Tukwila to Federal Way on Pacific Highway S./International Boulevard (scheduled to be launched in October 2010)
- **B Line** – Bellevue to Redmond on N.E. Eighth Street and 156th Avenue N.E. via the Crossroads area in Bellevue and the Overlake area in Redmond (2011)
- **C Line** – West Seattle to downtown Seattle via Fauntleroy Way S.W., California Avenue S.W., and SR 99 (2011/2012)
- **D Line** – Ballard to Uptown and downtown Seattle along 15th Avenue N.W. (possible alternate routing along 24th Avenue N.W.) (2012)
- **E Line** – Aurora Avenue N. (SR 99) between Shoreline and downtown Seattle (2013)
- **F Line** – Burien to Renton via Tukwila and Southcenter (2013)

Sound Transit North Link Light Rail

(construction/implementation: not scheduled)

In 2006, the Sound Transit Board identified a preferred route that extends beyond U-Link and includes the Brooklyn Station, Roosevelt Station, and Northgate Station.

Sound Transit East Link Light Rail

(construction/implementation: 2013–2021)

East Link is Sound Transit's voter-approved project to expand light rail from downtown Seattle to the Eastside, with stations serving Mercer Island, south Bellevue, downtown Bellevue, the Bel-Red area, and Redmond's Overlake area. East Link will connect to the Link light rail system between downtown Seattle and Seattle-Tacoma International (Sea-Tac) Airport. Sound Transit is also conducting environmental review on a future extension to downtown Redmond.

Washington State Ferries Seattle Terminal Improvements

(construction/implementation: winter 2010)

In fall 2010, seismic retrofit work will occur at the Seattle Ferry Terminal to improve earthquake resistance. It will be completed by the end of 2010.

Transportation Network Assumptions

HOV Definition Changes to 3+ Throughout the Puget Sound Region

(construction/implementation: 2013)

Moving Washington, WSDOT's vision of investments and priorities for the next 10 years, includes a new system that combines HOV lanes with existing express lanes to create a continuous express lane system for I-5, I-90, I-405, SR 520, and SR 16. Carpools of 3+ passengers are being considered to provide faster, more reliable commutes.

Sound Transit Phases 1 and 2

(construction/implementation: dates not available)

Sound Transit Phases 1 and 2 include Sounder commuter rail; ST Express bus; First Hill streetcar; and South Link, U-Link, North Link, and East Link light rail.

Other Transit Improvements

One of the planned transit improvements is converting Third Avenue to transit exclusivity (Stewart Street to Yesler Way) and the Fourth Avenue S. bus island north of S. Jackson Street (continuation of improvements put in place for the Sound Transit Tunnel Conversion).

Completed but Relevant Projects

Sound Transit Central Link Light Rail (Including the Sea-Tac Airport Extension)

(completed in 2010)

Central Link light rail operates between Sea-Tac Airport and the Westlake Station, including joint operations with buses in the Downtown Seattle Transit Tunnel.

Sound Transit launched Central Link light rail on July 18, 2009. The 14-mile line serves downtown Seattle, the International District/Pioneer Square, the stadiums and SODO, Beacon Hill, Mount Baker, southeast Seattle, and Tukwila. An extension to Sea-Tac Airport opened at the end of 2009. Central Link can be reached from the South Lake Union streetcar's Westlake Hub terminus at Westlake Center across the street from the streetcar at Fifth Avenue and Olive.

Access to the Central Link is also available using the various entrances to the transit tunnel on Pine Street.

South Lake Union Streetcar

(completed in 2007)

The City of Seattle's South Lake Union line of the Seattle Streetcar runs from the growing South Lake Union neighborhood to Seattle's downtown core. Eleven stops along the 2.6-mile line connect riders to restaurants, downtown shopping and entertainment, and Lake Union's new 12-acre lakeside park. The South Lake Union streetcar line connects to Seattle's other public transit systems: Metro buses; Sound Transit buses, trains, and light rail; and the Seattle Center Monorail.

SR 519 Intermodal Access Project, Phase 2

(completed in 2010)

WSDOT improved connections for traffic destined for the Port of Seattle terminals, the Seattle Ferry Terminal, the central waterfront area and sports stadiums, and the SODO area. The SR 519 Intermodal Access Project separated car, freight, pedestrian, and rail traffic to help improve mobility and pedestrian safety and reduce the risk of collisions. This project included the following components:

- Connection of a westbound off-ramp from I-5 and I-90 to the current S. Atlantic Street overpass
- Improvements at the intersection of First Avenue S. and S. Atlantic Street
- A grade-separated crossing at S. Royal Brougham Way to eliminate conflicts between cars, nonmotorized traffic, and trains.

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