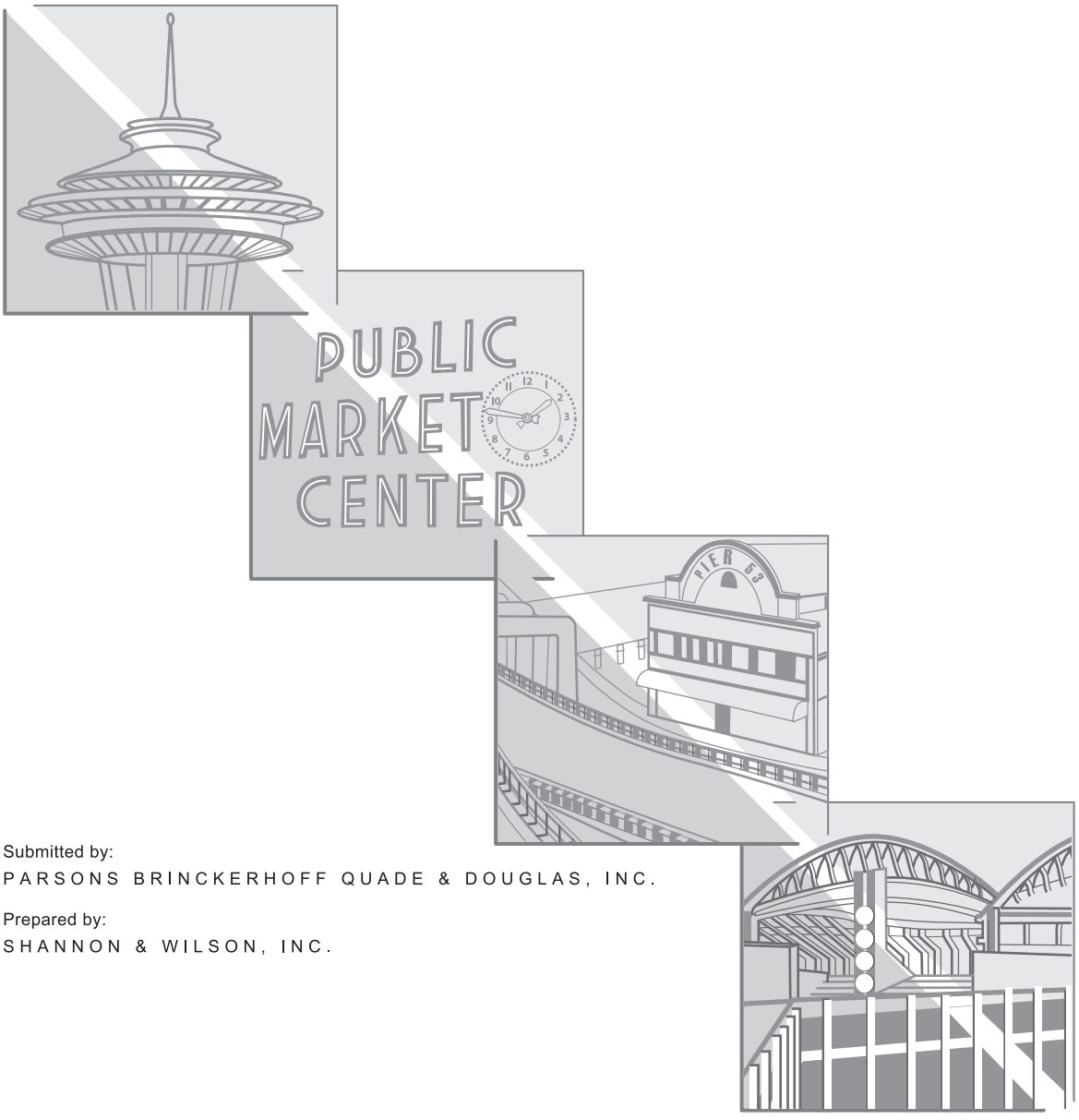
SR 99: ALASKAN WAY VIADUCT & SEAWALL REPLACEMENT PROJECT

Supplemental Draft Environmental Impact Statement

APPENDIX T

Geology and Soils Technical Memorandum



Submitted by:
PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

Prepared by:
SHANNON & WILSON, INC.

JULY 2006

U.S. Department of Transportation
Federal Highway Administration

Washington State
Department of Transportation

City of
Seattle

SR 99: ALASKAN WAY VIADUCT & SEAWALL REPLACEMENT PROJECT

Supplemental Draft EIS
Geology and Soils Technical Memorandum

AGREEMENT NO. Y-7888

FHWA-WA-EIS-04-01-DS

Submitted to:

Washington State Department of Transportation
Alaskan Way Viaduct and Seawall Replacement Project Office
999 Third Avenue, Suite 2424
Seattle, WA 98104

The SR 99: Alaskan Way Viaduct & Seawall Replacement Project is a joint effort between the Washington State Department of Transportation (WSDOT), the City of Seattle, and the Federal Highway Administration (FHWA). To conduct this project, WSDOT contracted with:

Parsons Brinckerhoff Quade & Douglas, Inc.
999 Third Avenue, Suite 2200
Seattle, WA 98104

In association with:
BERGER/ABAM Engineers Inc.
BJT Associates
David Evans and Associates, Inc.
Entech Northwest
EnviroIssues, Inc.
Harvey Parker & Associates, Inc.
HDR
Jacobs Civil Inc.
Larson Anthropological Archaeological Services Limited
Mimi Sheridan, AICP
Parametrix
Power Engineers, Inc.
Preston Gates & Ellis LLP
ROMA Design Group
RoseWater Engineering, Inc.
Shannon & Wilson, Inc.
So-Deep, Inc.
Taylor Associates, Inc.
Tom Warne and Associates, LLC
William P. Ott

This Page Intentionally Left Blank

TABLE OF CONTENTS

Preface iii

Chapter 1 Summary 1

Chapter 2 Methodology 3

Chapter 3 Studies and Coordination 5

Chapter 4 Affected Environment 7

Chapter 5 Operational Impacts and Benefits 9

5.1 Tunnel Alternative (Preferred Alternative) 9

5.1.1 South – S. Spokane Street to S. Dearborn Street 10

5.1.2 Central – S. Dearborn Street to Battery Street Tunnel 10

5.1.3 North Waterfront – Pine Street to Broad Street 12

5.1.4 North – Battery Street Tunnel to Comstock Street 13

5.1.5 Seawall – S. Washington Street to Broad Street 14

5.2 Elevated Structure Alternative 14

5.2.1 South – S. Spokane Street to S. Dearborn Street 14

5.2.2 Central – S. Dearborn Street to Battery Street Tunnel 15

5.2.3 North Waterfront – Pine Street to Broad Street 15

5.2.4 North – Battery Street Tunnel to Comstock Street 15

5.2.5 Seawall – S. Washington Street to Broad Street 15

Chapter 6 Construction Impacts 17

6.1 Tunnel Alternative (Preferred Alternative) 17

6.1.1 South – S. Spokane Street to S. Dearborn Street 17

6.1.2 Central – S. Dearborn Street to Battery Street Tunnel 17

6.1.3 North Waterfront – Pine Street to Broad Street 18

6.1.4 North – Battery Street Tunnel to Comstock Street 18

6.1.5 Seawall – S. Washington Street to Broad Street 19

6.2 Elevated Structure Alternative 19

6.2.1 South – S. Spokane Street to S. Dearborn Street 20

6.2.2 Central – S. Dearborn Street to Battery Street Tunnel 20

6.2.3 North Waterfront – Pine Street to Broad Street 20

6.2.4 North – Battery Street Tunnel to Comstock Street 20

6.2.5 Seawall – S. Washington Street to Broad Street 20

Chapter 7 Secondary and Cumulative Impacts 21

Chapter 8 Operational Mitigation 23

Chapter 9 Construction Mitigation 25

Chapter 10 References 27

ACRONYMS

EIS	Environmental Impact Statement
MSE	mechanically stabilized earth
SR 99	State Route 99

PREFACE

The technical appendices present the detailed analyses of existing conditions and predicted effects of each alternative. The results of these analyses are summarized and presented in the main text of the Supplemental Draft Environmental Impact Statement (EIS).

The Supplemental Draft EIS appendices are intended to add new information and updated analyses to those provided in the Draft EIS, published in March 2004. Information that has not changed since then is not repeated in these appendices. Therefore, to get a complete understanding of the project area conditions and projected effects, you may wish to refer to the appendices that were published with the Draft EIS. These are included on a CD in the Supplemental Draft EIS. To make it easier to understand where there is new information or analyses, the supplemental appendices present information in the same order as it was presented in the Draft EIS appendices.

The Supplemental Draft EIS and the technical appendices evaluate the effects of three construction plans: the shorter plan, the intermediate plan, and the longer plan. These plans vary in how long SR 99 would be completely closed, in how long the periodic closures may be, and in the total construction duration. For the purposes of the analyses in the technical appendices, two construction plans are evaluated with the Tunnel Alternative and one plan is evaluated with the Elevated Structure Alternative. However, each alternative could be built with any of the three plans. The construction durations and the sequencing would not be the same for a particular construction plan if paired with a different alternative; however, the effects would be within the ranges presented by the analyses.

There are several differences in how the information is presented between the main text of the Supplemental Draft EIS and how it is presented in these appendices. The Supplemental Draft EIS text refers to possible variations within the alternatives as "choices" while these appendices use the term "options." (For example, Reconfigured Whatcom Railyard versus Relocated Whatcom Railyard is referred to as a design choice in the Supplemental Draft EIS and as an option in the appendices.) In either case, the intent is to describe the various configurations that could be selected and the effects for each design.

One design choice in particular is handled very differently between the Supplemental Draft EIS text and the technical appendices. For the Tunnel Alternative in the central waterfront area, there is a choice between a stacked tunnel alignment and a side-by-side tunnel alignment. In the appendices, to simplify the discussion, these two alignments, as well as the Elevated

Structure Alternative, are each paired with a different set of options throughout the corridor and presented as complete sets that are evaluated separately. The Supplemental Draft EIS text communicates this information differently by describing one Tunnel Alternative and one Elevated Structure Alternative and evaluating the effects of the different design choices (or mix-and-match components) separately. While it may appear that there are three alternatives analyzed in the appendices and two in the Supplemental Draft EIS text, there are in fact only two alternatives. Each alternative has many potential components or design choices that can be made throughout the corridor.

The organization of the analysis of the alternatives is also a little different between the main body of the Supplemental Draft EIS and the appendices. In the Supplemental Draft EIS text, we identify two alternatives: a Tunnel Alternative and an Elevated Structure Alternative. The Supplemental Draft EIS text compares these alternatives directly by comparing effects (for example, the effects of both alternatives on water quality are presented together). The appendices present the effects of each alternative separately (for example, all of the effects of the Tunnel Alternative are presented first, followed by all of the effects of the Elevated Structure Alternative). The substance of both discussions is the same. The organization of the Supplemental Draft EIS technical appendices mirrors that of the Draft EIS appendices, allowing you to more easily find comparable information in the Draft EIS appendices.

Chapter 1 SUMMARY

This supplemental technical memorandum for soils and geology addresses changes related to the current Tunnel and Elevated Structure Alternatives only. A full discussion of impacts and mitigation for the five Build Alternatives and the No Build Alternative was presented in the 2004 Alaskan Way Viaduct and Seawall Replacement Project Draft Environmental Impact Statement (EIS), Appendix T, Geology and Soils Technical Memorandum, which can be referenced for original text, tables, and exhibits relating to geology and soils.

In December 2004, the project proponents selected the Tunnel Alternative and the Rebuild Alternative to be carried forward. The Tunnel Alternative was selected as the Preferred Alternative. Since that time, engineering and design has been refined and updated for the Tunnel and Rebuild Alternatives. Due to the magnitude of changes in the design of the Rebuild Alternative, it has been renamed the Elevated Structure Alternative. This document evaluates the changes to these alternatives.

The primary changes from the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum, include the following:

- The updated project includes the Partially Lowered Aurora Option and an updated Lowered Aurora Option, which extends the northern limit of the project. The north section now extends to about Comstock Street, about 0.8 mile north of the Battery Street Tunnel, and the geologic description is extended to cover this area.
- The AWV project team combined elements of the Aerial and Rebuild Alternatives evaluated in the Draft EIS (WSDOT et al. 2004) into the new Elevated Structure Alternative described and evaluated in the Supplemental Draft EIS and this memorandum. In the central section, the Elevated Structure Alternative would be wider than the Rebuild Alternative evaluated in the Draft EIS, but not quite as wide as the Aerial Alternative.
- The updated Tunnel and Elevated Structure Alternatives differ slightly in their alignments when compared to those presented in the Draft EIS. Some options previously being considered are no longer included within the updated alternatives.
- The Tunnel Alternative includes two alignments: (1) a stacked tunnel (preferred), and (2) a side-by-side tunnel. The stacked tunnel would be narrower and deeper than the side-by-side tunnel, which would affect the magnitude of some of the impacts and mitigation strategies.

- The alternatives in the Draft EIS only evaluated a fire and life safety (including seismic) upgrade of the Battery Street Tunnel. Both updated alternatives now include lowering the roadway by 2 feet to increase the vertical clearance to 16.5 feet. For the Tunnel Alternative, the project also includes an option to widen the curves at both portals of the Battery Street Tunnel.
- Two options are being considered for the Tunnel Alternative at Elliott and Western Avenues: (1) a roadway that passes under Elliott and Western Avenues (preferred), and (2) a roadway that extends over Elliott and Western Avenues. The option passing under these avenues includes the construction of a large cut on the slope below the existing viaduct.

There are many other changes in the updated Tunnel and Elevated Structure Alternatives, but these changes do not substantially affect the geology and soils related impacts. Impacts and mitigation strategies presented in the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum, remain applicable to the updated alternatives with the addition of what is included in this supplemental technical memorandum.

Chapter 2 METHODOLOGY

The methodology is the same as in Chapter 2 of the March 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum.

This Page Intentionally Left Blank

Chapter 3 STUDIES AND COORDINATION

The studies and coordination remain the same as in Chapter 3 of the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum.

This Page Intentionally Left Blank

Chapter 4 AFFECTED ENVIRONMENT

The geologic surface and subsurface conditions along the project corridor (affected environment) were evaluated by reviewing existing available subsurface information and by performing geologic field reconnaissance and subsurface explorations. Since preparation of the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum, additional field explorations have been performed along the project corridor (Shannon & Wilson 2005). The results of these explorations have not substantially changed the affected environment discussed in this chapter.

The extent of the project corridor has been revised to include the improvements north of the Battery Street Tunnel along Aurora Avenue N. The Lowered Aurora improvements would extend to about Comstock Street, about 0.8 mile north of the Battery Street Tunnel. This extent includes the Partially Lowered Aurora improvements that are paired with both the stacked tunnel alignment and the Elevated Structure Alternative and only go as far north as Aloha Street. Exhibit 4-5 in the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum, depicts surface geology in the north area extending to Ward Street. This exhibit is not resubmitted in this appendix. The surface geology between Ward Street and Comstock Street consists of dense glacial till (Qvt), similar to the surface geology just south of Ward Street.

This Page Intentionally Left Blank

Chapter 5 OPERATIONAL IMPACTS AND BENEFITS

Five Build Alternatives and a No Build Alternative were considered for the project in the Draft EIS. In December 2004, the project proponents selected the Tunnel Alternative and the Rebuild Alternative to be carried forward. The Tunnel Alternative was selected as the Preferred Alternative. Since that time, engineering and design has been refined and updated for the Tunnel and Rebuild Alternatives. Due to the magnitude of changes in the design of the Rebuild Alternative, it has been renamed the Elevated Structure Alternative. This document evaluates the changes to these alternatives.

The extent of the project corridor has been revised to extend from S. Spokane Street in the south (the same as in the Draft EIS) to Comstock Street, about 0.8 mile north of the Battery Street Tunnel on the west side of Lake Union in the north. Impacts for the Tunnel and Elevated Structure Alternatives are included in the following sections only if they are new or substantially revised. Refer to Sections 5.2 through 5.6 in the March 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum, for descriptions of impacts that have not changed related to the various alternatives.

5.1 Tunnel Alternative (Preferred Alternative)

The Tunnel Alternative would include a combination of aerial structures, cut-and-cover tunnels, retained cut sections, and at-grade roadways to replace the existing viaduct. These features were described in the Draft EIS; however, the alignment configurations and feature extents have been revised. These changes do not substantially affect the operational impacts related to geology and soils. The preferred alignment for the Tunnel Alternative includes the Reconfigured Whatcom Railyard in the south section and the stacked tunnel alignment through the central section. The preferred alignment would then travel under Elliott and Western Avenues to connect to the Battery Street Tunnel and would include the Partially Lowered Aurora improvements in the north section. Options for the Tunnel Alternative also include the Relocated Whatcom Railyard in the south, a side-by-side tunnel alignment through the central section, extending SR 99 over Elliott and Western Avenues, and the Lowered Aurora improvements in the north section. Revised descriptions of the proposed features of the Tunnel Alternative are presented in the following sections.

5.1.1 South – S. Spokane Street to S. Dearborn Street

Reconfigured Whatcom Railyard

No additional geology and soils operational impacts related to the reconfiguration of the Whatcom Railyard are anticipated. The alignment of the various structures has been revised, but these revisions do not affect the operational impacts. The geology and soils operational impacts related to seismic considerations, erosion and sediment transport, groundwater, fill embankments, utilities, foundations, and soil improvement are described in Section 5.4.1 of the 2004 Draft EIS Appendix T.

Option: Relocated Whatcom Railyard

No additional geology and soils operational impacts related to relocation of the Whatcom Railyard are anticipated. Refer to Section 5.4.1 in the 2004 Draft EIS Appendix T for geology and soils operational impacts related to seismic considerations, erosion and sediment transport, groundwater, fill embankments, utilities, and soil improvement.

5.1.2 Central – S. Dearborn Street to Battery Street Tunnel

The revisions in the Tunnel Alternative primarily relate to the alignment and dimensions of the structures. The geology and soils related operational impacts were identified in Section 5.4.2 of the 2004 Draft EIS Appendix T. No additional geology and soils related operational impacts are anticipated for surface streets, ferry access, and above-ground structural improvements (i.e., the Steinbrueck Park Walkway).

Stacked Tunnel Alignment with SR 99 Under Elliott and Western

SR 99 would be at-grade from S. Royal Brougham Way to about 600 feet to the north. From this point and extending about 800 feet farther to the north, the roadway would consist of four lanes and descend into a retained cut section with its sides supported by diaphragm walls. Diaphragm walls are continuous walls constructed with slurry. They are commonly used in congested areas for retention systems and permanent foundation walls. They can be installed in close proximity to existing structures with minimal loss of support to existing foundations. In addition, construction dewatering is not required, so there is no associated subsidence. Ramps on either side of the retained cut section would start as elevated structures near S. Royal Brougham Way and extend down into retained cuts as they lower to join the alignment grade near the south portal of the tunnel.

At the south portal, located about 850 feet south of S. King Street, the tunnel would have the northbound and southbound lanes side-by-side. The

northbound lanes would transition alongside and then under the southbound lanes until SR 99 becomes a stacked tunnel near S. Main Street. From the south portal to about Yesler Way, the tunnel would shift toward the west until meeting the existing seawall north of Yesler Way. Between S. Washington Street and Yesler Way, the west wall for the cut-and-cover tunnel would extend as much as 42 feet beyond the existing seawall into Elliott Bay. From Yesler Way to about Union Street, the new cut-and-cover tunnel would serve as the replacement for the seawall. The stacked tunnel would be about 79 feet wide and have a maximum depth of about 70 feet to the bottom of the lower tunnel. Diaphragm walls would be used to support the sides of the tunnel and would extend about 15 feet below the bottom of the tunnel.

The stacked tunnel would extend from S. Main Street to Seneca Street. Near Seneca Street, the tunnel would begin to transition as the northbound lanes move toward the east until they are next to the southbound lanes, and then they would ascend to a side-by-side alignment at the north portal near Pine Street. A portion of the north portal would be supported by a mechanically stabilized earth (MSE) wall. Vent structures would be constructed in the vicinity of the south and north portals and in the locations previously assessed in the 2004 Draft EIS Appendix T. Between the north portal at Pine Street and Virginia Street, the cut-and-cover roadway would transition to an aerial structure. The aerial structure would be supported by large-diameter drilled shafts. The roadway would touch down to the current ground surface near Virginia Street and transition to a retained cut section extending below Elliott Avenue and Western Avenue. The sides of the retained cut section would be supported by retaining walls that may consist of tied-back walls or diaphragm walls, depending on the depth. A southbound on-ramp would extend on an elevated structure from Elliott Avenue to the north portal. A northbound off-ramp would extend from the retained cut section up to Western Avenue in a retained cut.

Operational impacts for the stacked tunnel alignment and associated elements would be the same as those discussed in Section 5.3.2 for the Aerial Alternative and Section 5.4.2 for the Tunnel Alternative in the 2004 Draft EIS Appendix T.

Option: Side-by-Side Tunnel Alignment

The roadway south of the south portal of the tunnel would be the same as that discussed for the stacked tunnel above.

At the south portal, the structure would transition to a side-by-side, six-lane, cut-and-cover tunnel about 850 feet south of S. King Street. The side-by-side tunnel would be about 122 feet wide and have a maximum depth of about

60 feet to the bottom of the tunnel. Diaphragm walls would be used to support the sides of the tunnel and would extend about 15 feet below the bottom of the tunnel. From the south portal to about Yesler Way, the tunnel would shift toward the west until meeting the existing seawall north of Yesler Way. Between S. Washington Street and Yesler Way, the west wall for the cut-and-cover tunnel would extend as much as 53 feet beyond the existing seawall into Elliott Bay. From Yesler Way to about Union Street, the new cut-and-cover tunnel would serve as the replacement for the seawall. Since the east half of the cut-and-cover tunnel would be located under the existing viaduct alignment, the tunnel would be constructed in two phases so that traffic through the area could be maintained. The north portal of the cut-and-cover tunnel would be located near Pine Street. A portion of the north portal would be supported by an MSE wall. Vent structures would be constructed in the vicinity of the south and north portals and in the locations previously assessed in the 2004 Draft EIS Appendix T (Section 5.3.4).

Operational impacts for the side-by-side tunnel alignment and associated elements would be the same as those discussed in Section 5.4.2 of the 2004 Draft EIS Appendix T for the Tunnel Alternative.

Option: SR 99 Over Elliott and Western

Between Pine Street and the Battery Street Tunnel, the cut-and-cover roadway would transition to an aerial structure connecting to the Battery Street Tunnel. The construction of the aerial structure would require cuts into the existing hillside below the viaduct. These cuts would be supported by retaining walls with or without tiebacks extending under the existing viaduct. A southbound on-ramp would extend on an elevated structure from Elliott Avenue to the north portal. A northbound off-ramp would extend on an elevated structure from the north portal to Western Avenue. Large-diameter drilled shafts would support the aerial structure and ramps south of the Battery Street Tunnel.

Operational impacts for extending SR 99 over Elliott and Western Avenues would be the same as those discussed in Section 5.4.2 of the 2004 Draft EIS Appendix T for the Tunnel Alternative.

5.1.3 North Waterfront – Pine Street to Broad Street

The north waterfront area includes the Alaskan Way surface street improvements, which would not affect geology and soils.

5.1.4 North – Battery Street Tunnel to Comstock Street

Battery Street Tunnel Improvements

The 2004 Draft EIS Appendix T did not include major revisions to the Battery Street Tunnel, but only a fire and life safety upgrade. The Tunnel Alternative currently includes deepening the Battery Street Tunnel to accommodate vertical clearance requirements. An option under consideration with the side-by-side tunnel alignment also includes the widening of the curves at both tunnel portals. Construction impacts for revisions to the Battery Street Tunnel would be similar to the impacts identified for the cut-and-cover tunnel in the central section. Settlement and lateral movement could occur over the long term if the walls are not properly designed for the soil and groundwater conditions and applied surcharge loads. If the tunnel and/or the ventilation structures are located adjacent to existing facilities, settlement and lateral movement of the existing adjacent facilities could occur. The new structures must be properly designed to limit these movements, and/or the adjacent existing facilities could be underpinned to mitigate the impacts. Additional operational impacts related to retaining walls, seismic considerations, and sediment transport would be similar to those described in Section 5.3.4 for the Aerial Alternative in the 2004 Draft EIS Appendix T.

Partially Lowered Aurora

The Partially Lowered Aurora Option would lower Aurora Avenue N. to Republican Street and make other road improvements and widening up to Aloha Street. From the north portal of the Battery Street Tunnel, SR 99 would descend into a retained cut extending under Thomas and Harrison Streets. Two new bridges would reconnect the surface streets at Thomas Street and Harrison Street. The existing Mercer Street, which passes under Aurora Avenue N., would be widened. Areas that are either excavated or filled could settle and affect the new roadway or adjacent structures.

New on-ramps and off-ramps would be constructed at Republican Street, Denny Way, and Roy Street. In addition, the existing depressed Broad Street roadway would be backfilled between Fifth Avenue N. and Ninth Avenue N. The Tunnel Alternative also includes rebuilding Sixth Avenue N. along the west side of SR 99 from Harrison Street to Roy Street. The street would be built along the existing grade and would extend over the filled area of Broad Street. A large amount of fill would be placed and compacted into the current depressed roadway along Broad Street. Use of unsuitable fill materials (such as those containing debris and organics), fill placement in wet conditions, and/or improper fill placement and compaction methods could result in excessive settlement of the surface of the fill over time. This would result in

settlement of the new roadway, pavement damage, and/or damage to utilities. Other surface streets adjacent to new bridges and the lowered Aurora Avenue N. would also be improved.

Even though the configuration is different, the operational impacts discussed for the Aerial Alternative in Section 5.3.4 in the 2004 Draft EIS Appendix T are applicable to the Tunnel Alternative in the area north of the Battery Street Tunnel.

Option: Lowered Aurora

From the north portal of the Battery Street Tunnel, SR 99 would descend into a retained cut extending under Thomas, Harrison, Republican, Mercer, and Roy Streets. Five new bridges would be constructed to reconnect these surface streets over Aurora Avenue N. The operational impacts would be similar to those discussed in the previous section and to those presented in Section 5.3.4 for the Aerial Alternative in the 2004 Draft EIS Appendix T.

5.1.5 Seawall – S. Washington Street to Broad Street

For the Tunnel Alternative, the seawall would be replaced with the cut-and-cover tunnel from S. Washington Street to just past Union Street. The tunnel wall would then diverge from the seawall between Union and Pike Streets. The remainder of the seawall north to Broad Street would be replaced using L-Wall construction and soil improvement (jet grouting or other methods). Soils would also be improved between S. Jackson and S. Washington Streets. Drilled shafts, considered in the Draft EIS, would not be used.

Operational impacts would be similar to those discussed in Section 5.2.5 for the Rebuild Alternative in the 2004 Draft EIS Appendix T.

5.2 Elevated Structure Alternative

The Elevated Structure Alternative includes rebuilding the viaduct and seawall. Although the alignment configurations and feature extents have been revised, these revisions do not result in any major changes to the operational impacts related to geology and soils. Revised descriptions of the proposed features of the Elevated Structure Alternative are presented in the following sections.

5.2.1 South – S. Spokane Street to S. Dearborn Street

The same improvements discussed for the Tunnel Alternative are proposed in this area. Refer to Section 5.1.1 for a discussion of operational impacts.

5.2.2 Central – S. Dearborn Street to Battery Street Tunnel

For this area, the Elevated Structure Alternative is similar to the Aerial Alternative that was evaluated in the Draft EIS. The proposed roadway would be stacked and would generally follow the existing SR 99 alignment on an aerial structure. The new structure foundations would be constructed outside of the existing viaduct foundations to result in a wider structure. Large-diameter drilled shafts would likely be used to support the aerial structure. Soil improvements would be performed around each foundation south of S. Jackson Street. Elevated ramps, supported by drilled shaft foundations and with MSE wall approach fills, would be constructed to Columbia and Seneca Streets.

Operational impacts would be related to seismic considerations, erosion and sediment transport, groundwater, fill embankments, utilities, foundations, soil improvement, and retaining walls. These impacts would be similar to those discussed in Section 5.2.2 for the Rebuild Alternative in the 2004 Draft EIS Appendix T.

5.2.3 North Waterfront – Pine Street to Broad Street

The north waterfront area includes the Alaskan Way surface street improvements, which would not affect geology and soils.

5.2.4 North – Battery Street Tunnel to Comstock Street

Battery Street Tunnel

No improvements were included in the Rebuild Alternative for the Draft EIS. The Elevated Structure Alternative is the same as the Tunnel Alternative in this area. Refer to Section 5.1.4 for a discussion of operational impacts.

Partially Lowered Aurora

The Elevated Structure Alternative includes the same Partially Lowered Aurora Option as the Tunnel Alternative. Operational impacts would be the same as those referenced in Section 5.1.4 for the Tunnel Alternative.

5.2.5 Seawall – S. Washington Street to Broad Street

For the Elevated Structure Alternative, soil improvements (jet grouting or other methods) would be made for the Pier 48 bulkhead and the area in front of Pier 66. Along the rest of the seawall between S. Washington and Broad Streets, the existing seawall would be replaced using L-Wall construction and soil improvement (jet grouting or other methods).

Operational impacts would be similar to those discussed in Section 5.2.5 for the Rebuild Alternative in the 2004 Draft EIS Appendix T.

This Page Intentionally Left Blank

Chapter 6 CONSTRUCTION IMPACTS

Since the March 2004 submittal of the Draft EIS, further analysis has been performed for the Tunnel Alternative (the Preferred Alternative) and the Elevated Structure Alternative. Revised construction impacts for these two alternatives are included in the following sections. Refer to Chapter 6 of the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum, for impacts related to the other alternatives.

New construction plans are being evaluated for the Tunnel and Elevated Structure Alternatives. These plans are described in the 2006 Supplemental Draft EIS Appendix B, Alternatives Description and Construction Methods Technical Memorandum.

6.1 Tunnel Alternative (Preferred Alternative)

The Tunnel Alternative would include a combination of aerial structures, cut-and-cover tunnels, retained cut sections, and at-grade roadways to replace the existing viaduct. These features were considered in the Draft EIS; however, the alignment configurations and feature extents have been revised. These changes do not substantially affect the construction impacts related to geology and soils. Descriptions of the proposed features of the Tunnel Alternative are presented in Section 5.1. The two construction plans now being considered for the Tunnel Alternative, the intermediate plan and the shorter plan, also would not affect geology and soils.

6.1.1 South – S. Spokane Street to S. Dearborn Street

The alignment of the various structures has been revised, but these revisions do not substantially change the construction impacts presented in Section 6.4.1 of the 2004 Draft EIS Appendix T.

6.1.2 Central – S. Dearborn Street to Battery Street Tunnel

The revisions in the Tunnel Alternative primarily relate to the alignment and dimensions of the structures. In general, construction impacts for the stacked or side-by-side tunnel alignments would be the same as those discussed in Section 6.4.2 of the 2004 Draft EIS Appendix T for the Tunnel Alternative.

The volume of material that would be generated from site demolition, excavations (primarily the retained cut sections and cut-and-cover tunnels), foundation installation, and soil improvement has changed since the Draft EIS. These changes in volume quantities do not affect the impacts identified in Section 6.4.2 of the 2004 Draft EIS Appendix T. It should be noted that the

stacked tunnel alignment would require less volume of excavation than the side-by-side tunnel alignment; however, because the depth of the stacked tunnel is deeper, larger support elements may be required.

In the central waterfront area, to help maintain pedestrian access along the waterfront during construction, the project partners are considering the feasibility of constructing temporary over-water pedestrian walkways between some piers. Although these structures have not yet been designed, they might generate effects similar to those that could be caused by the Colman Dock over-water bridge.

Temporary Ferry Access Bridge

The Tunnel Alternative includes a temporary over-water ferry access bridge between Pier 48 and Colman Dock. Once construction is complete, this bridge would be removed. The bridge would likely be supported by driven piles. Pile driving would result in noise and vibration impacts on people, structures, and utilities near the pile driving activities. Vibration caused by driving piles could result in settlement or lateral movement of the ground, slope failures, and/or cracking or other damage to adjacent structures, utilities, and pavements. Vibrations could be made worse by the presence of logs, piles, riprap, or other debris within the soils near the mudline. Also, vibrations could increase if boulders or very dense native soil are encountered. When the pile encounters one of these obstructions during driving, vibrations could increase because of more intense driving movements and the movement of the obstruction caused by the pile. This could also result in increased ground movement.

6.1.3 North Waterfront – Pine Street to Broad Street

For the Tunnel Alternative, the existing seawall would be rebuilt in the area north of Union Street where the tunnel would diverge from the seawall, as described in Section 5.1.3. Construction impacts would be similar to those discussed for the Rebuild Alternative in Section 5.2.3 of the 2004 Draft EIS Appendix T.

6.1.4 North – Battery Street Tunnel to Comstock Street

The Tunnel Alternative included in the Draft EIS included the Widened Mercer Underpass. The updated Tunnel Alternative would include either the Partially Lowered Aurora or Lowered Aurora Option, which would have operational impacts similar to those presented for the Aerial Alternative in Section 5.3.3 of the 2004 Draft EIS Appendix T.

The Tunnel Alternative includes rebuilding Sixth Avenue N. along the west side of SR 99 from Harrison Street to Roy Street, as described in Section 5.1.4.

Construction impacts would include erosion and sediment transport, excavations, stockpiles, and spoil disposal, as presented in Section 6.3.4 of the 2004 Draft EIS Appendix T for the Aerial Alternative.

The on- and off-ramps connecting to the lowered Aurora Avenue N. would have construction impacts similar to those presented for retaining walls in Section 6.3.4 of the 2004 Draft EIS Appendix T for the Aerial Alternative.

Battery Street Tunnel Improvements

The 2004 Draft EIS Appendix T did not include major revisions to the Battery Street Tunnel, but only a fire and life safety upgrade. The updated Tunnel Alternative includes lowering the tunnel floor to increase the vertical clearance to 16.5 feet. An option under consideration with the side-by-side tunnel alignment also includes the widening of the curves at both tunnel portals. Construction impacts for revisions to the Battery Street Tunnel would be similar to the impacts identified for the cut-and-cover tunnel in the central section. Shoring walls would be installed adjacent to the existing Battery Street Tunnel walls in some areas and outside of the existing walls where the tunnel is being realigned. Settlement and ground movement adjacent to the wall could occur if the shoring walls are not constructed properly. Additional construction impacts related to shoring walls, excavations, sediment transport, stockpiles, and spoils disposal would be similar to those described for the Tunnel Alternative in Section 6.3.4 of the 2004 Draft EIS Appendix T.

6.1.5 Seawall – S. Washington Street to Broad Street

For the Tunnel Alternative, the existing seawall would be rebuilt, as described in Section 5.1.5. Construction impacts would be similar to those discussed for the Rebuild Alternative in the March 2004 Draft EIS Appendix T, Section 6.2.5. These impacts relate to erosion and sediment transport, pavements and utilities, excavation and dewatering, stockpiles and spoils disposal, retaining walls, and soil improvements.

6.2 Elevated Structure Alternative

The Elevated Structure Alternative includes rebuilding the viaduct and seawall with the longer construction plan. Although the alignment configurations and options have been revised, these revisions do not result in major changes to the construction impacts related to geology and soils. Revised descriptions of the proposed features of the Elevated Structure Alternative are provided in Section 5.2.

6.2.1 South – S. Spokane Street to S. Dearborn Street

The same improvements discussed for the Tunnel Alternative are proposed in this area. Refer to Section 6.1.1 for a discussion of construction impacts.

6.2.2 Central – S. Dearborn Street to Battery Street Tunnel

The construction impacts for the Elevated Structure Alternative would generally be the same as those discussed in Section 6.2.2 of the 2004 Draft EIS Appendix T for the Rebuild Alternative.

The volume of material that would be generated from site demolition, excavations, foundation installation, and soil improvements has changed since the Draft EIS. These changes in volume quantities do not affect the impacts identified in Section 6.2.2 of the 2004 Draft EIS Appendix T.

Temporary Ferry Access Bridge

The construction impacts for the temporary over-water ferry access bridge between Pier 48 and Colman Dock would be the same as described for the Tunnel Alternative in Section 6.1.2.

6.2.3 North Waterfront – Pine Street to Broad Street

The north waterfront area includes the Alaskan Way surface street improvements, which would not affect geology and soils.

6.2.4 North – Battery Street Tunnel to Comstock Street

The same retained cut configuration included in the Tunnel Alternative is included in the Elevated Structure Alternative. Construction impacts would be the same as those referenced in Section 6.1.4 for the Tunnel Alternative.

Battery Street Tunnel Improvements

No improvements were included in the Rebuild Alternative for the Draft EIS. The Elevated Structure Alternative is similar to the Tunnel Alternative in this area. Refer to Section 6.1.4 for a discussion of construction impacts.

6.2.5 Seawall – S. Washington Street to Broad Street

Construction impacts for replacing the seawall as described in Section 5.2.5 would be similar to those discussed for the Rebuild Alternative in Section 6.2.2 of the 2004 Draft EIS Appendix T. These impacts relate to erosion and sediment transport, pavements and utilities, excavation and dewatering, stockpiles and spoils disposal, retaining walls, and soil improvements.

Chapter 7 SECONDARY AND CUMULATIVE IMPACTS

No additional secondary or cumulative impacts related to geology and soils are anticipated for this Supplemental Draft EIS. The secondary and cumulative impacts would be the same as discussed in Chapter 7 of the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum, except that a remote ferry holding option would not be constructed as previously included in the Draft EIS. Instead, ferry holding would be on the east side of SR 99. Additional information is provided in the 2004 Draft EIS Appendix U, Hazardous Materials Discipline Report, with updates provided in the 2006 Supplemental Draft EIS Appendix U.

This Page Intentionally Left Blank

Chapter 8 OPERATIONAL MITIGATION

All operational impacts identified in Chapter 5 could be mitigated as described in Chapter 8 of the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum.

This Page Intentionally Left Blank

Chapter 9 CONSTRUCTION MITIGATION

All construction impacts identified in Chapter 6 could be mitigated as described in Chapter 9 of the 2004 Draft EIS Appendix T, Geology and Soils Technical Memorandum. Additional information is provided in the 2004 Draft EIS Appendix U, Hazardous Materials Discipline Report, with updates provided in the 2006 Supplemental Draft EIS Appendix U.

Mitigation measures for pile driving required for the Colman Dock Ferry Terminal temporary access bridge would be similar to those presented in Section 6.2.1 of the 2004 Draft EIS Appendix T for driven cast-in-place piles included in the Rebuild Alternative.

This Page Intentionally Left Blank

Chapter 10 REFERENCES

Shannon & Wilson, Inc. 2005. Draft geotechnical and environmental data report, SR 99: Alaskan Way Viaduct and Seawall Replacement Project, Seattle, Washington. Report prepared by Shannon & Wilson, Inc., Seattle, Washington, 21-1-09490, for WSDOT, FHWA, and City of Seattle, Seattle, Washington. May 2005. 7 volumes.

WSDOT (Washington State Department of Transportation), City of Seattle, and U.S. Department of Transportation, Federal Highway Administration. 2004. SR 99: Alaskan Way Viaduct & Seawall Replacement Project Draft Environmental Impact Statement. Washington State Department of Transportation, Urban Corridors Office, Seattle, Washington.

This Page Intentionally Left Blank