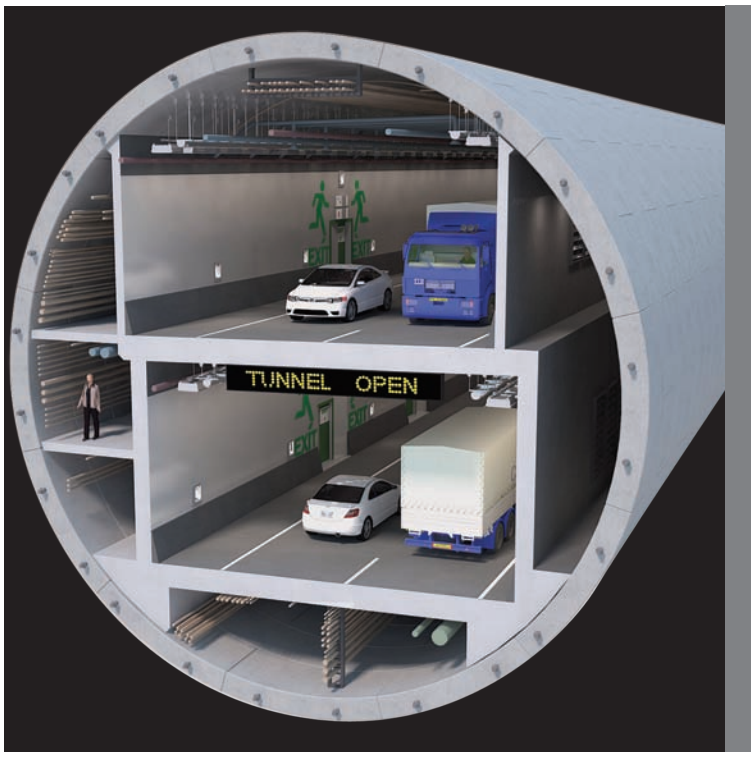
ALASKAN WAY VIADUCT REPLACEMENT PROJECT

2010 Supplemental Draft Environmental Impact Statement

APPENDIX C Transportation Discipline Report



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U.S. Department of Transportation
Federal Highway Administration

Washington State Department of Transportation

City of Seattle

OCTOBER 2010

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Alaskan Way Viaduct Replacement Project
Supplemental Draft EIS
Transportation 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:

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ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
AWV	Alaskan Way Viaduct
BAT	business access and transit
BINMIC	Ballard Interbay Northend Manufacturing and Industrial Center
BNSF	BNSF Railway (formerly Burlington Northern Santa Fe)
BRT	bus rapid transit
CBD	Central Business District
City	City of Seattle
DSTT	Downtown Seattle Transit Tunnel
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
HCM	Highway Capacity Manual
HOV	high-occupancy vehicle
I-5	Interstate 5
ITS	Intelligent Transportation System
LOS	level of service
LRT	light rail transit
mph	miles per hour
MOT	maintenance of traffic
MTP	Metropolitan Transportation Plan
MVMT	million vehicle miles of travel
NEPA	National Environmental Policy Act
PSRC	Puget Sound Regional Council
Program	Alaskan Way Viaduct and Seawall Replacement Program
project	Alaskan Way Viaduct Replacement Project
RDP	Route Development Plan
SDOT	Seattle Department of Transportation
SIG	Seattle International Gateway
SODO	South of Downtown
SOV	single-occupant vehicle
SR	state route
ST2	Sound Transit Phase 2
UPRR	Union Pacific Railroad
VHD	vehicle hours of delay
VHT	vehicle hours of travel
VMT	vehicle miles of travel
WOSCA	Washington-Oregon Shippers Cooperative Association
WSDOT	Washington State Department of Transportation

Chapter 1 INTRODUCTION AND SUMMARY

1.1 Introduction

This discipline report evaluates 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 analyzed 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 that 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 Report Overview

This Transportation Discipline Report, Appendix C to the Alaskan Way Viaduct Replacement Project Supplemental Draft EIS, describes transportation conditions associated with the SR 99 corridor through downtown Seattle and predicts the transportation performance and effects of the project and larger Program.

This Transportation Discipline Report comprises the following chapters:

- Chapter 2, Methodology, describes the methods used to assess the alternatives in this report.
- Chapter 3, Studies and Coordination, provides information regarding agency participation in the refinement of the Bored Tunnel Alternative.
- Chapter 4, Affected Environment, includes discussion of current transportation conditions.
- Chapter 5, Operational Effects, Mitigation, and Benefits, describes changes in travel patterns and traffic volumes under the following conditions, which were modeled by means of a travel demand model:
  - 2015 Existing Viaduct (with the Alaskan Way Viaduct [AWV])
  - 2015 Viaduct Closed (No Build Alternative)
  - 2015 Project (with the Bored Tunnel Alternative)
  - 2030 Project (with the Bored Tunnel Alternative)

  A brief discussion of 2040 conditions provides a basis for describing further changes in travel conditions beyond the horizon year.
- Chapter 6, Construction Effects and Mitigation, reviews the construction plans for the Bored Tunnel Alternative, traffic management approaches (detours), and expected performance associated with major construction stages.
- Chapter 7, Cumulative Effects, describes the secondary and cumulative effects of the combined effects of the Bored Tunnel Alternative, other Program elements, and other projects that are anticipated to affect transportation in the study area.
- Chapter 8, References, includes the information sources used in the preparation of this report.
- Attachment A, Surface and Transit Scenario Year 2030 Analysis Results, discusses a year 2030 analysis of the Interstate 5 (I-5), Surface, and Transit Hybrid scenario that was developed for the replacement of the Alaskan Way Viaduct during the Partnership Process of 2008 and was screened out

as a viable alternative due to its inability to effectively satisfy the purpose and need for the project.

- Attachment B, Analysis of 2030 Viaduct Closed (No Build Alternative),

1.3 Alternatives Studied

The Bored Tunnel Alternative and the Viaduct Closed (No Build Alternative) are analyzed and are discussed below.

1.3.1 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.

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 relatively short-term and would last until the Washington State Department of Transportation (WSDOT) 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.

Given the unpredictability associated with the long-term structural viability of the viaduct, the following two scenarios are considered as part of the Viaduct Closed (No Build Alternative):

- Scenario 1 – Sudden unplanned closure of the SR 99 viaduct due to structural damage from a smaller earthquake or other reasons for partial structural failures that render the viaduct unsafe or unusable.
- Scenario 2 – Catastrophic failure and collapse of the viaduct.

In this report, Scenario 1 is referred to as the 2015 Viaduct Closed (No Build Alternative). Scenario 2 is discussed qualitatively but is not quantitatively

analyzed in this report. This report also analyzes traffic and transportation conditions for continued operation of the current viaduct and seawall, which are referred to as the 2015 Existing Viaduct. Although a comparison to conditions represented by the 2015 Existing Viaduct is useful for assessing the performance and effects of the Bored Tunnel Alternative relative to the facility that is in place today, it should be recognized that the current facility is reaching the end of its service life, is unlikely to remain in satisfactory condition for long-term use, and is at risk of catastrophic failure in an earthquake.

1.3.2 Bored Tunnel Alternative

The Bored Tunnel Alternative would replace SR 99 between S. Royal Brougham Way and Roy Street. The tunnel would have two lanes in each direction. 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 travel in a northern direction 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 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 SR 99 and southbound off-ramp from SR 99 would be built in the vicinity of S. Royal Brougham Way and would intersect with the East Frontage Road.

The southbound on-ramp to SR 99 and northbound off-ramp from SR 99 would connect to a reconfigured Alaskan Way S. The northbound off-ramp would have a general-purpose lane and a peak hour transit-only lane to accommodate transit coming from south or West Seattle. The reconfigured Alaskan Way S. would have three lanes in each direction.

The reconfigured Alaskan Way S. would have a pedestrian and bicycle trail on the west side, called the Port Side Pedestrian/Bike Trail, and a multi-use path, called the City Side Trail, on the east side. The City Side Trail would extend from S. Atlantic Street to S. King Street and would replace the existing 15-foot-wide Waterfront Bicycle/Pedestrian Facility currently located on 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 frontage road east of SR 99 would be widened slightly at S. Atlantic Street to accommodate truck turning movements. A new right-turn pocket would also be added between S. Atlantic Street and S. Royal Brougham Way for southbound vehicles turning right (west).

A tunnel operations building would be constructed in the block bounded by S. Dearborn Street, Alaskan Way S., and a new access road located in the existing Railroad Way S. right-of-way. Part of the building 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 roof.

Central: Bored Tunnel Alignment – S. King Street to Denny Way

The bored tunnel would have two lanes in each direction. Southbound lanes would be located on the top deck of the tunnel, and the northbound lanes would be located on the bottom. Travel lanes would be approximately 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 space for motorists to access the refuge areas in an incident.

The wider shoulder would also provide access to emergency tunnel exits, which would be provided at least every 650 feet. 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's levels. Staircases inside the refuge area would provide access between the roadway levels. Signs would point travelers to the nearest exit, where they would either wait for assistance or walk out of the tunnel. Refuge areas would contain emergency telephones.

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 WSDOT's 24-hour tunnel control center. The primary tunnel control center would be incorporated into the WSDOT Northwest Region Traffic Management Center in Shoreline. The tunnel operations buildings at the south and north tunnel portals would have the capability to operate the tunnel in the event of a major incident or communications failure.

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 provided at Denny Way would be 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.

Surface streets would be reconfigured and improved in the north portal area. 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. These east-west streets are currently classified as access streets as opposed to arterials. Given the new expanded circulation role these streets are expected to fill, the City of Seattle (City) may consider reclassifying these streets as arterials. This rebuilt section of Aurora Avenue would connect to the new SR 99 alignment via the ramps at Harrison Street. The newly rebuilt Aurora Avenue would have two general-purpose lanes in each direction, a transit-only lane in the southbound direction, a northbound transit lane between Denny Way and John Street, and turn pockets between Denny Way and Harrison Street. Signalized intersections would be located at Denny Way and John, Thomas, and Harrison Streets. A slightly revised configuration of this section of Aurora Avenue, which would provide a northbound transit-only lane between Denny Way and Harrison Street, may also be considered. However, this configuration would require decreased sidewalk widths on the west side of the roadway.

John Street would be built with one lane in each direction, a center turn lane, 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 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:

- 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.

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 of the building is expected to be approximately 65 feet tall with vent stacks extending up to 30 feet above the roof.

Viaduct Removal and Battery Street Tunnel Decommissioning

Following completion of the new SR 99 bored tunnel, the existing viaduct would be removed. Utilities located on the viaduct and, where necessary, those under the viaduct would be relocated. The Battery Street Tunnel would be decommissioned.

1.4 Alaskan Way Viaduct and Seawall Replacement Program

This report evaluates the short- and long-term environmental effects of the Bored Tunnel Alternative and the cumulative effects of complementary projects referred to as the Program. Exhibit 1-1 lists the major components of the Bored Tunnel Alternative as well as those additional elements associated with the overall Program. Note that transit enhancement elements are not expected to be fully implemented by 2015.

Exhibit 1-1. Project and Program Elements

Bored Tunnel Alternative	Program Elements (Cumulative Effects)	
	Other Roadway Elements[1]	Non-Roadway Elements[1]
Replace SR 99 with a single bored tunnel Relocate utilities currently located on or under the viaduct Remove the viaduct Construct surface street improvements in the south portal area Construct surface street improvements in the north portal area (widen Mercer Street for two-way operation from Dexter Avenue N. to Fifth Avenue N.; extend Sixth Avenue N.; connect John, Thomas, and Harrison Streets; close and fill Broad Street) Decommission the Battery Street Tunnel	Alaskan Way surface street improvements (on location of former viaduct) from S. King to Pike Streets Elliott/Western Connector from Pike to Battery Streets Mercer West Project (Mercer Street west corridor improvements from Fifth Avenue N. to Elliott Avenue)	Elliott Bay Seawall Project (project limits – S. Washington Street to Broad Street) Alaskan Way Promenade/Public Space (on location of current Alaskan Way surface street) First Avenue Streetcar Evaluation Transit Enhancements

[1] The roadway and non-roadway elements are conceptual in nature at this stage and will be the subject of separate environmental review processes.

1.4.1 Roadway Elements

The roadway elements described below are assumed to be in place by 2015, although it is possible that some of them may not be fully implemented until after 2015.

Alaskan Way Surface Street Improvements

The Alaskan Way surface street would be rebuilt and improved between S. King Street and Pike Street. The new 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 street would be located east of the existing street where the viaduct is located today. The new street would include sidewalks, parking/loading zones, and signalized pedestrian crossings at cross streets. A cycle track may be provided along the west side in case the new street does not include bicycle lanes, although a decision on this has not been reached yet. The new surface street would provide a regional truck route for freight traveling to and from 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 downtown Seattle (including Ballard and

Magnolia). The connector would be four lanes wide and would provide a grade-separated crossing of the BNSF mainline railroad tracks. Additionally, it would provide local street access to Lenora Street and integrate back into 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

The Mercer West Project improvements include reconfiguring Mercer Street between Fifth Avenue N. and Elliott Avenue to accommodate two-way traffic. Mercer Street would be restriped and signalized between Fifth Avenue N. and Second Avenue W. to create a two-way street with turn pockets. The route would provide an alternative freight and general traffic connection from I-5 and SR 99 to Ballard/Interbay. 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.

1.4.2 Non-Roadway Elements

First Avenue Streetcar Evaluation

Functioning as a local connector, the First Avenue streetcar would circulate between S. Jackson Street and Republican Street. This alignment would travel within several of Seattle's densest neighborhoods, including Pioneer Square, the Commercial Core and Central Business District (CBD), Belltown, and Uptown (Lower Queen Anne). Additionally, it would serve many tourist and regional attractions, such as Pike Place Market, the Seattle waterfront piers, Seattle Art Museum, Seattle Aquarium, Seattle Center, and the Olympic Sculpture Park.

Transit Enhancements

A variety of transit enhancements would be provided to support planned transportation improvements associated with the Program and accommodate future demand. These 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 South Lake Union and Uptown, (4) local bus changes (such as realignments and a few additions) to several West Seattle and northwest Seattle routes, (5) transit priority on S. Main and/or S. Washington Streets between Alaskan Way and Third Avenue, and (6) simplification of the electric trolley system. Since it is possible that these transit enhancements will not be in place by 2015, the 2015 Program does not assume them. However, the 2015 Program Plus Transit Enhancements was also assessed to identify the effects of the enhancements if they were to occur within that timeframe.

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 promenade and public space would be provided to the west of the new Alaskan Way surface street between S. King Street and Pike Street. The promenade would vary in width and would serve Piers 48 through 59, which have varying uses, including ferry terminals, restaurants, retail shops, hotels, and regional entertainment such as 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 a 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.

1.4.3 Projects Under Construction

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

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. Construction and early utility relocations began in mid-2009, and the project is expected to be completed at the end of 2014.

Transit Enhancements and Other Improvements

Several transportation improvements are underway to help offset traffic effects during construction of projects included in the Program. Construction or implementation of the following improvements is underway:

- Adding variable speed signs and travel time signs on I-5 to help maximize safety and traffic flow.
- Providing funding for the S. 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.

1.4.4 Completed Projects

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

Construction to strengthen four Alaskan Way Viaduct column footings between Columbia Street and Yesler Way was completed in April 2008. To prevent the columns from sinking farther, crews drilled a series of steel rods surrounded by concrete into stable soil, and then 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 Viaduct's South End)

Construction to relocate electrical lines along the viaduct's south end 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.

1.5 Summary of Findings

Travel characteristics associated with the Bored Tunnel Alternative are compared with the 2015 Existing Viaduct as well as the 2015 Viaduct Closed (No Build Alternative). The 2015 Existing Viaduct presumes improved connections between SR 99 and the arterial street system in the south end area in comparison to existing conditions with the addition of the stadium area ramps to and from the south. Due to this additional access, in conjunction with forecasted areawide growth in traffic over time, SR 99 is projected to attract more trips with the 2015 Existing Viaduct than it does today.

Roadway capacity in the corridor is substantially reduced with the 2015 Viaduct Closed (No Build Alternative). This would adversely affect congestion on streets in the downtown area, and in particular increase traffic and congestion on the Alaskan Way surface street. Despite already congested conditions, additional vehicles would divert to I-5 in an effort to travel through the downtown area. Resulting increases in congestion and travel times would cause some travelers to avoid making trips to or through the downtown area (relative to the 2015 Existing

Viaduct). While some may switch modes of travel, few are projected to switch to bus transit because the buses would also be adversely affected by congestion and would therefore be unlikely to attract additional riders. PM peak hour travel times between Woodland Park and S. Spokane Street were assessed as an indicator of the general magnitude of travel time impacts through the corridor, showing that the forecasted duration of this trip would triple (i.e., 43 minutes southbound, and 47 minutes northbound) compared to the 2015 Existing Viaduct (15 minutes southbound, and 18 minutes northbound).

Travel patterns on SR 99 with the 2015 and 2030 Project (Bored Tunnel Alternative) would change compared to the 2015 Existing Viaduct due to changes in how and where access is provided between SR 99 and the arterial corridor. Alaskan Way S. would become the primary access route to downtown for SR 99 trips from the south, via the new Alaskan Way S. ramps near S. King Street. This route could also be used for trips to the Elliott/Western corridor, traveling on Alaskan Way to Broad Street or other connecting cross streets on the north waterfront. Under the broader Program, a new connection between the central waterfront and Elliott and Western Avenues would provide a more direct route for these trips. Another option for trips that use the current Elliott/Western ramps to access arterial routes heading toward northwest Seattle would be to continue through the new bored tunnel and either exit in the South Lake Union area or continue north on Aurora Avenue.

SR 99 mainline traffic is expected to operate better in both the 2015 and 2030 Project and the 2015 and 2030 Program than in the 2015 Existing Viaduct due to the removal of the merging and weaving conflicts associated with the Elliott/Western ramps and the midtown ramps. The replacement of the existing SR 99 right-side ramps to/from Denny Way with new left-side ramps to/from Harrison Street would require transit vehicles to weave across SR 99 from the last bus stop southbound to the inside off-ramp, and from the left-side on-ramp northbound to the first bus stop. However, operational analysis of this condition indicates that this would not affect transit speeds.

Peak hour travel times for SR 99 through trips generally are 2 to 4 minutes shorter in the 2015 Project as compared to the 2015 Existing Viaduct. Travel times with the 2015 Project would be much shorter than with the 2015 Viaduct Closed (No Build Alternative). For the Woodland Park to S. Spokane Street route in the peak direction of travel in the AM peak hour (southbound), a travel time of up to 2 minutes shorter is estimated with the 2015 Project in comparison to the 2015 Existing Viaduct. For the PM peak hour peak direction (northbound), travel times could be up to 4 minutes shorter compared to the 2015 Existing Viaduct.

Regarding other key peak hour travel time routes analyzed, the 2015 Project is projected to be about 3 minutes shorter than the 2015 Existing Viaduct from West

Seattle to downtown Seattle (measured to Fourth Avenue and Seneca Street) due to the removal of the midtown ramps. Between Ballard and S. Spokane Street, the 2015 Project using the Alaskan Way surface street route is projected to be about the same as the 2015 Existing Viaduct in the southbound direction and 1 minute shorter in the northbound direction during both peak hours. Travel times for the 2015 Project (which does not include the improved Alaskan Way or the Elliott/Western Connector) along this route would be slightly compromised due to the lack of a connection from Elliott/Western Avenues to the waterfront, causing traffic to use Broad Street, which includes an at-grade rail crossing. However, for traffic using Mercer Street and the bored tunnel, the 2015 Project is expected to result in a travel time that is 1 minute shorter than the 2015 Existing Viaduct for southbound travel in both the AM and PM peak hours. Northbound travel times between S. Spokane Street and Ballard using the bored tunnel would be the same as the 2015 Existing Viaduct travel times.

The main findings for each of the modeled conditions are summarized below. Refer to Section 2.3.2 for a description of the modeled conditions.

1.5.1 2015 Existing Viaduct

Compared to existing conditions, access between SR 99 and the local street system would be improved in the south end as a result of new and improved connections provided by the S. Holgate Street to S. King Street Viaduct Replacement Project.

New access between SR 99 and Alaskan Way S. (near S. King Street) would increase traffic levels on Alaskan Way surface street, especially south of Marion Street.

The intersection of First Avenue S. and S. Atlantic Street would continue to serve a number of major traffic movements, and as a result, it is expected to operate at level of service (LOS) E during the PM peak hour.

Travel times for most trips using SR 99 would likely be modestly longer than under existing conditions due to growth in traffic over time.

In the South Lake Union area, the Mercer Street/Fairview Avenue N. intersection is projected to operate at LOS F conditions during the PM peak hour. This is true for all the other modeled conditions as well.

1.5.2 2015 Viaduct Closed (No Build Alternative)

Closure of the existing viaduct would displace a relatively large number of corridor trips to other routes, leading to high levels of traffic congestion throughout the day.

The traffic congestion experienced due to the closure of the existing viaduct would also result in a change in travel patterns and a substantial reduction in corridor trips through downtown Seattle and between downtown Seattle and

points south (e.g., model projections indicate that trips between West Seattle and downtown would decrease by 11 percent; trips between West Seattle and both the Uptown and South Lake Union areas would decrease by 30 percent).

Alaskan Way surface street would experience severe congestion as a result of the increased traffic load and limited capacity under its present configuration. The interface of Alaskan Way traffic with Seattle Ferry Terminal traffic at Colman Dock would be problematic.

North/south CBD arterials would be substantially affected.

Many through trips that use SR 99 today would shift to I-5, which would be the only high-capacity, high-speed north-south route through Seattle for the 2015 Viaduct Closed (No Build Alternative). Because I-5 has very limited reserve capacity throughout most of the day, these diverted trips would exacerbate the congested conditions already experienced on I-5 during much of the day.

Increased congestion resulting from displaced trips would likely increase travel times for most trips in or near the downtown Seattle area.

Increased congestion and longer travel times would discourage trip making into or through the downtown Seattle area. Corresponding increases in trip making to other locations outside of the downtown area may occur.

Mode shifts to transit uses are unlikely unless measures to preserve transit (bus) travel times can be successfully implemented. Most measures that could be considered to preserve efficient bus operations (e.g., converting general-purpose traffic lanes to transit-only) would further reduce vehicle (automobile/truck) capacity beyond the reductions resulting from closure of the viaduct.

The increased volumes on CBD arterials as a result of the viaduct closure would negatively affect bicycle riders on city streets, as well as creating a less desirable environment for pedestrian travel.

1.5.3 2015 Project (Bored Tunnel Alternative)

The results of travel time comparisons between the 2015 Existing Viaduct and 2015 Project vary depending on the route. Through trips on SR 99 with the 2015 Project would be faster than comparable trips on the existing facility with the 2015 Existing Viaduct. Travel times for trips to and from downtown would typically be similar, depending on the specific destination in downtown. Trips that use the Elliott/Western ramps with the 2015 Existing Viaduct would take more time in most cases. For all routes, travel times for the 2015 Project would be substantially shorter than those for the 2015 Viaduct Closed (No Build Alternative).

With the 2015 Project, SR 99 is expected to operate better than it would with the 2015 Existing Viaduct because the Elliott/Western and midtown ramps would be removed, which would eliminate merging and weaving conflicts.

Net traffic diversion to I-5 is expected to be minor with the 2015 Project, and traffic conditions on I-5 would be similar to conditions with the 2015 Existing Viaduct.

Intersection operations at the First Avenue S./S. Atlantic Street intersection are expected to improve during the AM peak period compared to the 2015 Existing Viaduct because the Bored Tunnel Alternative would relocate access to and from SR 99 west of First Avenue S. However, similar LOS is forecasted for the PM peak.

Connecting east/west streets across Aurora Avenue would greatly improve local circulation and mobility for both motorized vehicles and nonmotorized modes in the South Lake Union area and between the South Lake Union area, Uptown, and surrounding areas. This is an especially key benefit for pedestrians and bicycles because the next nearest crossings (Mercer Street, Broad Street, and Denny Way) carry high volumes of motor vehicles and have relatively narrow sidewalks, contributing to a non-friendly environment for nonmotorized travel.

Extending Sixth Avenue N. to Mercer Street would improve access and would add a local connection route between downtown/Belltown and Uptown for both motorized and nonmotorized travel. If the Curved Sixth Avenue option is not signalized, then the Straight Sixth Avenue option would improve access to a greater degree than the Curved Sixth Avenue option because it would allow a connection between northbound Sixth Avenue N. and westbound Mercer Street, as well as a connection from westbound Mercer Street to southbound Sixth Avenue, including the bored tunnel southbound on-ramp at Republican Street. However, the City is investigating possibilities for signalizing the Curved Sixth Avenue option, and if it is signalized, these differences in accessibility would not exist. Traffic accessing southbound SR 99 via the Republican on-ramp from westbound Mercer Street could also travel southbound on Dexter Avenue and reach the ramp via the new Harrison Street connection across SR 99.

Extending Sixth Avenue N. to Mercer Street would improve access to southbound SR 99 from Mercer Street. Because it would facilitate a more direct connection from westbound Mercer Street to southbound SR 99, the Straight Sixth Avenue option would improve access to SR 99 from Mercer Street to a slightly greater degree than the Curved Sixth Avenue option without a signal at Mercer Street (note that this difference is negated if the Curved Sixth Avenue option is signalized). Traffic accessing southbound SR 99 via the Republican on-ramp from westbound Mercer Street could also travel southbound on Dexter Avenue and reach the ramp via the new Harrison Street connection across SR 99.

The connection of Sixth Avenue with Mercer Street would also provide an additional post-event egress route to Mercer Street for traffic exiting Seattle Center parking facilities. This combined with the new connections provided across SR 99 (i.e., at John, Thomas, and Harrison Streets) would aid in dispersing post-event traffic from the Seattle Center and would benefit post-event traffic flows on Fifth Avenue N., including the transit routes that use Fifth Avenue N. and currently get stuck in post-event congestion.

With the 2015 Project, Alaskan Way is expected to carry more vehicles than it would with the 2015 Existing Viaduct because it would be the primary access route from SR 99 into downtown from the south. This is expected to create congestion along the roadway, particularly near the Seattle Ferry Terminal at Colman Dock, without further improvements to Alaskan Way.

The ability of Alaskan Way to serve as a primary travel corridor for Elliott/Western traffic is limited by the rail crossing at Broad Street and multiple cross streets. The Elliott/Western Connector, proposed in the Program, would address this issue.

Consolidation of access between downtown and SR 99 to Alaskan Way S. south of S. King Street would attract more trips on First Avenue S. through Pioneer Square in comparison to the 2015 Existing Viaduct.

South Portal Area: New Dearborn Intersection Option

The New Dearborn Intersection option would operate adequately.

Because this option would provide one less signalized intersection for traffic to pass through, travel times between Alaskan Way and SR 99 would be slightly shorter than in the New Dearborn and Charles Intersections option.

This option would provide a longer northbound SR 99 off-ramp to Alaskan Way S., and hence more queuing distance on the ramp between the ramp terminus intersection and the SR 99 mainline.

South Portal Area: New Dearborn and Charles Intersections Option

Overall, the New Dearborn and Charles Intersections option would operate comparably to the New Dearborn Intersection option and provide an additional east-west surface street connection.

The S. Dearborn Street/Alaskan Way S. intersection would operate slightly better for this option in both the AM and PM peak hours as compared to the New Dearborn Intersection option. However, travel time along Alaskan Way S. is expected to be somewhat longer for this option because there would be one additional signalized intersection to pass through.

The New Dearborn and Charles Intersections option would provide an additional east-west crossing of Alaskan Way S. and E. Marginal Way S. in the south portal area, as compared to the New Dearborn Intersection option.

North Portal Area: Straight Sixth Avenue Option

The Straight Sixth Avenue option would provide for a full range of possible traffic movements at Sixth Avenue N./Mercer Street.

The Straight Sixth Avenue option would provide an additional route from downtown to Uptown, and a more direct route than the Curved Sixth Avenue option from I-5 to southbound SR 99, assuming westbound left turns from Mercer Street to Sixth Avenue N. are prohibited in the Curved Sixth Avenue option (note that this difference is negated if the Curved Sixth Avenue option is signalized).

The Straight Sixth Avenue option would provide pedestrians and cyclists with an additional access point to the combined bicycle and pedestrian facility on the north side of the redesigned Mercer Street. The Curved Sixth Avenue option would not provide this additional access.

Grades on the Straight Sixth Avenue option would be less than those on the Curved Sixth Avenue option because the latter option connects to Mercer Street at a lower elevation.

Travel times along Mercer Street would be slightly longer with the Straight Sixth Avenue option because there would be one additional traffic signal to pass through in comparison to the Curved Sixth Avenue option.

North Portal Area: Curved Sixth Avenue Option

The Curved Sixth Avenue option would move the Sixth Avenue N. intersection closer to Dexter Avenue N. and immediately adjacent to the Aurora Avenue overcrossing. Due to intersection spacing, left turns to and from Mercer Street would likely be prohibited, resulting in direct access to SR 99 only being provided from and to eastbound Mercer Street.

The other new street connections proposed as part of the Bored Tunnel Alternative improvements would facilitate access from westbound Mercer Street. For example, to travel from I-5 to SR 99 southbound, drivers would need to take either Dexter Avenue N. to Harrison Street to the Republican Street on-ramp or Taylor Avenue N. to Roy Street to SR 99.

The Curved Sixth Avenue option would likely not include a traffic signal at the new intersection, and therefore it would not provide for pedestrian and bicycle crossings of Mercer Street at Sixth Avenue N. Some of these crossings could occur on SR 99, depending on the origination/pattern of the trip being made.

If a traffic signal is not provided under this option, northbound left turns from Sixth Avenue N. to Mercer Street would be prohibited; hence, it would not provide an additional route from downtown to Uptown.

Travel times along Mercer Street would be slightly shorter with the Curved Sixth Avenue option because there would be one less traffic signal to pass through in comparison to the Straight Sixth Avenue option.

1.5.4 2015 Program

Traffic operations resulting from the 2015 Program are expected to be similar or improved compared to those resulting from the 2015 Project.

The Alaskan Way surface street would be improved with additional capacity to the south and a new grade-separated connection over the BNSF railroad tracks linking to the Elliott/Western corridor. This improved route would provide more reliable and faster access into downtown and to the Elliott/Western corridor than that provided with the 2015 Project.

The extension of two-way operations on Mercer Street west from Fifth Avenue N. would provide more direct east-west travel routes near Seattle Center and improve westbound connections and way-finding between the South Lake Union area and Uptown.

1.5.5 2015 Program Plus Enhanced Transit

Increased RapidRide service from West Seattle and Ballard would likely attract additional ridership along those lines.

1.5.6 Construction (Traffic Stage 7 Construction Using Washington-Oregon Shippers Cooperative Association [WOSCA] Detour)

Two lanes in each direction would be maintained on SR 99 during daytime hours.

Access to and from SR 99 would be maintained in all areas where current access exists.

Peak period traffic speeds on SR 99 are expected to be slower, and travel times are expected to be longer than those for the 2015 Existing Viaduct.

During the closure of SR 99 for up to 3 weeks just prior to the opening of the bored tunnel, travel times are anticipated to be similar to those for the 2015 Viaduct Closed (No Build Alternative).

Some peak period traffic is expected to divert to north/south arterials and I-5 and/or travel at other times.

Traffic volumes on First Avenue S. would increase through Pioneer Square.

1.5.7 2030 Project and Program

By 2030, traffic patterns would be similar to those for the 2015 Project and Program, except with slightly lower performance due to overall traffic growth.

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Chapter 2 METHODOLOGY

This chapter details the transportation data collection process, specifies the methods for performing travel forecasting and traffic analysis, and describes the types of transportation effects investigated and how those effects were evaluated.

2.1 Study Area

The primary study area for transportation encompasses the project area and nearby transportation facilities that are related to or affected by the SR 99 corridor. The study area is very similar to that used in previous EIS studies, such as the 2006 Supplemental Draft EIS (see Exhibit 2-1). It is generally bounded by S. Spokane Street to the south, Elliott Bay to the west, Aloha Street (three blocks north of Mercer Street) to the north, and I-5 to the east.

Changes in travel patterns and transportation-related effects outside of the study area were reviewed and found to be minimal. Additionally, the potential for cumulative effects is considered for the broader region.

2.2 Data Collection and Sources

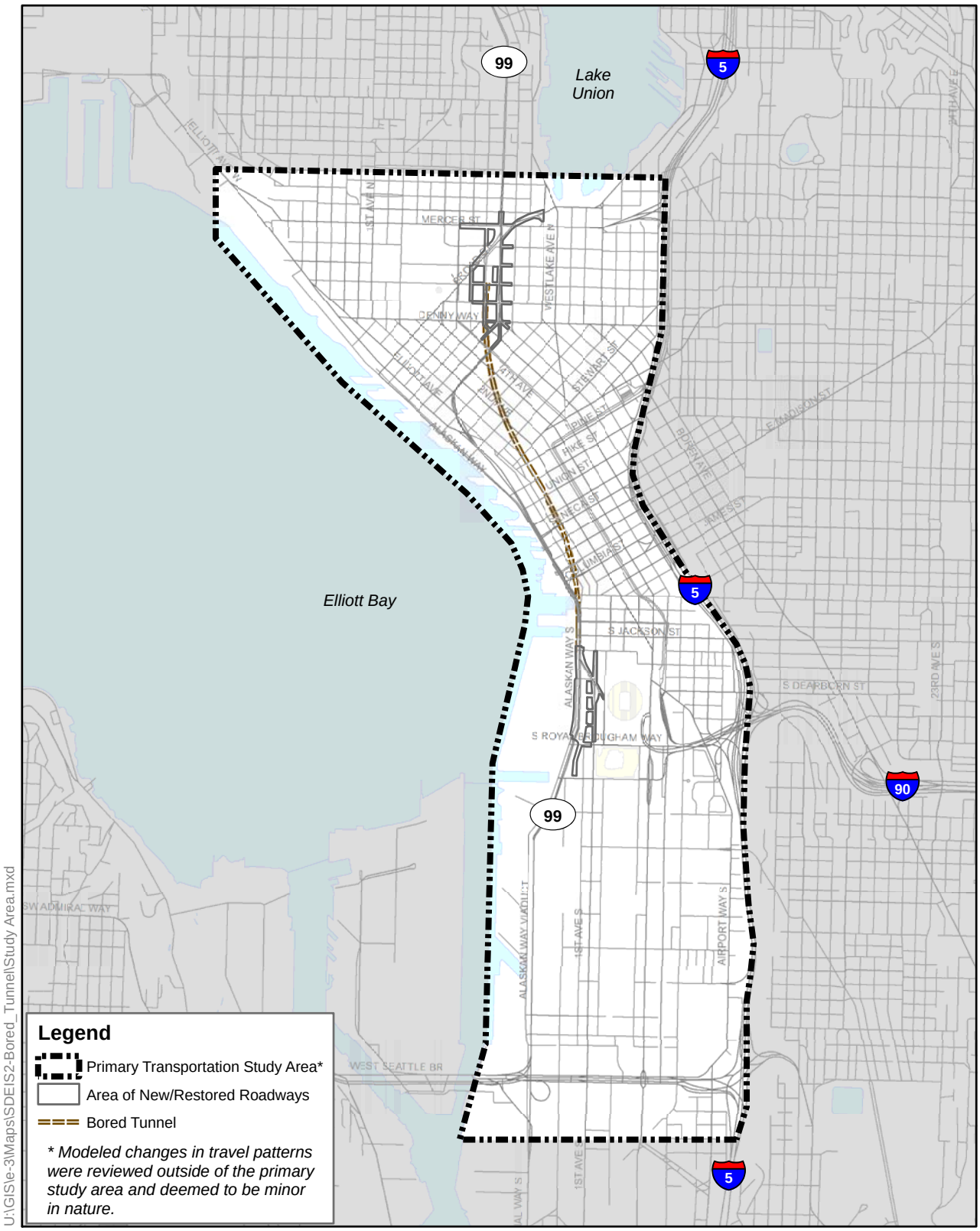
2.2.1 Transportation Analyses

The Transportation Research Board's 2000 *Highway Capacity Manual* (HCM) provides guidance for assessing traffic operating conditions for the range of roadway types found within the study area, including limited-access segments and ramps on SR 99, as well as signalized and unsignalized intersections on study area arterials (TRC 2000).

The *National Cooperative Highway Research Report #255, Highway Traffic Data for Urbanized Area Project Planning and Design* outlines recommended practices for preparation of transportation data, including travel forecasts (Transportation Research Board 1982).

In addition, design guidelines that are relevant to the study of transportation conditions include the following:

- *A Policy on Geometric Design of Highways and Streets, 5th edition* (AASHTO 2004a).
- *A Guide for Achieving Flexibility in Highway Design, 1st edition* (AASHTO 2004b).
- *Guide for the Development of Bicycle Facilities, 3rd edition* (AASHTO 1999).
- *Manual on Uniform Traffic Control Devices, 3rd edition* (FHWA 2003).



Data Source: City of Seattle, 2009.

Exhibit 2-1
Study Area

- *Design Manual M 22-01* (WSDOT 2009).
- Any relevant City of Seattle design guidelines or standards.

2.3 Travel Demand Estimates and Forecasts

Assessment of future travel conditions is based in part on travel forecasts generated by application of a regional travel demand model. The project model is based on the current (2008) Seattle Department of Transportation (SDOT) enhanced version of the Puget Sound Regional Council (PSRC) regional planning model, which operates in the EMME software environment. The model reflects assumptions for regional population and employment growth as defined in PSRC's adopted regional plan, *Destination 2030, the Metropolitan Transportation Plan for the Central Puget Sound Region* (PSRC 2001). These data were most recently updated in 2006.

Documentation of model development and validation is detailed in three documents:

- *PSRC Travel Model Documentation (for Version 1.0), Updated for Congestion Relief Analysis, Final Report* (PSRC 2007).
- *Alaskan Way Viaduct (AWV) Central Waterfront Travel Demand Model Documentation* (Fehr and Peers 2008).
- *Alaskan Way Viaduct & Seawall Replacement Program Travel Demand Model Refinement and Validation Report* (Parsons Brinckerhoff 2009).

The travel demand model was used to establish baseline traffic estimates for future years that reflect forecasted population and employment changes, as well as planned transportation system improvements. Horizon year forecasts were developed for 2030 conditions, while forecasts for the year of opening and the construction period were derived from model runs for 2015.

2.3.1 Model Assumptions

The future year model conditions include a unique set of baseline assumptions for each horizon year (e.g., 2015, 2030). These assumptions include population and employment forecasts for the specific horizon year and transportation network elements, including today's highway, street, and transit system components as well as other transportation improvements that are currently identified in adopted regional plans and have a funding commitment toward implementation in place.

In addition to using the PSRC four-county EMME travel demand forecasting model assumptions for population and employment to develop future year forecasts, the project team compiled a list of transportation projects that are included in the baseline and build networks and have worked with the lead

agencies to finalize and reach consensus on these assumptions. The current list of major new transportation system components for 2030 is as follows:

- New ramps to and from Alaskan Way S. south of S. King Street and reconfiguration of Alaskan Way S. and S. Atlantic Street as proposed in the S. Holgate Street to S. King Street Viaduct Replacement Project.
- Sound Transit Phases 1 and 2: Sounder commuter rail; ST Express bus; First Hill Streetcar; and South Link, University Link, North Link, and East Link light rail.
- Existing transit services and new services proposed in agencies' 6-year plans.
- Third Avenue 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).
- King County Transit Now service changes and bus rapid transit (BRT) corridors (called RapidRide) approved through the Transit Now initiative (2006).
- SR 519 Intermodal Access Project, Phase 2.
- The Mercer East Project, which would widen Mercer Street between I-5 and Dexter Avenue N. to accommodate three lanes of travel in each direction, parking, sidewalks, and a median with left-turn lanes.
- S. Spokane Street Viaduct Widening Project, including widening between Sixth Avenue S. and SR 99, relocation of the westbound off-ramp from Fourth Avenue S. to First Avenue S., and a new eastbound off-ramp at Fourth Avenue S.

The 2015 model has similar components as the 2030 model, but does not include Sound Transit Phase 2 (ST2) elements (North Link or East Link).

Based on input from King County Metro, the model assumes fall 2009 service levels as a year 2015 baseline for transit due to the national recession and sales tax revenues being substantially less than predicted in the 2009 budget.

The assumptions for Port of Seattle container terminal/rail terminal trips (Terminal 46, Terminal 30, and the North Seattle International Gateway [SIG], in particular) in the S. Holgate Street to S. King Street Viaduct Replacement Project are included in the analysis in the post-processing portion of volume development (i.e., they were incorporated into the volumes after the travel demand model runs, but prior to any operational analyses). The PSRC 2040 freight element is not incorporated into the travel demand model at this point.

2.3.2 Model Conditions

Transportation planners prepared a model for the 2015 Existing Viaduct that included the baseline elements described previously. The 2015 Existing Viaduct assumes that the existing viaduct would remain in place in its current configuration except for new ramps to and from Alaskan Way S. south of S. King Street and reconfiguration of Alaskan Way S. and S. Atlantic Street as proposed in the S. Holgate Street to S. King Street Viaduct Replacement Project. The 2015 Existing Viaduct serves as a reference point for comparison to the 2015 Viaduct Closed (No Build Alternative) and the Bored Tunnel Alternative.

The 2015 Viaduct Closed (No Build Alternative) assumes that the existing viaduct would not be in service from S. Royal Brougham Way to the south portal of the Battery Street Tunnel, with SR 99 instead connecting to the existing street grid at these locations. The existing linkage from the central waterfront to the Battery Street Tunnel provided by the Alaskan Way Viaduct would not be replicated. The Alaskan Way surface street would be maintained in its current alignment, but restriped to provide four travel lanes.

The project is reflected in the 2015 Project that gauges year-of-opening conditions that include network changes associated with the Bored Tunnel Alternative. Additionally, a Construction condition was modeled to reflect conditions during the most disruptive construction phase. The Bored Tunnel Alternative was also modeled for design year (2030) conditions (referred to as the 2030 Project). A "high-level" year 2040 assessment was conducted by analyzing projected population and employment growth in the region and in the Center City area. This assessment did not require travel demand model runs. Two 2015 networks and one 2030 network were modeled to analyze cumulative effects as well (results presented in Chapter 7).

In total, nine model runs were conducted, representing the following conditions:

1. Existing Conditions (used for model calibration)
2. 2015 Existing Viaduct (with the Alaskan Way Viaduct)
3. 2015 Viaduct Closed (No Build Alternative)
4. 2015 Project (Bored Tunnel Alternative)
5. 2015 Program (Bored Tunnel Alternative plus all Program elements except the First Avenue streetcar and King County Metro transit improvements, which are not expected to be in place by 2015)
6. 2015 Program Plus Enhanced Transit (Bored Tunnel Alternative plus all Program elements – Cumulative Effects)
7. 2030 Project (Bored Tunnel Alternative)

8. 2030 Program (Cumulative Effects)
9. 2015 Construction (Traffic Stage 7 construction using WOSCA detour)

Existing conditions are presented in Chapter 4, while the 2015 Existing Viaduct, the 2015 Viaduct Closed (No Build Alternative), the 2015 Project, and the 2030 Project are discussed in Chapter 5. The 2015 Construction is discussed in Chapter 6. Finally, the 2015 Program, the 2015 Program Plus Enhanced Transit, and the 2030 Program are discussed in Chapter 7.

2.4 Traffic Operations Analysis

2.4.1 Highway Simulation

SR 99 traffic operations were assessed for the AM and PM peak hours using a traffic simulation model developed in the VISSIM modeling environment (version 5.1). The VISSIM model includes mainline SR 99 segments, ramps, and ramp terminal intersections. The model replicates traffic flow by simulating discrete vehicle movements to produce estimates of travel speeds and traffic density, which can be used to assess highway LOS consistent with HCM definitions.

2.4.2 Arterial Intersection Analysis

Intersection traffic operations were evaluated for key locations on the arterial network using VISSIM, described above, and Trafficware Corporation's Synchro software (version 7.0 or later). Synchro is a traffic modeling program designed for analysis of intersection traffic operations and the optimization of traffic signal timings. Synchro reports average vehicle delay, allowing calculation of LOS consistent with HCM definitions. Synchro also estimates average and maximum queue lengths.

Intersections selected for analysis were chosen based primarily on relation to the AWV corridor and changes in traffic patterns predicted by the travel forecasting model. VISSIM was used to evaluate intersections located at ramp terminals and on the following segments:

- Alaskan Way from S. Royal Brougham Way to Broad Street
- Elliott and Western Avenues from Blanchard Street to Mercer Place W.
- New Elliott/Western Connector arterial between Elliott and Western Avenues and Alaskan Way surface street (where applicable)
- Mercer Street from I-5 to Elliott Avenue

Other intersections were evaluated using Synchro. Exhibit 2-2 displays the intersections that were analyzed, and Exhibit 2-3 shows the intersections that are specifically addressed in this report.

2.5 Transportation Data and Performance Measures

2.5.1 Sources of Existing Geometric Data and Traffic Control Information

Transportation analysts have previously compiled roadway geometry, channelization, and traffic control (including signal timing) data for the Program. These data were reviewed for consistency with existing field conditions and updated as necessary.

2.5.2 Traffic Volume Information

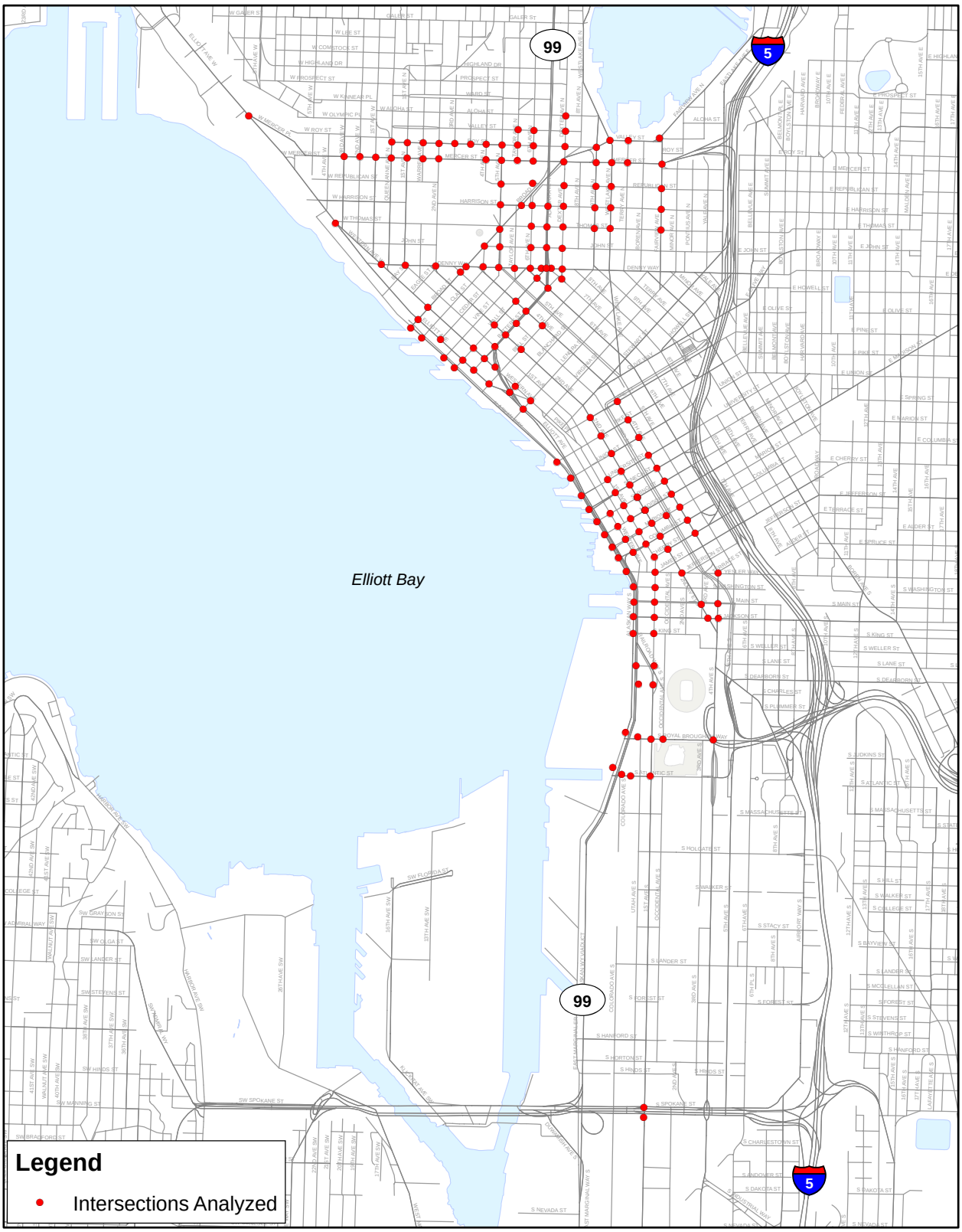
Mainline SR 99 Traffic Counts

Transportation analysts have previously prepared AM peak hour, PM peak hour, and daily traffic volume estimates for SR 99 mainline segments and ramps for 2005 conditions. These volume estimates were derived from traffic counts conducted by WSDOT and City of Seattle from 2004 through 2006. Traffic volumes on SR 99 within the study area have generally remained stable in recent years, so these volume estimates may still be considered current. Some additional on-corridor traffic count data were collected in 2007 and 2008 by the City of Seattle. These data were evaluated and existing traffic volume estimates updated as necessary to reflect changes evident in these latest counts.

Intersection Traffic Counts and Related Data

Previous work associated with the Program led to development of a database of turning movement counts for intersections throughout the study area. Data include AM and PM peak hour vehicle turning movements, heavy vehicle percentages, peak-hour factors, and pedestrian crossings for each intersection leg. Counts have been collected for most traffic signal-controlled intersections within the primary study area. Traffic volumes at minor intersections for which counts are not available have been estimated based on counts at adjacent intersections.

Turning movement counts were originally conducted between 2003 and 2005, though the database has been updated as newer data become available. The intersections selected for detailed traffic analysis were evaluated to determine whether newer traffic counts were needed. This process involved considering whether new development in the area is likely to have altered traffic patterns since the date the current traffic count was conducted, and comparing turning movement count volumes to newer automated traffic counter data available from the City of Seattle (2007–2008). New peak hour turning movement counts were conducted for locations where current estimates were determined to be out of date. Newer counts were compared to prior counts to identify any anomalies.

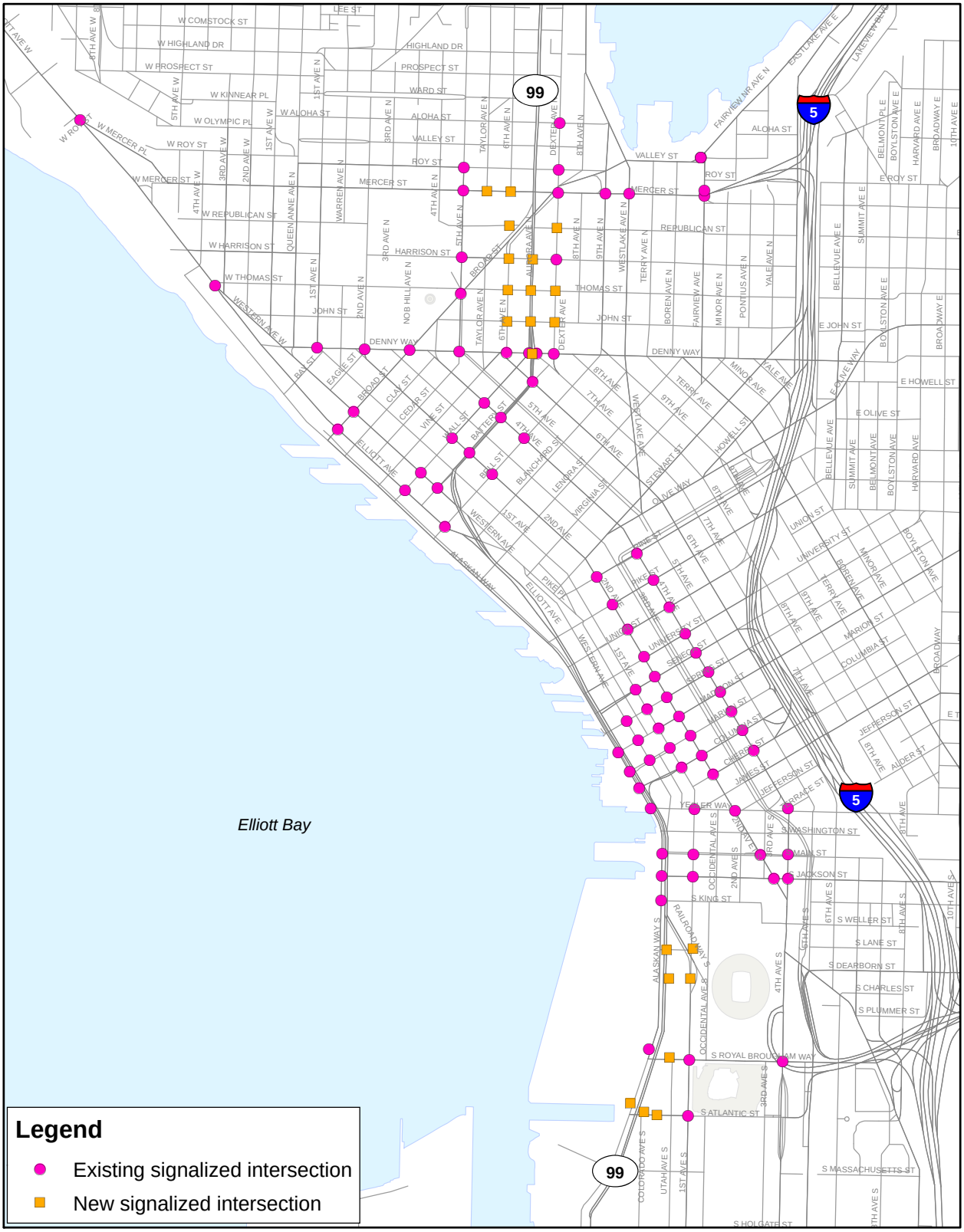


N

0 2,000 4,000 8,000 Feet

Basemap Data Source: King County, 2005.

Exhibit 2-2
Intersections Analyzed



N

0 1,000 2,000 4,000 Feet

Basemap Data Source: King County, 2005.

Exhibit 2-3
Intersections Reported

High-Occupancy Vehicles

AM and PM peak period vehicle occupancy data were collected for the existing Seneca Street off-ramp and Columbia Street on-ramp. The purpose for focusing on the midtown ramps is to assess high-occupancy vehicle (HOV) usage into and out of downtown to support decisions related to providing transit and/or HOV priority into the CBD from the south. The SR 99 corridor does not presently contain any HOV facilities within the study area.

Nonmotorized Users

Pedestrian volumes at intersections were collected with the arterial turning movement counts described previously. Generally, bicycle traffic is counted as part of the vehicle stream. Discrete counts of bicycle traffic were not conducted.

Trucks

Heavy truck volumes were collected during the arterial turning movement counts described previously. Heavy trucks include single and double trailer units, dump trucks, and similar large trucks. Medium and light duty trucks and delivery vans are not included in these totals. These data were supplemented by video reconnaissance of freight traffic on SR 99 conducted in June 2006. Additional information on heavy trucks' use of the SR 99 corridor is summarized in the project memorandum *Updated SR 99 Truck Volumes* (Parsons Brinckerhoff 2006a). Following the Nisqually earthquake of February 2001, weight restrictions were established to prohibit vehicles weighing over 10,000 pounds from using the two left lanes on each level of the viaduct. These restrictions remain in place today.

2.5.3 Parking Inventory

On-street parking in the Seattle CBD and along the waterfront was counted in 2001, with additional counts in 2002 and 2003 and an updated count in 2006. Location and types of parking were rechecked in 2009. Parking spaces surrounding the north portal area were counted in the summer of 2009 and rechecked in early 2010. City of Seattle parking space data from 2009 also were used. Off-street parking data collected in 2005 and published in 2006 by PSRC have been obtained.

2.5.4 Transit Service Routes and Frequencies

Transit information was collected that related to service coverage, frequency, and travel times for buses that currently use SR 99 and other nearby street segments from published schedules and maps provided by King County Metro, Community Transit, Pierce Transit, and Sound Transit. Available transit ridership data from King County Metro were collected, and modeled transit

ridership statistics from the project's travel demand model (see Section 2.3) were used to compare relative levels of ridership.

2.5.5 Ferry Service Characteristics at Colman Dock

Washington State Ferries representatives have previously provided data relating to current ferry vessel capacities, ferry operating schedules, Seattle Ferry Terminal vehicle holding capacity, and typical loading and unloading procedures. Information on street-level pedestrian activity and actual traffic counts in the vicinity of Colman Dock have also been collected, as previously described.

2.5.6 Collision Data for SR 99

A comprehensive evaluation of collision history on the SR 99 corridor was conducted in 2007, reviewing collision data from 2000 through 2003. Additional collision data for the Battery Street Tunnel area were assessed for 2004. Collision data recently gathered for the corridor for years 2005 through 2007 were also assessed.

2.6 Analysis of Existing Conditions (Affected Environment)

Existing conditions were analyzed for a base year of 2005, unless otherwise noted. The elements of the analysis are described below. The findings are typically reported for daily conditions corresponding to average daily totals for weekday (Monday through Friday) conditions, or for the AM (morning) or PM (evening) peak hours. These peak hours correspond to the hour-long periods in the morning and evening when overall traffic volumes and travel demand are at their highest levels. For SR 99, the peak hours assessed correspond to 8:00 to 9:00 a.m., and 5:00 to 6:00 p.m. Generally, traffic volumes are at similar levels at other times during the morning and evening commute periods as well. Therefore, peak hour results are largely representative of travel conditions anytime between 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.

2.6.1 Regional Context and Travel Patterns

The project's travel forecasting model was used to estimate travel patterns on regional transportation corridors, including I-5, SR 99, and major arterials in central Seattle at screenline locations south of, within, and north of downtown Seattle. Transit ridership and total person-throughput estimates for all travel modes were prepared at the screenline level. Additionally, projected regionwide AM peak period, PM peak period, and daily vehicle miles of travel (VMT), vehicle hours of travel (VHT), and vehicle hours of delay (VHD) are reported from the travel demand forecasting model, as well as daily transit mode shares to and from the Center City area.

2.6.2 Traffic Operations on SR 99

AM and PM peak hour travel speed and LOS are reported for all mainline segments and ramps on SR 99. These data were estimated from traffic simulation modeling as described previously. Notable areas of congestion are identified and described.

LOS is a measure that characterizes the operating conditions, as perceived by a driver or facility user, of a highway, street, or other transportation facility. Although LOS is a qualitative measure, it is based on quantitative measures, such as traffic density, average speed, or average vehicle delay. A range of six LOS designations, ranging from "A" to "F," is defined in the HCM. LOS A represents ideal, uncongested operating conditions, while LOS F designates congested, breakdown conditions. Generally, LOS A, B, and C conditions are considered relatively uncongested for peak conditions in the urban environment. LOS D conditions reflect heavier traffic volumes and noticeable slowing, while LOS E denotes congested conditions at the point of maximum vehicle throughput (i.e., the facility is operating at full capacity).

LOS for either freeway segments or multilane highway segments is derived from traffic density and classified according to the ranges shown in Exhibit 2-4. SR 99 is best classified as a multilane highway north of Denny Way. South of Denny Way it most closely functions as a freeway, though its posted speed is lower than a typical freeway. Both multilane arterial and freeway classifications use the same density range to estimate LOS. These traffic density ranges are used to classify LOS for all SR 99 mainline and ramp segments. However, because posted speeds on SR 99 are less than on a typical freeway, the LOS as based on the HCM density ranges for freeways will likely be lower than is truly experienced on the facility. Note that intersection LOS at ramp termini are also categorized using intersection-based LOS measurements, as described in the following section.

Exhibit 2-4. Level of Service Designations for Freeways or Multilane Highways

LOS for Freeway/Highway Segments	Density Range (pcpmpl)
A	0–11
B	> 11–18
C	> 18–26
D	> 26–35
E	> 35–45
F	> 45

Source: Transportation Research Board 2000.

LOS = level of service

pcpmpl = passenger car equivalents per mile per lane

2.6.3 Traffic Operations at Key Arterial Intersections

Average vehicle delay and LOS are reported for AM and PM peak hour conditions for key study area intersections on adjacent and nearby arterials. Average vehicle delay is reported from either Synchro's HCM Signals report or from the simulation runs in the VISSIM model (see Section 2.4.2 for more information). Intersection LOS is based on the average delay per vehicle and is categorized as shown in Exhibit 2-5.

Exhibit 2-5. Level of Service Designations for Signalized Intersections

LOS for Signalized Intersections	Average Vehicle Delay (seconds)
A	0–10
B	> 10–20
C	> 20–35
D	> 35–55
E	> 55–80
F	> 80

Source: Transportation Research Board 2000.
LOS = level of service

2.6.4 Roadway Connectivity and Access

SR 99 connections were identified by movement (e.g., southbound SR 99 to Denny Way) and evaluated qualitatively as providing "good access," "partial or substandard access," or "no access." These designations reflect the degree of connectivity provided (full access, partial access, or no access); the quality of connections (high-speed/capacity ramp connections, low-speed/capacity ramp connections, or arterial connections); and the type of connection provided (direct connection, short indirect connection, or longer indirect connection requiring extended arterial travel).

2.6.5 Transit Services

Public transportation services in the study area are described. Those bus routes that could be directly affected by proposed changes to SR 99 under the Bored Tunnel Alternative are identified and described in terms of routing, frequency of service, and scheduled travel times.

2.6.6 Truck Traffic and Freight

Truck volumes on SR 99 were mapped. Major freight generators and destinations were identified, and truck use of SR 99 is described (including current weight and flammable/hazardous materials restrictions).

2.6.7 Parking

The location and type of parking for areas that may be affected by the project are described. Parking utilization is also described in a general sense as allowed by existing data.

2.6.8 Pedestrians

Pedestrian facilities proximate to the corridor are described. Major pedestrian generators and their characteristics are also identified, such as the stadiums, the Seattle Ferry Terminal at Colman Dock, and attractions along the waterfront. Pedestrian activity is quantified for areas where activity is known to be high, with particular emphasis on the waterfront. Pedestrian interactions with vehicle traffic are discussed as related to Alaskan Way, Aurora Avenue, and ramps from the Alaskan Way Viaduct.

2.6.9 Bicycles

Bicycle routes and facilities are identified, and bicycle activity in the study area is generally described.

2.6.10 Ferries

Current ferry operations at the Seattle Ferry Terminal, with emphasis on both pedestrian and vehicle access and egress from the terminal, are described. To capture traffic operating characteristics for the intersections that provide egress from Colman Dock, delay and LOS were calculated separately for periods during which ferry traffic is actively exiting the dock (and signal preemption is ongoing) and periods during which no ferry traffic is exiting the dock.

2.6.11 Collision History

Current high-accident locations and high-accident corridors were identified, and the factors that contribute to the high incidence of collisions at those locations were described. A more detailed discussion of collision history also is presented, updating the prior Program analysis conducted for 2001–2003 to reflect the most recent available collision data (2005–2007). The following elements are considered:

- Collision rates - To allow comparison of collision rates between corridor segments and to average rates on similar facilities, collisions per million vehicle miles of travel (MVMT) were calculated for each corridor segment.
- Collision types - The share of collisions for major collision types (e.g., fixed-object collisions, rear-end collisions) relative to total collisions, and collision rates by type (per MVMT) were reported. Comparing the proportion of accident types by segment can help identify possible contributing factors to collisions.

- Collision severity - The share of injury collisions (per MVMT) relative to total collisions was reported.

2.7 Analysis of Future Conditions and Environmental Effects

As discussed in Section 2.3.2, the project's travel demand forecasting model was used to derive estimated changes in travel patterns and traffic volumes for the future years of 2015 and 2030. Project construction is expected to occur between 2011 and 2016. Both the construction analysis and year-of-opening analysis rely on model runs for 2015. Detailed analysis was conducted for the baseline (2015), project design year (2015), and project horizon year (2030) conditions.

2.7.1 Conditions in 2015 and 2030

Changes in Travel Patterns and Systemwide Performance Measures

The travel demand forecasting model was used to estimate how travel patterns might change with the 2015 Existing Viaduct, the 2015 Viaduct Closed (No Build Alternative), and the 2015 Project, as well as the 2030 Project. Traffic volumes on regional transportation corridors, including I-5, SR 99, and major arterials in central Seattle, were compared at study area screenline locations south of, within, and north of downtown Seattle.

Transit ridership and total person-throughput estimates (for total vehicles and transit modes) were prepared at the screenline level. Additionally, forecasted regionwide AM peak period, PM peak period, and daily VMT, VHT, and VHD are reported, as well as daily transit mode shares to and from the Center City area.

Traffic Operations on SR 99

AM and PM peak hour travel speeds and LOS for all mainline segments and ramps on SR 99 were developed for 2015 and 2030 modeled conditions. These data were estimated from VISSIM traffic simulation modeling of the 2015 Existing Viaduct, the Viaduct Closed (No Build Alternative), the Project, and the Program. Notable areas of congestion and any substantial difference in operating conditions are identified and described.

Travel characteristics on Alaskan Way for the Bored Tunnel Alternative were compared to existing SR 99 trips that use the Elliott/Western ramps.

Traffic Operations at Key Arterial Intersections

Average vehicle delay and LOS were estimated for AM and PM peak hour conditions for the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project at key study area intersections, consistent with locations evaluated for existing conditions. Additionally, any intersections that would be newly created or reconfigured under the Bored Tunnel Alternative were included in the evaluation.

Vehicle delays at select locations were also extracted for the Viaduct Closed (No Build Alternative) and the Program as needed to provide input to the travel time analyses, though full analysis of intersection LOS was not conducted.

Peak hour volume estimates used for these intersection analyses were developed based on changes in traffic volumes projected by the project's travel demand model. For each intersection location, existing counts were adjusted by the modeled change in traffic volumes to derive the appropriate future condition volume. This "post-processing" of model volumes helps ensure that forecasts derived from the model are calibrated to observed field conditions. In cases of new intersections, estimates are based on modeled volumes adjusted to balance with those at nearby intersections.

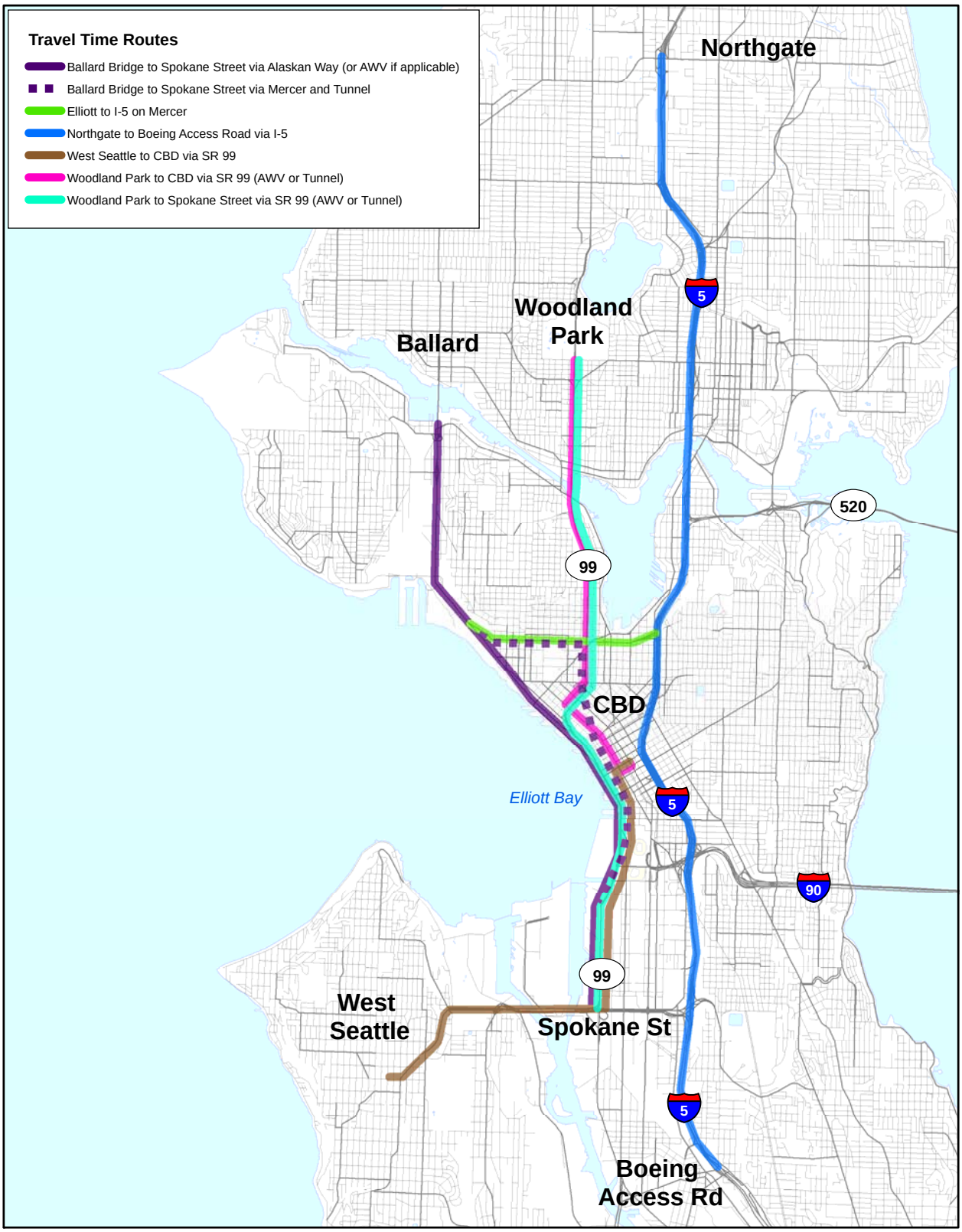
Travel Times

AM and PM peak hour travel time estimates for 2015 conditions and the 2030 Bored Tunnel Alternative were developed for routes that represent major traffic movements accommodated by the SR 99 corridor. The routes selected extend beyond the traffic study area boundary to better represent the total travel times that actual trips might take. This allows the relative difference in travel times to be considered in context with the total travel times for longer-distance trips (i.e., those originating or destined to locations outside the study area).

Travel time estimates were generated from models. Within the study area, travel time estimates for SR 99 segments and ramps were derived from VISSIM simulation model results. For arterial segments, travel time estimates were based on free-flow speeds and intersection delay estimated from VISSIM simulation model results where available, and/or Synchro operations analysis results as available. Finally, the travel demand model travel speeds were used as a basis for calculating travel times along route segments outside of the study area (e.g., SR 99 north of Aloha Street, 15th Avenue W. north of Elliott Avenue, and the West Seattle Bridge west of Harbor Island). Additionally, travel time contours were estimated from the travel demand model and presented graphically for each alternative.

Travel times are reported for routes that correspond to a range of trips that typically use the corridor (the routes are shown on Exhibit 2-6):

- South to and from downtown, represented by West Seattle to CBD via SR 99.
- North to and from downtown via SR 99, represented by Woodland Park (SR 99 and N. 50th Street) to CBD.
- Through trips on SR 99, represented by Woodland Park to S. Spokane Street.



N

0 0.5 1 2 Miles

Basemap Data Source: King County, 2005.

Exhibit 2-6
Travel Time Routes Map

- Through trips on the Elliott/Western corridor, represented by Ballard Bridge to S. Spokane Street via two routes:
  - Via Alaskan Way (or AWV if applicable)
  - Via Mercer Street and the bored tunnel
- Mercer Street: from I-5 to Elliott Avenue
- Northgate to Boeing Access Road via I-5

Travel times to downtown are reported for the peak direction only, while other routes—which do not have strong differences in directional traffic volumes during commute times—are assessed for both directions of travel during each peak hour. All routes are assessed for the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project. Select routes are reviewed for existing conditions and the 2015 Viaduct Closed (No Build Alternative) to establish the general degree of corridor travel time differences that could be expected for those respective modeled conditions. Exhibit 2-7 identifies which travel time estimates were developed for each of the modeled conditions analyzed, including for existing conditions.

Exhibit 2-7. Modeled Conditions and Routes for Estimated Travel Times

Routes	Existing[1]	Year 2015			Year 2030
		Existing Viaduct	Viaduct Closed	Project	Project
West Seattle Junction to CBD (Seneca Street and Fourth Avenue) via SR 99 and Alaskan Way surface street		Peak direction only		Peak direction only	Peak direction only
Woodland Park (SR 99 and N. 50th Street) to CBD		Peak direction only		Peak direction only	Peak direction only
Woodland Park (SR 99 and N. 50th Street) to S. Spokane Street	PM peak only	AM & PM	AM & PM	AM & PM	AM & PM
Ballard Bridge/Elliott Avenue to S. Spokane Street					
a) Via Alaskan Way (or AWV if applicable)	PM peak only	AM & PM		AM & PM	AM & PM
b) Via Mercer Street, bored tunnel				AM & PM	AM & PM
Mercer Street: I-5 to Elliott		AM & PM		AM & PM	AM & PM
Northgate to Boeing Access Road via I-5		AM & PM		AM & PM	AM & PM

AWV = Alaskan Way Viaduct
CBD = Central Business District
[1] Existing conditions are represented by 2005 data.

Roadway Connectivity and Access

The Bored Tunnel Alternative's connections were identified by movement (e.g., southbound SR 99 to Denny Way) and evaluated qualitatively as providing

"good access," "partial or substandard access," or "no access." These designations reflect the degree of connectivity provided (full access, partial access, or no access); the quality of connections (high-speed/capacity ramp connections, low-speed/capacity ramp connections, or arterial connections); and the type of connection provided (direct connection, short indirect connection, or longer indirect connection requiring extended arterial travel).

Transit

The expected effects on transit services were assessed using both qualitative and quantitative information. Expected changes in transit routing for the Project are identified and compared to routing for the 2015 Existing Viaduct. The comparison focuses on changes in coverage area and potential effects on speed and reliability (based on traffic operations results). Traffic analysis results are used to gauge potential travel time effects on routes operating on SR 99 (Aurora Avenue and SODO). Modeled changes in mode share are reported as well.

Truck Traffic and Freight

The Bored Tunnel Alternative's effects on freight and goods movement, including comparison of routing alternatives for trips that currently use the Elliott/Western Avenue corridor, are described, along with potential changes in vehicle restrictions (regarding weight and/or flammable or hazardous materials).

Parking

Potential parking effects are quantified for the area that would be directly affected by the Bored Tunnel Alternative. The location and proximity to dependent uses and alternative parking availability also are qualitatively examined.

Pedestrians

Pedestrian components of the Bored Tunnel Alternative are described in addition to other project-related changes that could affect the quality and/or safety of pedestrian facilities. In particular, potential effects associated with changes to Alaskan Way, Aurora Avenue, and SR 99 ramp locations were examined to gauge pedestrian exposure to vehicle traffic, effects to pedestrian connectivity, and means for providing safe and convenient crossings of streets and highways.

Bicycles

Bicycle facility components of the Bored Tunnel Alternative are characterized, as well as other project-related changes that could affect the quality and/or safety of bicycle travel. The assessment considers how changes in roadway configuration and traffic volumes on Alaskan Way might affect bicycling there.

Ferry Traffic

Changes in vehicle access and egress from the Seattle Ferry Terminal at Colman Dock are described and compared to baseline conditions.

Event Traffic

Traffic conditions and access to major events in the stadium area and at Seattle Center are described qualitatively, taking into consideration normal peak hour traffic conditions, changes in traffic patterns and volumes associated with events, and event-related pedestrian activity.

Safety

Potential changes in conditions that could affect motorist, pedestrian, and vehicle safety are assessed based on review of the major design elements associated with the Bored Tunnel Alternative, including facility type, lane widths, geometric configuration, and potential vehicle and pedestrian conflict locations. The safety discussion also assesses how design features might affect existing locations that experience a relatively higher share of accidents, or potentially introduce new or different safety issues.

2.7.2 Conditions in 2040

A "high-level" year 2040 assessment was conducted by analyzing projected population and employment growth both in the region and in the Center City area. Based on this, a qualitative discussion of the potential effect of year 2040 conditions on the Bored Tunnel Alternative's operational performance is included.

2.7.3 Construction Travel Conditions

Traffic management approaches (detours) associated with major construction stages of the Bored Tunnel Alternative are described. Travel forecasts were prepared for one construction stage, corresponding to the stage that is expected to be most disruptive. SR 99 mainline speeds and travel times are estimated. Travel disruption during other construction stages is described qualitatively relative to this modeled stage. Transportation measures to help maintain mobility and access during construction are suggested based on the degree, location, and extent of disruption forecasted. Impacts to stadium and Seattle Center event access and egress are assessed and discussed qualitatively.

2.8 Cumulative Effects

Cumulative effects are effects that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. The focus of the cumulative effects analysis is on the combined effect of the Bored Tunnel Alternative, other Program elements, and other past, present,

and reasonably foreseeable future projects that are anticipated to add to transportation effects in the study area. Two levels of cumulative effects were assessed. The first level includes the Bored Tunnel Alternative and the other Program elements. This level is assessed quantitatively. The second level of cumulative effects includes the Bored Tunnel Alternative, the other Program elements, and other regional transportation projects. This analysis is qualitative in nature and relies on other studies previously conducted.

2.8.1 Program Elements

Other roadway elements of the Program were assessed for operational and Traffic Stage 7 construction effects using the available design year (2015) and horizon year (2030) traffic data and potential roadway alignments. Because transit enhancement elements are not expected to be fully implemented by 2015, the 2015 Program consists of the roadway elements only. The full Program is assessed for 2030. The following projects are included in this analysis:

- Alaskan Way Surface Street Improvements
- Elliott/Western Connector
- Mercer West Project
- First Avenue Streetcar Evaluation

Non-roadway and transit elements of the Program are qualitatively evaluated:

- Transit Enhancements
- Elliott Bay Seawall Project
- Alaskan Way Promenade/Public Space

2.8.2 Other Projects

Other projects include the following major projects (some of which are already included in the project baseline):

- Cumulative effects specifically associated with major construction projects in or near downtown Seattle:
  - Bridging the Gap Projects
  - Sound Transit University Link Light Rail Project – extension to University of Washington
  - Mercer East Project – conversion of Mercer Street to two-way operations from I-5 ramps to Dexter Avenue N.
  - North Parking Lot Development at Qwest Field
  - Bill and Melinda Gates Foundation Campus Master Plan
  - SR 99/E. Marginal Way Grade Separation
  - S. Spokane Street Viaduct Widening

- Other planned transportation projects with potential cumulative effects:
  - I-5 Improvements
  - SR 520 Bridge Replacement and HOV Program
  - I-405 Corridor Program
  - I-90 Two-way Transit and HOV Operations, Stages 1 and 2
  - SR 509 Improvements
  - South Lake Union and/or SODO redevelopment

Potential changes in travel effects associated with the combined or cumulative implementation of the identified projects are qualitatively described for both construction and operational timeframes. Other subject areas also describe related cumulative effects in their discipline reports (e.g., any potential for induced growth would be described in Appendix G, Land Use Discipline Report).

2.8.3 Changes in Travel Patterns and Systemwide Performance Measures

The travel demand forecasting model was used to estimate how travel patterns might change with the 2015 Program and the 2030 Program. The same performance measures as outlined in Section 2.7.1 are assessed for cumulative effects.

2.8.4 Traffic Operations on SR 99

AM and PM peak hour travel speeds and LOS were calculated for all mainline segments and ramps on SR 99 for the 2015 Program. These data were estimated from VISSIM traffic simulation modeling. Notable areas of congestion and any substantial difference in operating conditions are identified and described. Travel characteristics on Alaskan Way surface street with the Program are specifically compared to existing SR 99 trips that use the Elliott/Western ramps.

2.8.5 Traffic Operations at Key Arterial Intersections

AM and PM peak hour vehicle delay by approach was developed for key study area arterial intersections for the 2015 Program and the 2030 Program, as needed, to provide input to the travel time analyses.

Intersection analyses were conducted using the Synchro/SimTraffic model software version 7.0. Additionally, the VISSIM model version 5.1 was used to analyze intersections on the following arterials:

- Alaskan Way from S. Royal Brougham Way to Broad Street
- Elliott and Western Avenues from Blanchard Street to Mercer Place W.
- New Elliott/Western Connector arterial between Elliott and Western Avenues and Alaskan Way surface street (where applicable)
- Mercer Street from I-5 to Elliott Avenue

2.8.6 Travel Times

AM and PM peak hour travel time estimates were developed for the modeled conditions included in the cumulative effects analysis as indicated in Exhibit 2-8 consistent with the method identified previously. The routes are graphically depicted on Exhibit 2-6.

Exhibit 2-8. Modeled Conditions and Routes for Estimated Travel Times for Cumulative Effects

Routes	2015 Program	2030 Full Program
West Seattle Junction to CBD (Seneca Street and Fourth Avenue) via SR 99, Alaskan Way	Peak direction only	
Woodland Park (SR 99 and N. 50th Street) to CBD	Peak direction only	
Woodland Park (SR 99 and N. 50th Street) to S. Spokane Street	AM & PM	
Ballard Bridge/Elliott Avenue to S. Spokane Street		
a) Via Alaskan Way (or AWV if applicable)	AM & PM	AM & PM
b) Via Mercer Street, bored tunnel	AM & PM	AM & PM
Northgate to Boeing Access Road via I-5	AM & PM	
Mercer Street: I-5 to Elliott Avenue	AM & PM	AM & PM

AWV = Alaskan Way Viaduct

CBD = Central Business District

2.9 Determining Transportation Mitigation Measures

2.9.1 Operational Mitigation

Long-term (post-construction) transportation mitigation measures are not anticipated for the project.

2.9.2 Mitigation of Adverse Effects on Travel During Construction

A program of measures to help maintain mobility and access during construction is recommended based on proposed detour routes and the forecasted degree of travel disruption, including changes in existing pedestrian or vehicle circulation patterns, parking, and changes in access. The measures build on efforts completed previously for the Program's *Draft Construction Transportation Management Plan* (Parsons Brinckerhoff 2006b). The intent of the mobility measures is to maximize the throughput of available routes; preserve vehicular and pedestrian access to businesses, public facilities, and residences; maintain truck and Port drayage routes; and protect the reliability of transit services during the construction period.

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Chapter 3 STUDIES AND COORDINATION

This section provides a summary of the studies and adopted plans undertaken in the region that have relevance to this project. Also included is a summary of coordination activities undertaken to guide the development of traffic and transportation components of the Bored Tunnel Alternative.

3.1 Relevant Studies and Plans

3.1.1 City of Seattle Comprehensive Plan (2005)

The *City of Seattle's Comprehensive Plan: Toward a Sustainable Seattle* (City of Seattle 2005a), articulates a vision of how Seattle will grow in ways that sustain its citizens' values. The City first adopted the Comprehensive Plan in 1994 in response to the state Growth Management Act of 1990. Multimodal transportation policies discussed in the Comprehensive Plan were used to define the project's system elements. In particular, transportation demand policies and system management strategies were used to guide development of the project's mitigation plans.

3.1.2 City of Seattle Transportation Strategic Plan (2005)

The *Transportation Strategic Plan* (City of Seattle 2005b) describes SDOT's vision, goals, and policies for achieving the City's long-range objectives. It describes the actions, projects, and programs that SDOT will take to promote economic growth in Seattle and the region, support livable neighborhoods, improve the environment, and address the traveling public's complex demands. Information from this plan was used to help refine the project's travel demand models.

3.1.3 City of Seattle Bicycle Master Plan (2007)

The *Seattle Bicycle Master Plan* (City of Seattle 2007a) is a planning document used to guide future improvements to Seattle's bicycle network. This master plan focuses on evaluating arterial streets to implement bicycle lanes and encourage more bicycling throughout the city of Seattle.

3.1.4 Seattle Pedestrian Master Plan (2009)

The mission of the Seattle *Pedestrian Master Plan* (City of Seattle 2009b) is to make Seattle the most walkable city in the country by meeting four primary supporting goals:

- Safety – reduce the number and severity of collisions involving pedestrians.

- Equity – make Seattle a more walkable city for all through equity in public engagement, service delivery, accessibility, and capital investments.
- Vibrancy – develop a pedestrian environment that sustains healthy communities and supports a vibrant economy.
- Health – raise awareness of the important role of walking in promoting health and preventing disease.

The plan defines walkable streets by outlining the elements of a walkable street and potential destinations that generate pedestrian traffic.

3.1.5 City of Seattle Center City Circulation Report (2003)

The City of Seattle conducted a study of transit and nonmotorized circulation and service options in the downtown area (City of Seattle 2003a). This study is an effort to better integrate numerous independent transportation components and plans in the downtown area.

3.1.6 City of Seattle Center City Access Strategy (2007)

In preparation for construction and growth, including the project and Program, SDOT is planning, building, and monitoring the implementation of projects in the city center. This strategy involves creating a livable and walkable city center, integrating and simplifying the transit system, accommodating anticipated growth, maintaining access into downtown during major construction projects, and continuing mobility into the future (City of Seattle 2007b).

3.1.7 City of Seattle Freight Mobility Strategic Action Plan (2005 Plan Update)

The *Freight Mobility Strategic Action Plan* (City of Seattle 2005c) presents a list of actions that SDOT will implement. These actions or tasks address administrative and functional actions that SDOT will carry out to benefit freight, in accordance with the Seattle Comprehensive Plan and the Seattle *Transportation Strategic Plan*. Actions include railroad grade separations, truck guide signing, street improvements, and ongoing communication with the Seattle freight community via the Seattle Freight Mobility Advisory Committee.

3.1.8 Seattle Intermediate Capacity Transit Study (2001)

The *Intermediate Capacity Transit Study* (City of Seattle 2001) examined a wide range of transit technologies and services that offer higher passenger carrying capacity and greater reliability than buses operating in mixed traffic. It included an assessment of the following transit services:

- Bus rapid transit (BRT) – buses that move quickly and reliably because of improvements such as transit-only lanes or transit priority technology, which gives buses a green light at intersections.
- Streetcars and trams – electric vehicles running on rails in the streets.
- Elevated transit (like monorail) – electric vehicles that are grade-separated or operate in exclusive rights-of-way, allowing them to avoid traffic congestion and other barriers.

The intermediate-capacity transit study examined transit system performance for various types of transit service that may operate in the AWV corridor.

3.1.9 City of Seattle Transit Plan (2005)

The City of Seattle adopted a Transit Plan (City of Seattle 2005d) to define its transit strategies for its *Transportation Strategic Plan*. The purpose of the Transit Plan is to provide sound direction on how Seattle can achieve the transit system it needs to meet long-term growth, economic, and transportation objectives for connecting downtown and the emerging set of urban villages. Information from the plan was used to help refine travel networks within the Program's travel demand models.

3.1.10 Seattle Streetcar Network Development Report (2008)

The City Council approved a Seattle Streetcar Network Concept in early 2008 and authorized SDOT to evaluate the concept and identify the most promising routes for early implementation. The report evaluated a number of potential corridors and routes, including the First Avenue streetcar line that is part of the Program (City of Seattle 2008a).

3.1.11 Center City Parking Program Work Plan (2008)

The Center City Parking Program is SDOT's effort to address anticipated changes to on-street parking in the Center City over the next several years (City of Seattle 2008b). This would be accomplished with new marketing, way-finding, and technology measures in place by 2012. This program's goal is to provide easy-to-access off-street short-term parking with easy-to-understand pricing that keeps the Center City moving and contributes to a sustainable transportation system.

3.1.12 Waterfront Parking Strategy (2002)

The *Waterfront Parking Strategy* was developed through a partnership between the City of Seattle Strategic Planning Office, the Seattle Aquarium, the Metropolitan Improvement District, the Pike Place Market Preservation & Development Authority, and the Port of Seattle (City of Seattle 2002). It was commissioned to develop a parking strategy to meet changing needs brought about by new and

emerging land uses along the Seattle central waterfront area. The purpose of the strategy was to help the City balance the access and parking needs of a revitalized waterfront with preservation of neighborhood character and businesses.

3.1.13 South Lake Union Transportation Study (Final Report, July 2004)

The main objective of the *South Lake Union Transportation Study* (City of Seattle 2004) is to form a set of transportation strategies to address existing problems and to support and shape the development of the South Lake Union Urban Village.

3.1.14 Mercer Corridor Improvements Project NEPA Environmental Assessment (December 2008) and Finding of No Significant Impact (May 2009)

The Mercer Corridor Improvements Project will replace the existing Mercer/Valley couplet in the South Lake Union neighborhood with a widened two-way Mercer Street and a narrowed two-way Valley Street. The widened Mercer Street will have three lanes in each direction, with widened sidewalks, on-street parking, and a landscaped median. On May 12, 2009, FHWA issued a Finding of No Significant Impact (FONSI) (City of Seattle 2009c), based on the analysis presented in the Environmental Assessment (City of Seattle 2008c).

3.1.15 Seattle Center Century 21 Master Plan (2008)

The *Seattle Center Century 21 Master Plan* calls for substantial, long-term investment in Seattle Center over the next 20 years (Seattle Center Century 21 Committee and City of Seattle 2008). It allows for a mix of commercial and community spaces. In terms of transportation, the master plan calls for increasing the mode 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.

3.1.16 Destination 2030 Metropolitan Transportation Plan

The *Destination 2030* Metropolitan Transportation Plan (MTP) (PSRC 2001) is the adopted regional long-range transportation plan for the central Puget Sound region. The MTP comprises all transportation projects and programs planned for implementation by 2030 (funded and unfunded). The MTP also describes land use and socioeconomic conditions forecasted for 2030, which form the basis for PSRC's travel demand models (the project's travel demand model, as described in Chapter 2, is an enhanced version of the PSRC model).

The MTP describes the regional transportation system's performance, given implementation of the full complement of projects identified in the plan. It illustrates the cumulative effects of implementing all of the transportation projects and programs planned throughout the region. Conversely, the analysis conducted

for the project's Supplemental Draft EIS presumes only those projects that have secured funding and are presently programmed for implementation by 2030.

3.1.17 Transportation 2040

PSRC prepared *Transportation 2040*, a new transportation plan to address critical issues such as congestion and mobility, the environment, and transportation finance in the central Puget Sound region (PSRC 2010). This plan is an update of the central Puget Sound region's MTP. *Transportation 2040* was adopted by the General Assembly on May 20, 2010.

3.1.18 Sound Transit 2 Plan (2008)

In 2008, voters approved funding for the ST2 Plan (Sound Transit 2008), which identified a major expansion of regional transit services. This program includes extensions of the Link light rail transit (LRT) system by 36 miles, a new streetcar line connecting Capitol Hill and First Hill to downtown Seattle, and significant expansion of Sounder commuter rail and ST Express bus service.

Currently operating between downtown Seattle and the Seattle-Tacoma International (Sea-Tac) Airport, Link LRT will make the connection between Pioneer Square and Capitol Hill in 2016. Under ST2, Link LRT will be extended to Lynnwood in the north, Overlake in the east, and Federal Way in the south. A new streetcar line will connect Pioneer Square in the south end of downtown Seattle with First Hill and Capitol Hill. Sounder commuter rail serving downtown Seattle will be enhanced through expanded operations, extended platforms at stations, and improved access at South King County and Pierce County stations. ST Express bus service will undergo expansion. Potential improvements along the SR 520 corridor were also identified for study under ST2.

ST2 builds on the initial program of regional service development known as *Sound Move*. One of the major elements of Sound Move is construction of LRT to serve the University District. This element, which is currently under construction, is scheduled for completion in 2016. Once complete, LRT service will be provided between downtown Seattle and the University of Washington campus (near Husky Stadium) via Capitol Hill.

The transit investments approved in ST2 are included as part of future conditions.

3.1.19 King County Comprehensive Plan for Public Transportation (2007)

The *Comprehensive Plan for Public Transportation* is the guiding policy document for King County Metro Transit (King County Department of Transportation 2007). It identifies goals, objectives, and policies to fulfill Metro's mission and progress toward an efficient, reliable, and convenient public transportation system of the future. It also lays the foundation for Metro's 10-year *Strategic Plan for Public*

Transportation (2007–2016) (King County Metro 2007a). The plan supports the growth management principles and is consistent with the regional vision identified in *VISION 2040* (PSRC 2009b).

3.1.20 King County Metro Strategic Plan for Public Transportation 2007–2016

The King County *Strategic Plan for Public Transportation 2007–2016* (King County Metro 2009) outlines strategies to achieve the goals and objectives in Metro's long-range *Comprehensive Plan for Public Transportation* (King County Department of Transportation 2007). It builds on previous 6-year transit development plans guiding service and capital investments for Metro's transit, paratransit, and rideshare services. It also guides planning and management efforts.

The Transit Now initiative to expand King County Metro bus transit service by 15 to 20 percent over the next 10 years was approved by King County voters in the general election on November 7, 2006 (King County Ordinance 2006-0285). This initiative is a major component of the current strategic plan.

Elements of Transit Now are expected to supplement the strategies identified through the project's construction transportation planning process. Travelers to downtown Seattle will benefit from Transit Now both during and after project construction. RapidRide is a key feature of Transit Now and will consist of several BRT lines that will be implemented over the next few years. RapidRide is a branded service that will have unique low-floor buses with wider aisles, three doors, and faster fare collection for shorter dwell times and travel times. Service will be frequent, with trips every 10 minutes or less in the peak periods and every 15 minutes or less in the off-peak periods. The A and B Lines are in south and east King County, respectively. The C Line, serving West Seattle, is scheduled to be completed in 2012, although some of the new service will be implemented in 2011. The D Line, serving Ballard-Uptown, is scheduled to be implemented in 2012. The E Line, serving Aurora Avenue N. is scheduled to be implemented in 2013. The C, D, and E Lines will all serve downtown Seattle via the Third Avenue transit spine.

Although BRT corridors and targeted implementation timelines have been identified, the extent and phasing of the program will depend on available funding.

3.1.21 King County Metro Transit Development Plans

The King County Metro *Looking to the Future, Six-Year Transit Development Plan for 2002 to 2007* provided the framework for transit service and capital investments (King County Metro 2004). This plan guided transit development for 2002 through 2007. The 6-year transit plan was used to determine annual transit service growth for the regional travel demand models, including Metro bus service and transportation demand management strategies provided by King County Metro. In November 2007,

the *Strategic Plan for Public Transportation (2007–2016)* (King County Metro 2007a) replaced and updated the *Six-Year Transit Development Plan for 2002 to 2007*.

3.1.22 King County Ferry District – Technical Studies (2009)

The King County Ferry District is assessing the feasibility of adding new routes to its system. The *King County Ferry District Demonstration Project, Technical Studies Implementation, Refined Route Analysis* (King County 2009) documented the assessment of several potential new ferry routes, including those connecting to downtown Seattle. The analysis identified a short list of four routes for potential implementation in 2010. The routes include Ballard (Shilshole) to downtown Seattle (Pier 50) and Des Moines to downtown Seattle.

3.1.23 Evaluation of Joint Operations in the Downtown Seattle Transit Tunnel (2001)

This joint Sound Transit and King County study issued in August 2001 examined the impact of removing Downtown Seattle Transit Tunnel (DSTT) buses during the planned conversion of the DSTT to joint bus and light rail operations (Sound Transit and King County 2001). Of particular note was the impact to downtown streets of distributing tunnel buses to the downtown Seattle arterials for 2 years.

3.1.24 King County Metro Transit Tunnel Conversion Project Performance Reports (2005–2007)

King County Metro, under the "Agreement Regarding the Design, Construction and Operation of the Downtown Seattle Transit Tunnel and Related Facilities," was mandated to provide periodic reports on the performance of the downtown transportation system during the closure of the Downtown Transit Tunnel Conversion Project. These reports have provided updates on a number of performance measures during the closure of the DSTT (King County Metro 2005–2007). The information in these studies has been helpful in the documentation of potential traffic impacts during construction.

3.1.25 Alaskan Way Viaduct Project: Task 1 Report (December 1996)

The Task 1 Report (WSDOT 1996a) provides insights on travel characteristics of trips made on the Alaskan Way Viaduct. The report led to four distinct approaches (Framework Policies) for seeking a course of action. Information from the report provided comparison information for the development of travel forecasts and traffic analysis activities.

3.1.26 Route Development Plan: State Route 99 North/Aurora Avenue North (2003)

The Route Development Plan (RDP) was prepared by WSDOT for the segment of SR 99 (Aurora Avenue N.) between the north end of the Battery Street Tunnel and N. 145th Street (WSDOT 2003b). The RDP is a 25-year plan developed to assist

WSDOT, the City of Seattle, and King County Metro in making informed decisions on future improvements to the SR 99 north corridor.

3.1.27 Washington State Transportation Plan 2007–2026 (November 2006)

The Washington State Transportation Plan 2007–2026 (Washington State Transportation Commission and WSDOT 2006) identifies needs and deficiencies of the state's transportation system, including designated state highways. The plan was the result of a continuous, comprehensive, and coordinated planning and outreach effort with other agencies and the public to identify potential transportation improvements.

3.2 Coordination

FHWA, WSDOT, and City of Seattle are lead agencies for this study. Cooperating agencies include the U.S. Army Corps of Engineers, Federal Transit Administration, King County, and the Port of Seattle.

Ongoing coordination has been conducted as needed with agencies that manage operations or have a stake in particular transportation modes. This includes the following agencies:

- City of Seattle planning, design, and operations staff for multimodal design and operations input.
- King County Metro staff for transit service and transit capital planning.
- The Port of Seattle and BNSF for freight and rail operations.
- Washington State Ferries for vehicle and pedestrian access issues to and from the Seattle Ferry Terminal.

In addition, there has been coordination with major stakeholders, including the stadiums, Seattle Center, the freight community, and BNSF Railway and Union Pacific Railroad (UPRR).

Chapter 4 AFFECTED ENVIRONMENT

This chapter describes existing conditions for transportation systems within the study area. Information is presented regarding current transportation facilities, their use, and their performance. This information establishes an understanding of current conditions and serves as a basis against which projected future conditions for the Bored Tunnel Alternative can be compared.

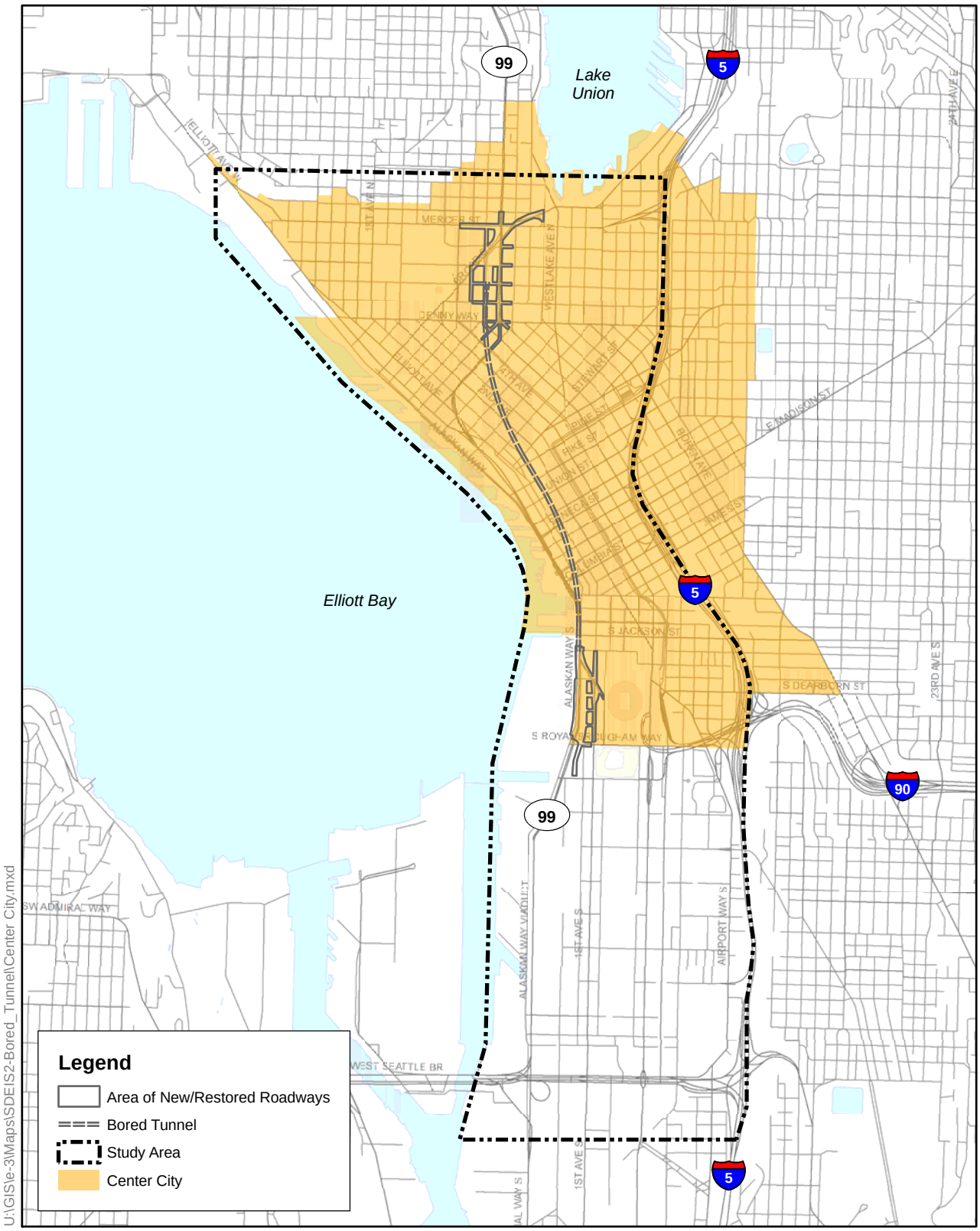
Note that while 2005 is listed as the analysis year, existing conditions as reported in this document have been updated where appropriate to reflect more current conditions. This includes changes in transportation facilities and services since 2005 (e.g., roadways, transit, parking supply), and changes in traffic volumes where appropriate. Data from 2008 are the most current data available. In many cases, 2005 traffic volumes were found to be higher than 2008 volumes due to the recent economic downturn. To reflect more conservative existing conditions, 2005 volumes were retained in those instances.

4.1 Regional Context and Travel Patterns

This report analyzes the effects of the Bored Tunnel Alternative for the SR 99 corridor through downtown Seattle. The project limits extend from S. Atlantic Street in the south to Roy Street in the north.

The transportation study area, which encompasses the project limits on SR 99, as well as nearby transportation facilities that are closely related to or affected by the SR 99 corridor, is shown in Exhibit 2-1. The primary study area (smaller than the full transportation study area) is roughly bordered by I-5 to the east, Puget Sound to the west, Valley Street to the north, and S. Spokane Street to the south. It includes a range of multimodal transportation facilities and service types, including limited-access highways, arterial streets, HOV facilities, transit services and facilities, ferry services and facilities, nonmotorized facilities and routes, and important freight corridors. Modeled changes in travel patterns outside the primary study area were reviewed and deemed to be minor in nature.

The transportation study area is located in a dense urban area that contains a major interstate freeway (I-5), two state routes (SR 99 and SR 519), five interchanges on I-5 (including the I-5 and I-90 interchange), arterial streets (primary, minor, and collector), and local streets. I-5 is a major state and regional facility and carries the majority of regional traffic through the study area, as well as considerable local traffic. Seattle's Center City is also a useful area for reference. Center City represents the core of Seattle, in terms of geography and density of jobs and housing. Center City is shown in relation to the study area in Exhibit 4-1.



Data Source: City of Seattle, 2009.

Exhibit 4-1
Center City

The transportation study area establishes the area for which the transportation performance and impacts of the Bored Tunnel Alternative are assessed. The changes in traffic volumes and patterns were reviewed for a larger area, although the detailed analysis is limited to areas where there are notable changes. The most intensive evaluation of transportation performance and impacts is performed on SR 99 itself. Elsewhere in the study area, assessment focuses on capturing the important impacts and primary operational differences associated with the different analysis conditions. On occasion, information beyond the study area boundaries is provided to provide context for the data being presented.

4.1.1 State Route 99

SR 99 serves important local and regional transportation functions. Within the project area, it provides access to downtown for many parts of the western neighborhoods of the city of Seattle and provides freight access between the SODO and Duwamish and the Ballard/Interbay industrial areas. It is an important alternative route to I-5, the most heavily used highway in the Pacific Northwest. SR 99 also provides an important link to major league sports stadiums at the south end of downtown and access to I-90 for trips coming from northwest Seattle.

Within the study area, the existing viaduct is classified as an "Other Urban Expressway" and is part of the National Highway System within Washington State. The roadway was designed in the 1940s and was open for traffic in 1953. SR 99 is an at-grade facility as it enters downtown Seattle from both the north and south. However, between S. Holgate Street and the Battery Street Tunnel, SR 99 is a double-level viaduct facility with two to four lanes available in each direction and no shoulders. Access between SR 99 and the surface street system is provided by several ramps along the length of the corridor, as well as side-street connections to Aurora Avenue that allow right-on and right-off maneuvers in the South Lake Union area. Access to downtown Seattle is provided at Denny Way and Battery Street to and from the north, and at Seneca and Columbia Streets to and from the south.

4.1.2 Other Freeways, Highways, and Expressways

I-5 is a major Urban Interstate freeway that runs the length of the west coast from the Mexican border south of San Diego, California, to the Canadian border north of Bellingham, Washington. I-5 is the most used and most important highway corridor in the region. Within the study area, I-5 runs north-south just east of downtown. The corridor serves a number of roles, including freight transport, commuting, and longer-distance regional trips.

The roadway varies from two to five travel lanes in each direction, with additional collector-distributor lanes providing access to downtown ramps and accommodating merging traffic from I-90. Only two continuous lanes are provided through downtown in each direction, as other lanes are added or dropped to provide access in downtown.

In addition to the mainline, a reversible set of express lanes provides general-purpose and HOV access to and from downtown and additional capacity for general-purpose through traffic. This facility operates southbound during the morning commute and northbound at other times.

There are five interchanges on I-5 within the study area. The I-5/I-90 interchange is by far the largest and most complicated of the interchanges, providing access to a number of arterials in south downtown, as well as the two interstates. A number of entrance and exit points are located between James and Stewart Streets that directly access downtown Seattle. The interchange at Mercer Street provides the main access point to the northern study area and South Lake Union.

Figure 4-2 shows average congestion by location and time of day on the general-purpose lanes of I-5 on weekdays in 2005. The general congestion pattern reflects the typical commute pattern, with higher congestion inbound to Seattle during the AM peak period and outbound during the PM peak period. The southbound direction additionally experiences restricted movement and minor congestion north of Seattle, which becomes very severe south of Northgate Way and continues into downtown Seattle. In the Center City area, I-5 experiences restricted movement or congestion throughout most of the day, from 6:00 a.m. to 7:00 p.m. in both directions. In the southbound direction, congestion during the AM peak period is not as severe due to the additional capacity provided by the reversible lanes. Without the additional capacity of the reversible lanes in the afternoon, southbound traffic experiences more severe congestion in the PM peak period as compared to the AM peak period. The northbound direction also experiences severe congestion during the AM peak period. In contrast to the southbound direction, the additional capacity of the reversible lanes in the northbound direction during the PM peak period does not prevent the general-purpose lanes from experiencing severe congestion and unstable flow.

4.1.3 Arterial and Local Streets

Nearly all of the downtown area streets are designated as either a principal or minor arterial. Principal arterials make up the majority of the central downtown area between Yesler Way and Denny Way. Principal arterials provide major north-south travelways, with a mixture of minor and collector arterials providing travel opportunities in the east and west directions. In the South Lake Union area, street classifications are a mix of principal, minor, and collector arterials,

with access streets (i.e., non-arterials) filling in the remainder of the grid, particularly east-west streets between Fifth Avenue N. and Fairview Avenue N.

While SR 99 is designated as an "Other Urban Expressway," approximately 42 percent of all users (vehicle and transit) on the viaduct on a daily basis have one trip end in downtown Seattle. Therefore, connections to the downtown street network are of considerable importance.

Recent Improvements to Local Streets

Since the 2006 Supplemental Draft EIS was published, recent improvements have been made to Westlake Avenue. Westlake Avenue and Westlake Avenue N. between Blanchard Street and Valley Street were restriped from one-way traffic to two-way traffic in the fall of 2007 to prepare for the South Lake Union streetcar. Westlake Avenue N. was restriped for two northbound and two southbound travel lanes. New left-turn pockets were added at Valley Street, Mercer Street, Republican Street, and Denny Way, with on-street parking on both sides of Westlake Avenue N. between Republican Street and Denny Way. Ninth Avenue N. was converted to two-way operation between Blanchard Street and Broad Street.

4.1.4 Travel Demand and Traffic Patterns

Vehicle Miles of Travel

VMT, derived from the project's travel demand model, provides a measure of vehicle demand on the four-county regional roadway network. In short, VMT is the sum for each roadway segment of the product of number of vehicles traveling over each segment times the length of each segment. The existing conditions (2005) total for regional daily VMT is estimated to be approximately 84,458,000. During the AM peak period, regional VMT is estimated at about 15,767,000, and PM peak period regional VMT is estimated to be 18,433,000. VMT is shown in Exhibit 4-2.

Vehicle Hours of Travel

VHT provides an estimate of how long travelers spend on the roadway system. Regional daily VHT for existing conditions is estimated to be 2,667,000. During the AM peak period, the VHT is estimated to be 567,000, while for the PM peak period, the estimate is 657,000. VHT is shown in Exhibit 4-2.

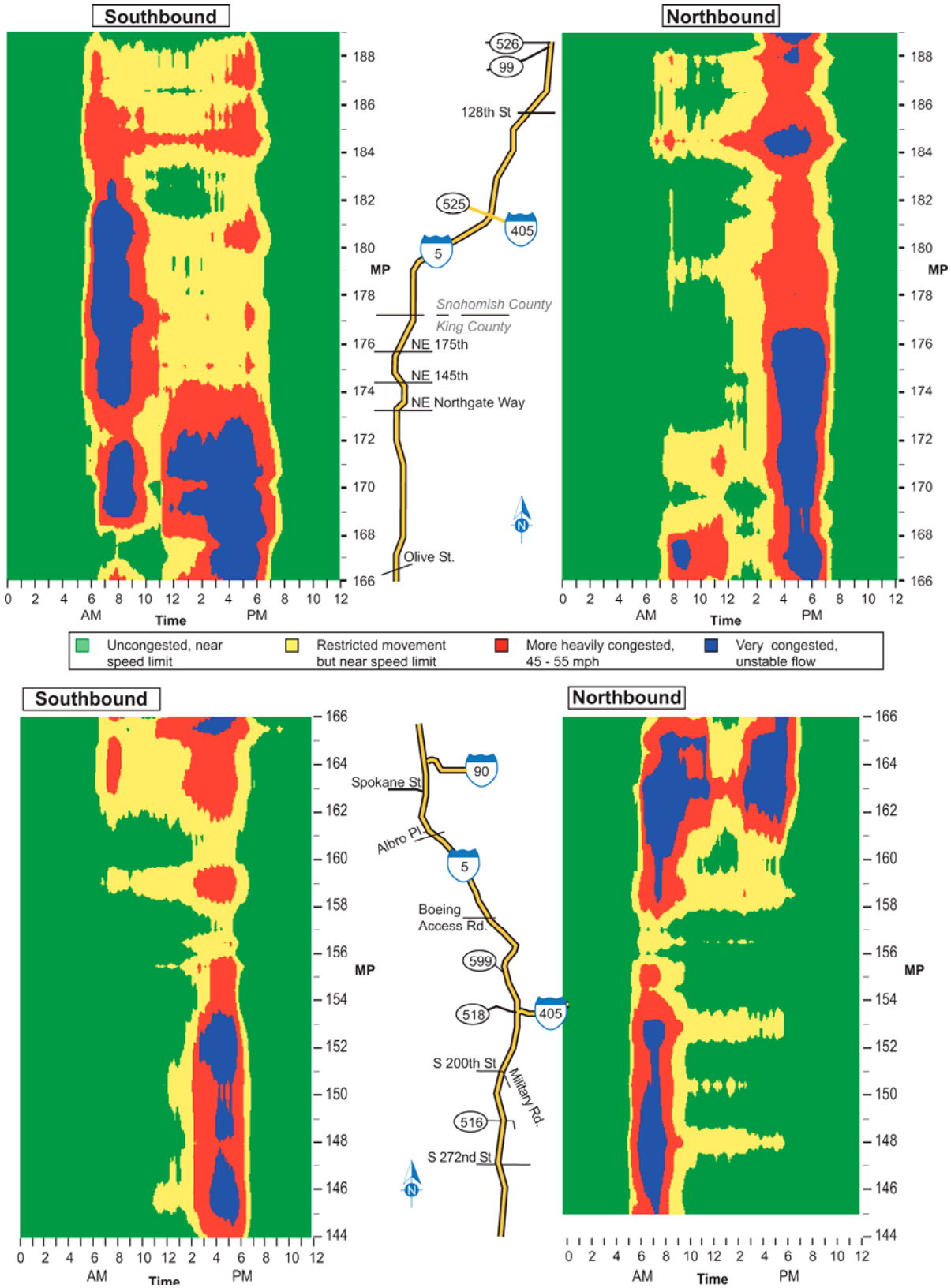


Exhibit 4-2
Average Congestion on I-5

Vehicle Hours of Delay

VHD measures the number of hours of travel on a transportation network that are considered to be operating at less than optimum speeds. VHD is often considered as an indicator of congestion levels. Regional daily VHD for existing conditions is estimated to be 385,000. Regional VHD for the AM peak period is 138,000, while the PM peak period is estimated to be 150,000. VHD is shown in Exhibit 4-3.

Exhibit 4-3. VMT, VHT, and VHD for Center City and Region

Performance Measure	AM Peak	PM Peak	Daily
Seattle's Center City			
VMT	394,200	484,500	2,170,000
VHT	13,700	18,300	71,000
VHD	3,500	5,300	14,400
Four-County Region			
VMT	15,767,300	18,432,500	84,458,000
VHT	566,600	656,800	2,666,700
VHD	137,700	149,900	385,200

Note: The VMT, VHT, and VHD estimates include centroid connectors in the calculations.
VHD = vehicle hours of delay
VHT = vehicle hours of travel
VMT = vehicle miles of travel

Alaskan Way Viaduct (SR 99) Users

SR 99 travels north-south, passing through downtown Seattle on the Alaskan Way Viaduct. I-5 parallels SR 99 through downtown, and together they are the primary north-south corridors in Seattle. SR 99 connects west-side communities such as West Seattle, Burien, Ballard, and Greenwood with each other and downtown. The following sections present data that describe users of SR 99 within the study area for existing conditions (2005 analysis year).

Existing SR 99 Daily Traffic Patterns

Exhibit 4-4 shows the existing daily traffic patterns on SR 99 within the study area. Blue lines indicate trips that use the viaduct (SR 99 between the stadium area and Battery Street Tunnel), while red lines show trips that use SR 99 (Aurora Avenue), but enter or exit north of the viaduct. Arrows indicate locations where traffic enters or exits the corridor, with each arrow representing a major access and egress movement. Because access in the South Lake Union area is provided by many closely spaced cross streets, these movements are shown grouped.

At S. Spokane Street, a combined 33,100 vehicles either enter SR 99 northbound from the West Seattle high bridge or exit the corridor southbound to either the

West Seattle high bridge or the low bridge to Harbor Island. Approximately 53,900 trips combined continue northbound or southbound on SR 99 south of the Spokane Street Viaduct. South of midtown, a total of 24,200 vehicles either exit southbound in the stadium area on the First Avenue S. off-ramp or enter northbound on the corresponding on-ramp. This is the first connection in the greater downtown area, as no other connections are provided between S. Spokane Street and the stadium area.

In downtown, 19,800 vehicles either join southbound SR 99 from the Columbia Street on-ramp or exit northbound via the Seneca Street off-ramp. South of these ramps, the viaduct carries its highest level of traffic: 111,200 vehicles on a typical weekday.

The Elliott/Western ramps are major access points to the corridor. About 34,500 vehicles either enter SR 99 southbound on the Elliott Avenue on-ramp or exit on the Western Avenue off-ramp. These connections provide access to Belltown, Uptown, and points farther north, including Magnolia and the Ballard/ Interbay area via 15th Avenue W.

Some 63,500 vehicles use the Battery Street Tunnel on a typical weekday. They include the remainder of the Aurora Avenue trips, as well as 15,100 additional trips entering or exiting the corridor in the South Lake Union area. A relatively small number of trips enter or exit at the Battery Street Tunnel ramps in the Belltown area. About 6,600 vehicles exit southbound or enter northbound at this location at the south portal of the Battery Street Tunnel.

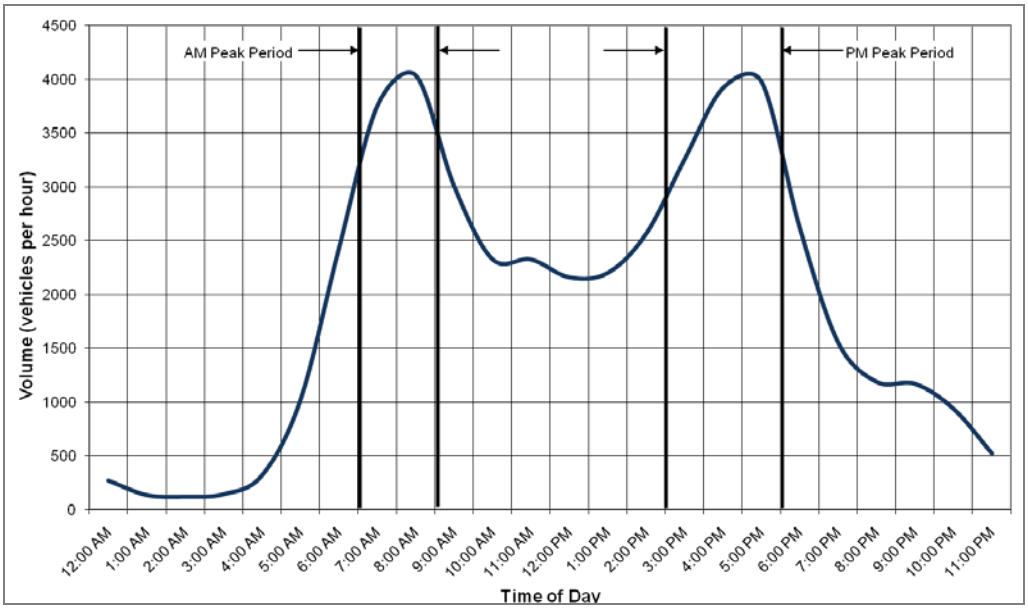
At the north end of the study area (on Aurora Avenue), almost half of trips using SR 99 north of Mercer Street enter or exit the corridor north of the Battery Street Tunnel. Of the 84,800 daily vehicle trips on Aurora Avenue, 36,400 trips enter or exit in the South Lake Union area.

Weekday Traffic Peaking Characteristics

The current 24-hour volume distribution for weekday SR 99 traffic exhibits sharp peaking characteristics. As seen on Exhibits 4-5 and 4-6, traffic volumes in the SR 99 corridor are highest during AM and PM peak commuting hours, at nearly twice the midday volumes in both the northbound and southbound directions.

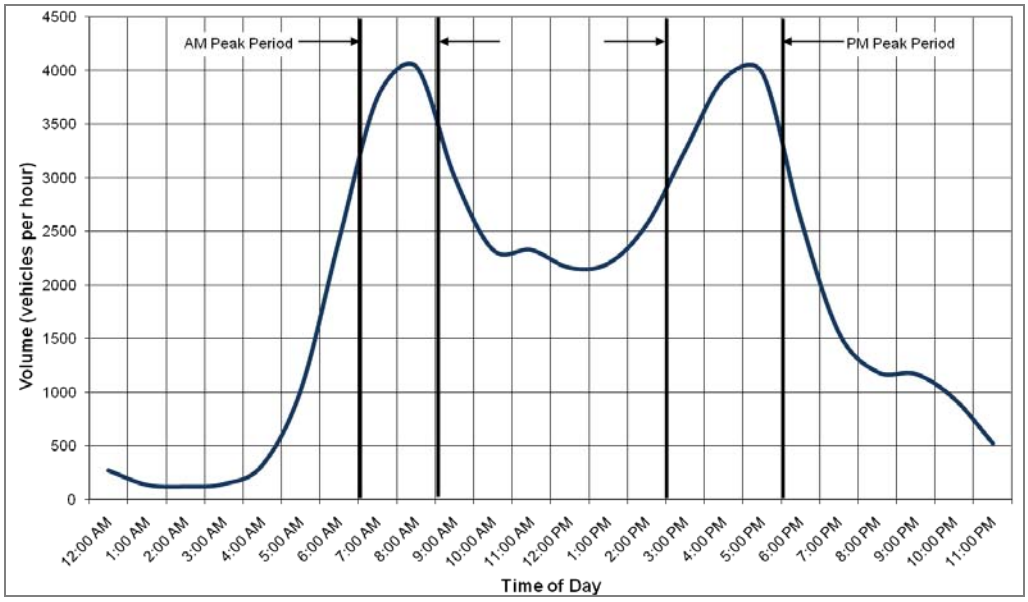
Exhibit 4-4
Existing Daily SR 99 Traffic Patterns

Exhibit 4-5. Existing Peaking Characteristics of Northbound SR 99 Weekday Traffic



Note: Between midtown and Elliott/Western ramps.

Exhibit 4-6. Existing Peaking Characteristics of Southbound SR 99 Weekday Traffic

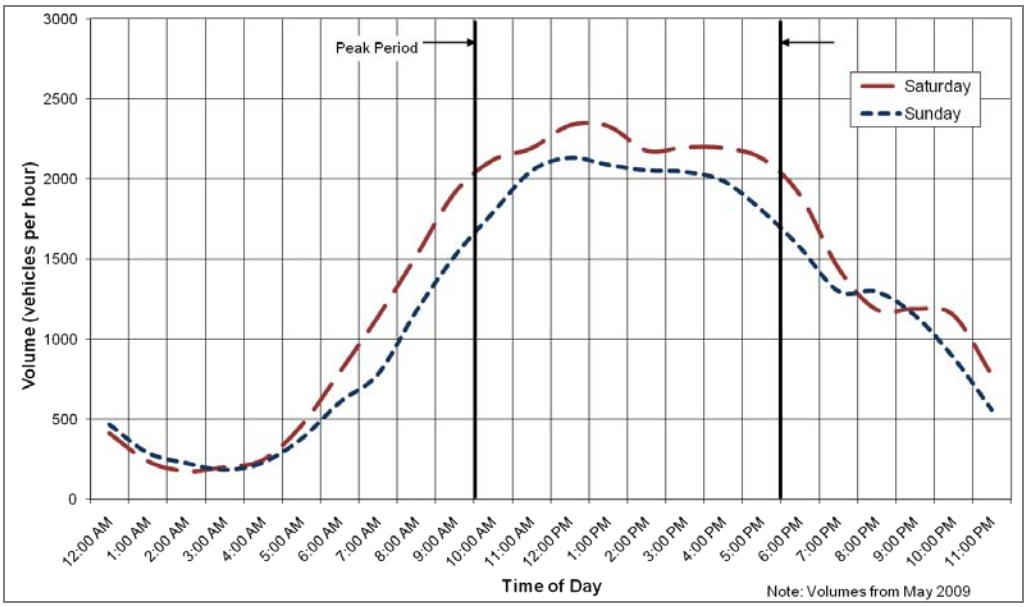


Note: Between midtown and Elliott/Western ramps.

Weekend Traffic Peaking Characteristics

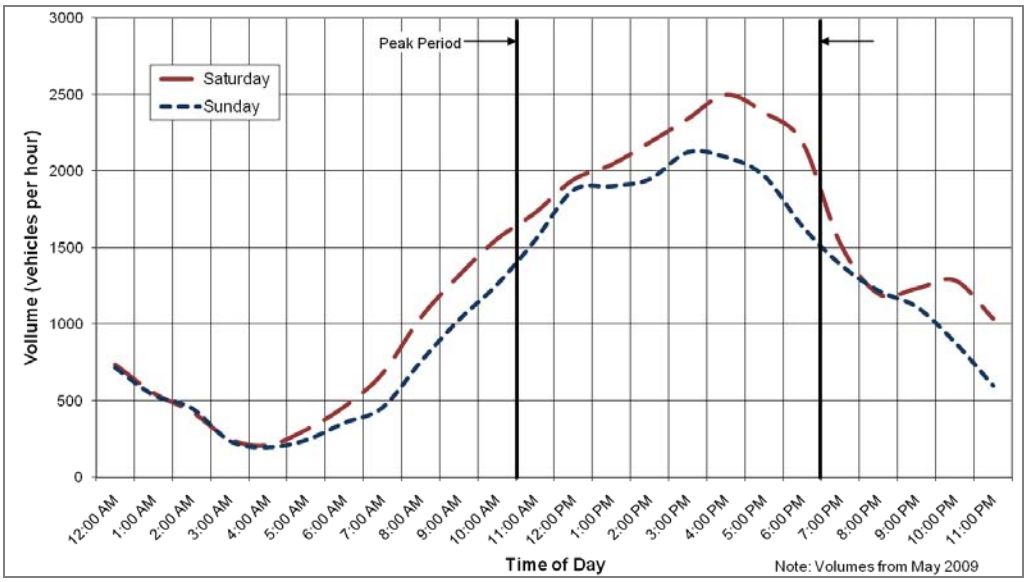
As shown on Exhibits 4-7 and 4-8, weekend traffic patterns differ from weekday patterns in that there are no sharp peaks in hourly distribution, instead there is one relatively flat peak that runs from midmorning to early evening. The peak volumes on the weekends are slightly higher than the midday peak volumes experienced during the week.

Exhibit 4-7. Existing Peaking Characteristics of Northbound SR 99 Weekend Traffic



Note: Between midtown and Elliott/Western ramps.

Exhibit 4-8. Existing Peaking Characteristics of Southbound SR 99 Weekend Traffic



Note: Between midtown and Elliott/Western ramps.

Origins and Destinations of AWV Trips

The origins and destinations of trips using the viaduct were estimated from travel demand model assignments. During the morning commute, the highest concentration of AWV trip origins are in the downtown, Queen Anne, Fremont, Ballard, and West Seattle neighborhoods. Trips beginning as far south as Pierce County and as far north as Snohomish County also use SR 99. These trips primarily originate from westside communities (e.g., Burien, Shoreline, White Center). Destinations are more concentrated, with most trips accessing work and commercial sites downtown, in the Ballard/Fremont/Interbay areas northwest of downtown, and to the south, in the SODO and Duwamish industrial areas. West Seattle, the University of Washington, and Sea-Tac Airport are other primary destinations during the AM peak.

Existing daily trips along the viaduct were also estimated using travel demand model assignments. Approximately 42 percent of trips (including transit) on SR 99 are going to or coming from the CBD of downtown Seattle. Approximately 21 percent of all users travel along SR 99 through the study area but are originating from or destined to nearby locations just north or south of downtown, such as South Lake Union, Uptown, Capitol Hill, or SODO. The remaining trips that use SR 99 are longer-distance through trips, such as trips from Ballard to Burien. Exhibit 4-9 lists the modeled percentage of daily trips beginning or ending in various areas. Trips originating from or destined to areas near downtown do not include trips with a trip end in downtown since those trips are already counted in the downtown Seattle trip total.

Exhibit 4-9. Model-Estimated Existing Daily Person-Trips Using SR 99 Through Seattle's Center City by Trip End Location

	Downtown Seattle	Areas Near Downtown[1]	Longer-Distance Trips
Automobiles	39%	21%	40%
Automobiles + transit	42%	21%	37%

[1] South Lake Union, Uptown, Capitol Hill, or SODO.

Modeled Traffic Volumes

Exhibit 4-10 depicts the modeled distribution of daily traffic on north-south-oriented highways and streets entering the study area from the north and south, as well as in the central downtown Seattle area. I-5 carries the majority of traffic in the study area, approximately 54 percent in the downtown area. SR 99 carries about 21 percent of traffic in the central downtown area, while the local streets in downtown combined carry the remaining 25 percent of daily north-south traffic.

Exhibit 4-10. Existing (2005) Model-Estimated Daily Traffic Distributions

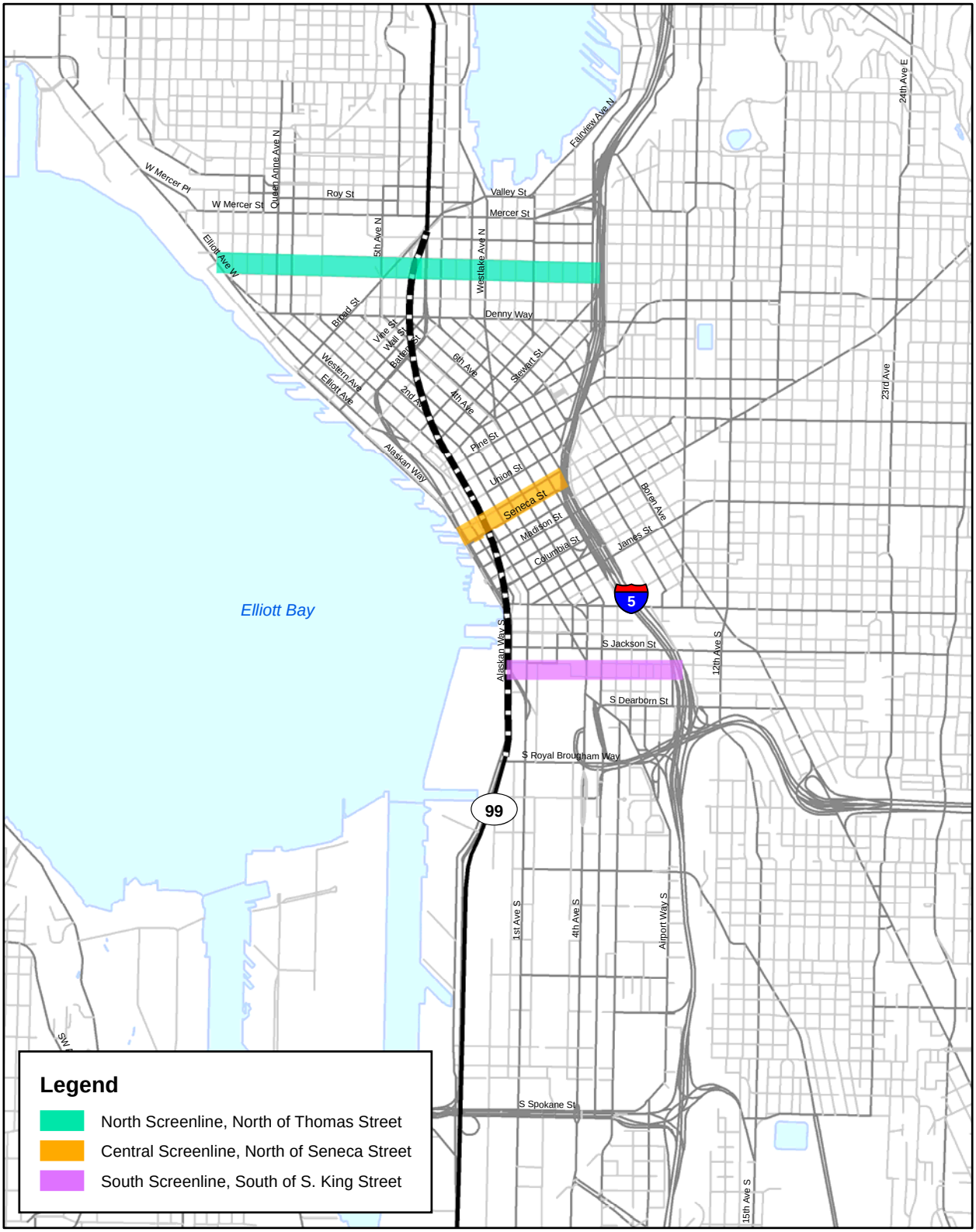
	Existing Daily Traffic (vehicles)
Alaskan Way	
South (south of S. King Street)	10,700
Central (north of Seneca Street)	12,000
North (north of Thomas Street)	N/A
North-South Arterials West of I-5 (Except SR 99)	
South (south of S. King Street)	56,500
Central (north of Seneca Street)	99,100
North (north of Thomas Street)	154,400
SR 99 (AWV)	
South (south of S. King Street)	87,000
Central (north of Seneca Street)	91,400
North (north of Thomas Street)	84,800
I-5 (Main and Reversible/HOV)	
South (south of S. King Street)	284,600
Central (north of Seneca Street)	242,600
North (north of Thomas Street)	266,300
TOTAL VEHICLE TRAFFIC	
South (south of S. King Street)	438,800
Central (north of Seneca Street)	445,100
North (north of Thomas Street)	505,500

AWV = Alaskan Way Viaduct
HOV - high-occupancy vehicle
N/A = not applicable

North of downtown, SR 99's share of traffic decreases relative to local streets or I-5. South of downtown, SR 99 carries about 20 percent of traffic. SR 99 carries more traffic than any single facility in the study area other than I-5.

Modeled Transit Ridership

SR 99 is an important transit corridor that provides access into the downtown area from neighborhoods and communities to the north and south. SR 99 carries a model-estimated 11,900 transit riders per day north of downtown, and 14,300 riders per day south of downtown. Exhibit 4-11 shows the screenline locations, and Exhibit 4-12 indicates transit ridership. About 25 percent of transit riders entering or leaving downtown from the south currently use bus routes that travel on SR 99. Most of the riders are from the West Seattle area.



N

0 2,000 4,000 8,000 Feet

Data Source: City of Seattle, 2009.

Exhibit 4-11
Transit Screenline Locations

Exhibit 4-12. Existing (2005) Model-Estimated Daily Transit Ridership

	Existing Transit Ridership (persons)
Buses on SR 99	
South (south of S. King Street)	14,300
Central (north of Seneca Street)	N/A
North (north of Thomas Street)	11,900
Other North-South Transit (Bus or Rail) Routes in Seattle	
South (south of S. King Street)	42,300
Central (north of Seneca Street)	90,100
North (north of Thomas Street)	77,700
TOTAL Daily Transit Passengers	
South (south of S. King Street)	56,600
Central (north of Seneca Street)	90,100
North (north of Thomas Street)	89,600

N/A = not applicable

Modeled Person-Trips

Analysts use person-trips to measure the number of people, rather than vehicles, that travel on the transportation system. Increased use of transit or carpools can increase the overall number of people conveyed, even if vehicle traffic does not increase.

Exhibit 4-13 summarizes model-estimated daily person-trips at screenline locations. The figures reported include all trip purposes (e.g., work trips, commercial trips, and non-work trips).

Exhibit 4-13. Existing (2005) Model-Estimated Daily Person Throughput at Selected Screenlines

Screenline Location	Total Person Throughput	Transit Riders
South (south of S. King Street)	645,100	56,600
Central (north of Seneca Street)	630,500	90,100
North (north of Thomas Street)	708,400	89,600

4.1.5 Roadway Connectivity and Access

SR 99 is a regional highway facility, though it primarily serves shorter regional trips and intracity trips, whereas parallel route I-5 carries a higher share of longer-distance trips. Between S. Spokane Street and Denny Way, SR 99 is fully access controlled, with traffic able to enter or exit the roadway only at ramps. North of the Battery Street Tunnel, access is provided by right turn on/right turn off movements to side streets.

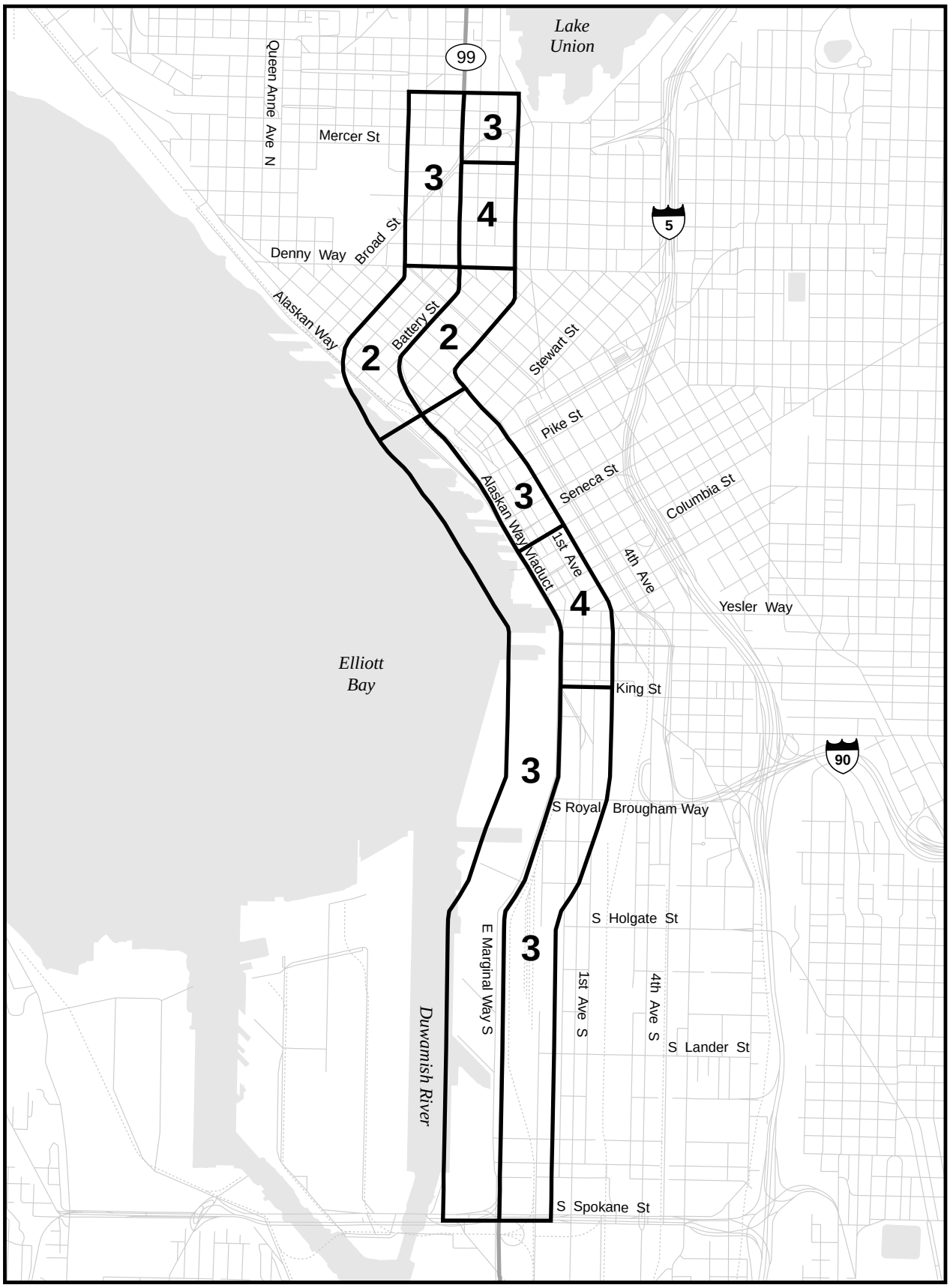
Travel Lanes

Two or more general-purpose travel lanes are provided on SR 99 in each direction through the study area, as depicted in Exhibit 4-14. Northbound, the SR 99 corridor carries three lanes from S. Spokane Street to the First Avenue S. ramps, which join the corridor as a fourth, outside (right) lane. This additional lane continues until just north of the Seneca Street off-ramp (which essentially functions as a drop lane), and helps accommodate traffic entering and exiting SR 99 at these two ramps. Three lanes continue northbound, with the outside (right) lane dropping to the Western Avenue off-ramp. Just prior to entering the tunnel, the Battery Street Tunnel on-ramp (from Western Avenue) merges into the outside (right) mainline lane. Two lanes continue northbound through the Battery Street Tunnel.

Emerging from the Battery Street Tunnel as Aurora Avenue, an arterial with a center median barrier, SR 99's two primary travel lanes are joined by two additional lanes from the Denny Way on-ramp. The outside lane operates essentially as an auxiliary lane, which accommodates slower-moving traffic entering and exiting Aurora Avenue via right-hand turns to connecting cross streets. Thomas Street, Harrison Street, and Republican Street intersect northbound SR 99, and an off-ramp is provided to the Mercer Street/Dexter Avenue N. intersection. Additional arterial connections (right-turns only) occur at Roy Street, Valley Street, and Aloha Street. The outermost northbound lane of Aurora Avenue is regulated by a stop sign at Valley Street, which provides an opportunity for traffic from Valley Street to enter the northbound mainline. Aurora Avenue traffic tends to move out of the right-hand lane to avoid stopping at this location. North of Aloha Street, the outside lane ends and merges on the right side of the roadway to form a three-lane section that continues north to the Aurora Bridge and beyond.

In the southbound direction, three lanes are provided on Aurora Avenue, with one lane dropping to the Denny Way off-ramp just north of the Battery Street Tunnel. As with the northbound direction, the outside lane serves to collect and distribute right-turning vehicles to side streets, and it also provides access to the Denny Way off-ramp. Southbound side-street connections are provided at Aloha, Valley, Roy, Republican, Harrison, and Thomas Streets, while an off-ramp to Broad Street exits the roadway south of Roy Street. Through movements are primarily accommodated in the inside two lanes. Two lanes continue through the Battery Street Tunnel, with the diverging Battery Street Tunnel off-ramp providing a connection to Western Avenue near the south tunnel portal.

The two mainline lanes are joined by a third lane entering from the Elliott Avenue on-ramp, and the three southbound lanes are carried through the corridor.



0 2,500
SCALE IN FEET

N

Exhibit 4-14
SR 99 Lane Configuration

Unlike in the northbound direction, the segment between downtown (the Columbia Street on-ramp) and the stadium area (First Avenue S. off-ramp) does not have an additional lane to accommodate entering and exiting traffic. Instead, the Columbia on-ramp enters the corridor as a left-side merge, while the First Avenue S. off-ramp exits as a diverging left-side ramp. Three mainline lanes continue southbound past S. Spokane Street (following the off-ramp to the West Seattle Bridge), where they merge into two lanes prior to transitioning into E. Marginal Way S., a surface arterial.

Access to SR 99

Exhibit 4-15 summarizes connections currently provided between SR 99 and other roadways. Transit connections are addressed separately in Section 4.4.

Exhibit 4-15. Connections Provided To and From SR 99

	Existing Facility
Stadium Area (South of S. King Street)	
SB SR 99 to Stadium Area	First Avenue off-ramp
Stadium Area to NB SR 99	First Avenue on-ramp
Stadium Area to SB SR 99	Indirect arterial routes to E. Marginal Way or S. Spokane Street
NB SR 99 to Stadium Area	Indirect arterial routes from E. Marginal Way or S. Spokane Street
Downtown Seattle (S. King Street to Stewart Street)	
SB SR 99 to Downtown	Denny Way off-ramp or Battery Street Tunnel off-ramp
Downtown to NB SR 99	Denny Way on-ramp or Battery Street Tunnel on-ramp
Downtown to SB SR 99	Columbia Street on-ramp
NB SR 99 to Downtown	Seneca Street off-ramp
Elliott and Western Corridor (Stewart Street to Denny Way)	
SB SR 99 to Belltown	Denny Way off-ramp or Battery Street Tunnel off-ramp
Belltown to NB SR 99	Denny Way on-ramp or Battery Street Tunnel on-ramp
Belltown to SB SR 99	Elliott Avenue on-ramp
NB SR 99 to Belltown	Western Avenue off-ramp
South Lake Union Area (North of Denny Way)	
SB SR 99 to Uptown	Denny Way off-ramp or Broad Street off-ramp or arterial connections
SB SR 99 to South Lake Union	Denny Way off-ramp or Broad Street off-ramp
Uptown to SB SR 99	Arterial connections
South Lake Union to SB SR 99	Arterial connections
NB SR 99 to Uptown	Mercer Street/Dexter Avenue off-ramp or arterial connections
NB SR 99 to South Lake Union	Mercer Street/Dexter Avenue off-ramp or arterial connections
Uptown to NB SR 99	Arterial connections
South Lake Union to NB SR 99	Denny Way on-ramp or arterial connections

NB = northbound
SB = southbound

To and From West Seattle

At S. Spokane Street, an eastbound to northbound on-ramp provides access from West Seattle, while in the opposing direction a southbound to westbound off-ramp provides for the reciprocal movement to the West Seattle high bridge. The southbound off-ramp also provides access to Harbor Island and the West Seattle low bridge. (These movements are not shown in Exhibit 4-14 because no changes are proposed here).

To and From Stadium Area

Near the stadium area, ramps at First Avenue S. provide access to northbound SR 99 and egress from southbound SR 99. No direct ramp access to SR 99 to or from the south is currently provided in this location.

To and From Downtown

In downtown Seattle, a northbound off-ramp connects to Seneca Street, while an on-ramp from Columbia Street provides access from downtown to southbound SR 99. These midtown ramps provide access to the CBD, including the retail and financial districts, and are also the downtown transit access point for routes traveling to and from the south. No direct access to or from the north is provided in the downtown area.

To and From Elliott and Western Avenues

In the Belltown area, an interchange at Western Avenue and Elliott Avenue provides access to north downtown, Belltown, Pike Place Market, and the north waterfront, as well as access to arterials connecting to Interbay, Uptown, Magnolia, and Ballard. To accommodate substantial traffic flows, the northbound off-ramp to Western Avenue and southbound on-ramp from Elliott Avenue exit and enter the mainline as their own, additional lanes. The Battery Street Tunnel ramps, which comprise the southbound off-ramp and northbound on-ramp at the south tunnel portal, carry a small share of corridor traffic and have issues concerning geometrics and sight-distance.

To and From the South Lake Union and Uptown Area

The Denny Way ramps provide access to north downtown and a variety of locations to the east and west of SR 99 (South Lake Union, Uptown, Seattle Center, Queen Anne, the north waterfront, and Port of Seattle facilities). These ramps are also the transit access point for all routes traveling on the corridor between downtown and points north.

In the South Lake Union/Uptown area, an off-ramp to Mercer Street at Dexter Avenue provides direct access to the South Lake Union neighborhood for northbound traffic, while an exit to Broad Street provides access to Uptown, Seattle Center, and Queen Anne for southbound traffic. Other access in the South

Lake Union/Uptown area is provided by a number of right-on and right-off access points connecting to the local street grid. No left turns or at-grade crossings of SR 99 are allowed. Access at these locations is somewhat limited because the side streets enter at right angles, requiring drivers to accelerate from a stopped position when entering or decelerate considerably before exiting SR 99.

Effects of Design and Operational Constraints

SR 99 was constructed in the 1950s and was designed to conform to different standards than those found on more contemporary facilities. Certain physical and operational characteristics associated with the corridor affect the quality of connections provided in some locations.

The transport of hazardous materials through the Battery Street Tunnel is prohibited at all times and is also prohibited on the viaduct during peak commuting hours. The adjacent Battery Street Tunnel ramps have limited ability to efficiently accommodate traffic due to the location of their connections to the street-grid and geometric limitations.

In the northbound direction, the off-ramp to Seneca Street includes a sharp, 90-degree corner requiring rapid deceleration for traffic leaving the mainline, as well as an abrupt transition to the downtown street-grid at the ramp terminal (First Avenue at Seneca Street). These factors contribute to congestion that slows traffic on the off-ramp and the viaduct itself during peak periods. Southbound, connections from downtown (Columbia Street) and to the stadium area (First Avenue S. off-ramp) are affected by congestion and vehicle weaving conflicts associated with the proximity and left-side location of these ramps.

North of the Battery Street Tunnel, access to and from side-street connections can be difficult, especially during peak periods when mainline traffic flows are heavy.

Speed Limits

Posted speed limits on the SR 99 mainline are shown in Exhibit 4-16.

Exhibit 4-16. Posted Speed Limits on SR 99 (Miles per Hour)

Mainline Segment	Posted Speed Limit (NB and SB)
South of S. Spokane Street	45
S. Spokane Street to First Avenue S. ramps	50 (40 trucks north of S. Holgate Street)
First Avenue S. ramps to Seneca/Columbia ramps	50 (40 trucks)
Seneca/Columbia ramps to Elliott/Western ramps	50 (40 trucks)
Battery Street Tunnel	40 (35 advisory)
North of Denny Way	40

NB = northbound
SB = southbound

4.2 Traffic Operations on SR 99

4.2.1 Alaskan Way Viaduct Mainline and Ramp Volumes

This section describes the AM peak hour, PM peak hour, and daily traffic volume estimates for the existing (2005) SR 99 mainline and ramps. Existing (2005) volume estimates are based on average weekday traffic counts for years 2004 through 2006 for the mainline and ramps.

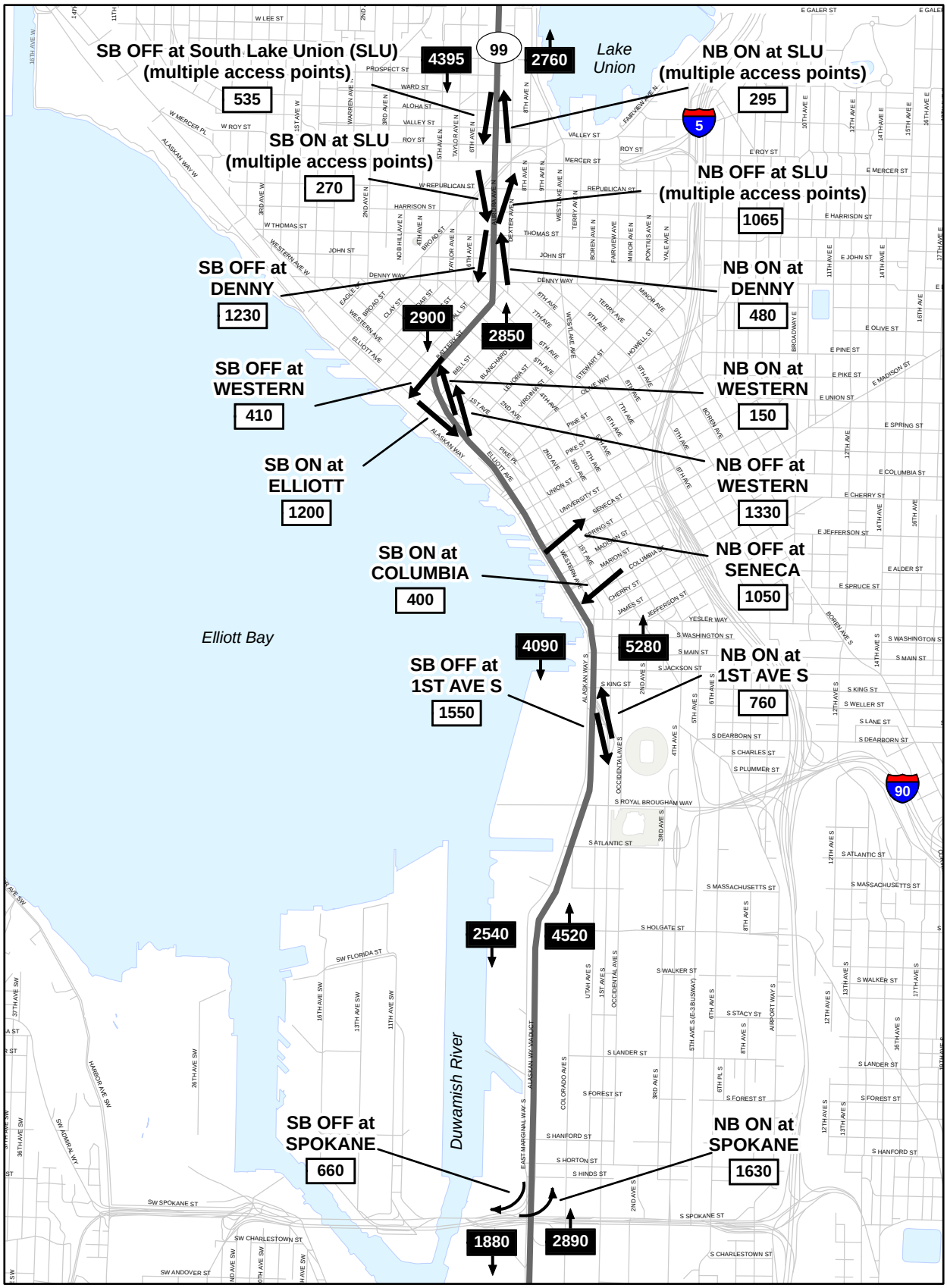
AM Peak Hour

Traffic volumes on the SR 99 corridor are highest during commuting hours. In the morning, peak hour traffic volumes on SR 99 are fairly directional, with heavier volumes entering the central downtown area. At S. Spokane Street, volumes entering northbound from West Seattle (1,630 vehicles) are over double those exiting southbound to West Seattle (660 vehicles). In the stadium area, mainline volumes are considerably higher in the northbound direction (4,520 vehicles) than the southbound direction (2,540 vehicles). The First Avenue S. ramps show similar directionality favoring travel to downtown, with 1,550 vehicles exiting southbound but only 760 vehicles entering northbound. The downtown ramps providing access to and from the south show the same directionality, with substantially more vehicles exiting northbound at Seneca Street (1,050 vehicles) than entering southbound at Columbia Street (400 vehicles).

At the north end of the study area, AM peak hour mainline volumes are higher in the southbound direction, as more vehicles are entering the downtown area (4,395 vehicles) than are leaving it (2,760 vehicles). The ramps to and from the south at Elliott and Western Avenues show slight directionality in the opposite direction, with 1,200 vehicles entering southbound and 1,330 vehicles exiting northbound. The Battery Street Tunnel ramps providing access to and from the north show directionality, with 410 vehicles exiting southbound and only 150 vehicles entering northbound. In the Battery Street Tunnel, the volumes are fairly balanced, with approximately the same volume of northbound vehicles (2,850 vehicles) as southbound vehicles (2,900 vehicles). Southbound off-ramp volumes at Denny Way (1,230 vehicles) substantially exceed those on the northbound on-ramp (480 vehicles). AM peak hour mainline and ramp volumes are shown on Exhibit 4-17.

PM Peak Hour

Similar to the AM, the PM peak hour traffic volumes along SR 99 are directional, with heavier volumes leaving the central downtown area. At S. Spokane Street, volumes exiting southbound to West Seattle (1,890 vehicles) are almost double those entering northbound from West Seattle (1,110 vehicles). The First Avenue S. ramps show similar directionality, with 1,300 vehicles entering northbound but only 950 vehicles exiting southbound. South of downtown and in the stadium area, mainline volumes are



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XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 4-17
AM Peak Hour Mainline and Ramp Volumes - Existing Conditions (2005)

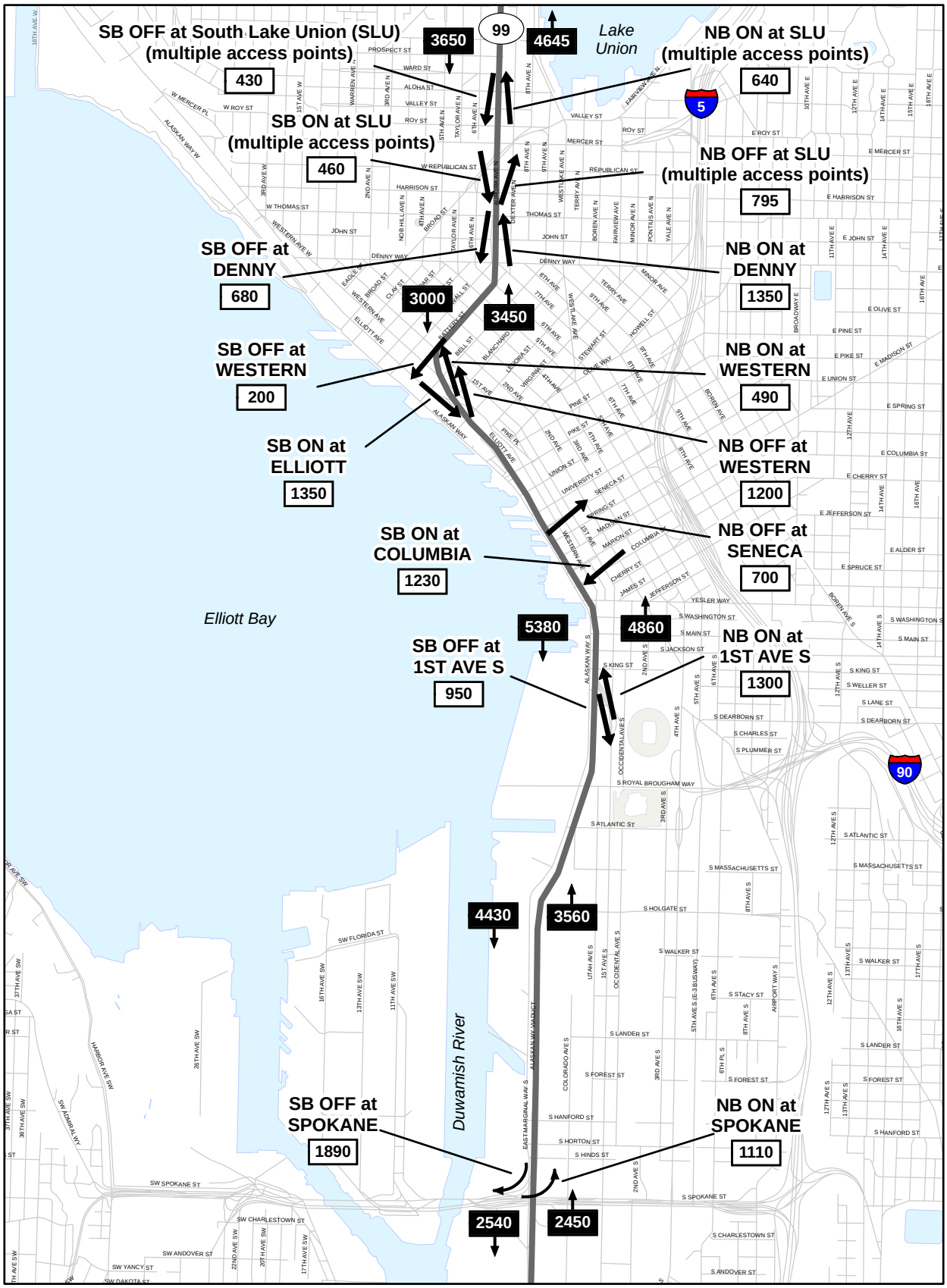
considerably higher in the southbound direction (4,430 vehicles) than the northbound direction (3,560 vehicles). The downtown ramps providing access to and from the south show the same directionality with almost twice as many vehicles entering southbound at Columbia Street (1,230 vehicles) than exiting northbound at Seneca Street (700 vehicles).

At the north end of the study area, PM peak hour mainline volumes are higher in the northbound direction, as more vehicles are leaving the downtown area (4,645 vehicles) than are entering it (3,650 vehicles). The Elliott/Western ramps to and from the south again show slight directionality in the opposite direction, with 1,350 vehicles entering southbound and 1,200 vehicles exiting northbound. The Battery Street Tunnel ramps providing access to and from the north also show directionality, with 490 vehicles entering northbound but only 200 vehicles exiting southbound. In the Battery Street Tunnel, the volume of northbound vehicles (3,450 vehicles) exceeds the volume of southbound vehicles (3,000 vehicles). Northbound on-ramp volumes at Denny Way (1,350 vehicles) exceed those on the southbound off-ramp (680 vehicles). PM peak hour mainline and ramp volumes are shown on Exhibit 4-18.

Daily

As expected, daily traffic volumes along SR 99 are generally balanced by direction, with similar volumes leaving the central downtown area as entering. At S. Spokane Street, volumes exiting southbound to West Seattle (16,200 vehicles) are similar to those entering northbound from West Seattle (16,900 vehicles). South of downtown and in the stadium area, mainline volumes are somewhat higher in the northbound direction (44,800 vehicles) than the southbound direction (42,200 vehicles). The First Avenue S. ramps are relatively balanced, with 11,300 vehicles entering northbound and 12,900 vehicles exiting southbound. The downtown ramps providing access to and from the south are similarly balanced, with 9,700 vehicles entering southbound at Columbia Street and 10,100 vehicles exiting northbound at Seneca Street.

Traffic volumes using the Elliott/Western ramps to and from the south are relatively balanced, with 17,100 vehicles entering southbound and 17,400 vehicles exiting northbound. These ramps have the highest volume of all ramps in the project area. The ramps at the south end of the Battery Street Tunnel providing access to and from the north are not as balanced as other ramps in the study area on a daily basis, with 3,900 vehicles entering northbound but only 2,700 vehicles exiting southbound. In the Battery Street Tunnel, the volume of northbound vehicles (32,500 vehicles) is similar to the volume of southbound vehicles (31,000 vehicles). At the north end of the study area, the majority of exiting southbound vehicles exit at Denny Way (11,200 vehicles), with a little more than half that many exiting at the multiple access points in South Lake Union (6,200 vehicles). Similarly, about 11,100 northbound vehicles enter SR 99 at Denny Way, with 7,900 vehicles entering at other South Lake Union access points. Daily mainline and ramp volumes are shown on Exhibit 4-19.



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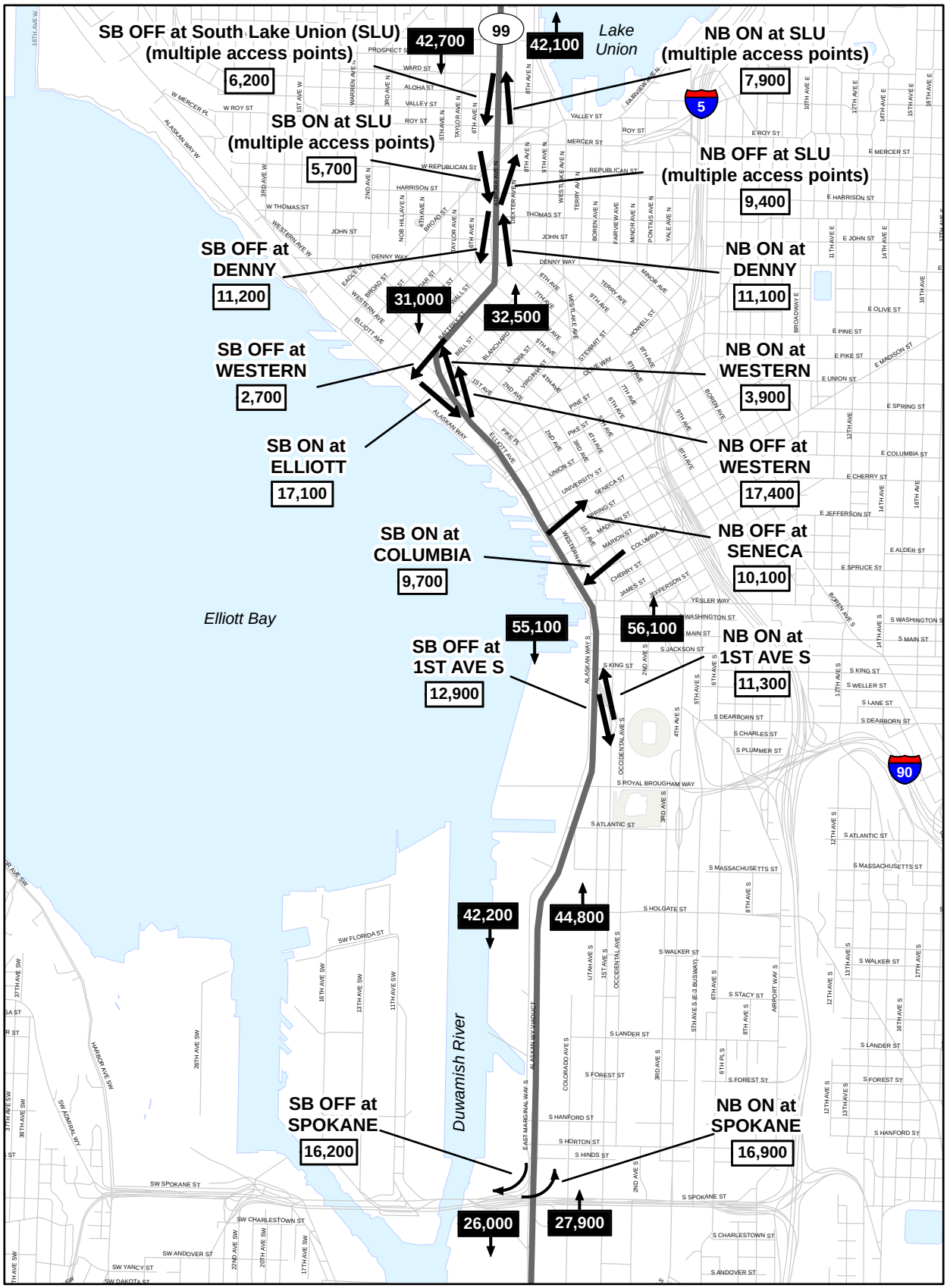
XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 4-18
PM Peak Hour Mainline and Ramp Volumes - Existing Conditions (2005)



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XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Note: Totals may not sum due to rounding.

Exhibit 4-19
Daily Mainline and Ramp Volumes - Existing Conditions (2005)

4.2.2 SR 99 Mainline Level of Service

Mainline traffic conditions and ramp interactions for the SR 99 corridor in terms of AM and PM peak hour volumes, travel speeds, and LOS are presented in this section for key mainline segments and related on- and off-ramps.

For limited-access facilities such as SR 99, the LOS ranges published in the HCM are measured by traffic density and scaled to reflect conditions where free-flow (uncongested) speeds are 55 miles per hour (mph) or higher. Because free-flow (and posted) travel speeds on SR 99 are generally slower than 55 mph, vehicles tend to travel closer together, resulting in higher traffic densities and poorer LOS when measured against the most-applicable published standards. The LOS results reported for SR 99 segments are therefore likely to overstate the level of congestion on SR 99 to a modest degree.

Mainline traffic performance was modeled using VISSIM simulation software. Current AM and PM peak hour LOS estimates for mainline segments were calculated based on simulation results for the SR 99 mainline and are presented in Exhibits 4-20 to 4-23.

Exhibit 4-20. Existing (2005) AM Peak Hour Southbound SR 99 Segment LOS

Southbound – AM Segment	Existing LOS
South Corridor	
First Avenue S. off to S. Spokane Street	B
Midtown	
Columbia on to First Avenue S. off (SB)	F
Elliott on to Columbia on (SB)	D
Battery Street Tunnel	E
North Corridor	
North of Battery Street Tunnel	F

LOS = level of service
SB = southbound

Exhibit 4-21. Existing (2005) AM Peak Hour Northbound SR 99 Segment LOS

Northbound – AM Segment	Existing LOS
South Corridor	
S. Spokane Street to First Avenue S.	E
Midtown	
First Avenue S. on to Seneca off (NB)	F
Seneca off to Western off (NB)	F
Battery Street Tunnel	E
North Corridor	
North of Battery Street Tunnel	C

LOS = level of service
NB = northbound

Exhibit 4-22. Existing (2005) PM Peak Hour Southbound SR 99 Segment LOS

Southbound – PM Segment	Existing LOS
South Corridor	
First Avenue S. off to S. Spokane Street	E
Midtown	
Columbia on to First Avenue S. off (SB)	F
Elliott on to Columbia on (SB)	D
Battery Street Tunnel	F
North Corridor	
North of Battery Street Tunnel	E

LOS = level of service
SB = southbound

Exhibit 4-23. Existing (2005) PM Peak Hour Northbound SR 99 Segment LOS

Northbound – PM Segment	Existing LOS
South Corridor	
S. Spokane Street to First Avenue S.	D
Midtown	
First Avenue S. on to Seneca off (NB)	F
Seneca off to Western off (NB)	F
Battery Street Tunnel	F
North Corridor	
North of Battery Street Tunnel	E

LOS = level of service
NB = northbound

In the south end of the corridor, mainline traffic operates at LOS B in the southbound direction and at LOS E in the northbound direction in the AM peak hour. During the PM peak hour, mainline traffic in the south end operates at LOS E in the southbound direction and at LOS D in the northbound direction. Mainline traffic through midtown operates at LOS D to LOS F in both directions in the AM and PM peak hours. Particular areas of congestion include southbound between the Columbia Street left-side on-ramp merge and the left-side off-ramp to First Avenue S. Conditions here are exacerbated by the lack of an acceleration lane for the merge, as well as traffic weaving into the lane to exit at First Avenue S. Northbound traffic also experiences significant congestion due to backups from both the Seneca Street and Western Avenue off-ramps. These backups are due to a combination of substandard geometry on the Seneca Street off-ramp, as well as queues emanating from the ramp termini intersections. Through the Battery Street Tunnel, operations are at or over capacity (i.e., LOS E or F) in both directions in both peak hours. North of the Battery Street Tunnel, operations are at LOS E to LOS F, except for northbound traffic during the AM peak hour, which operates at LOS C.

4.2.3 SR 99 Mainline Speeds

The existing 2005 AM and PM peak hour segment speed results are shown in Exhibits 4-24 to 4-27. These may be compared with the posted speed limits to gauge the level of delay experienced on the mainline during the AM and PM peak hours. The posted speed on the northbound mainline is 50 mph between S. Spokane Street and Virginia Street. Between Virginia Street and Bell Street, the posted speed drops to 45 mph. North of Bell Street, the posted speed drops again to 40 mph and remains 40 mph to the north end of the project area. The southbound posted speed limit is 40 mph from the north end of the project area to Bell Street and 45 mph from Bell Street to Virginia Street, where it increases to 50 mph.

Exhibit 4-24. Existing (2005) AM Peak Hour Southbound SR 99 Segment Speeds

Southbound – AM Segment	Posted Speed (mph)	Existing Speed (mph)
South Corridor		
First Avenue S. off to S. Spokane Street	50	48
Midtown		
Columbia on to First Avenue S. off (SB)	50	29
Elliott on to Columbia on (SB)	50	46
Battery Street Tunnel	40	33
North Corridor		
North of Battery Street Tunnel	40	30

SB = southbound

Exhibit 4-25. Existing (2005) AM Peak Hour Northbound SR 99 Segment Speeds

Northbound – AM Segment	Posted Speed (mph)	Existing Speed (mph)
South Corridor		
S. Spokane Street to First Avenue S.	50	39
Midtown		
First Avenue S. on to Seneca off (NB)	50	26
Seneca off to Western off (NB)	50	18
Battery Street Tunnel	40	33
North Corridor		
North of Battery Street Tunnel	40	33

NB = northbound

Exhibit 4-26. Existing (2005) PM Peak Hour Southbound SR 99 Segment Speeds

Southbound – PM Segment	Posted Speed (mph)	Existing Speed (mph)
South Corridor		
First Avenue S. off to S. Spokane Street	50	42
Midtown		
Columbia on to First Avenue S. off (SB)	50	33
Elliott on to Columbia on (SB)	50	46
Battery Street Tunnel	40	33
North Corridor		
North of Battery Street Tunnel	40	32

SB = southbound

Exhibit 4-27. Existing (2005) PM Peak Hour Northbound SR 99 Segment Speeds

Northbound – PM Segment	Posted Speed (mph)	Existing Speed (mph)
South Corridor		
S. Spokane Street to First Avenue S.	50	44
Midtown		
First Avenue S. on to Seneca off (NB)	50	32
Seneca off to Western off (NB)	50	24
Battery Street Tunnel	40	33
North Corridor		
North of Battery Street Tunnel	40	32

NB = northbound

Existing estimated speeds on SR 99 in the AM peak hour range from 29 to 48 mph in the southbound direction and 18 to 39 mph in the northbound direction. In the PM peak hour, speeds range from 32 to 46 mph in the southbound direction and 24 to 44 mph in the northbound direction. The segments with the slowest speeds generally correspond to the locations with lower LOS, i.e., the Battery Street Tunnel and midtown sections.

4.3 Traffic Operations at Key Arterial Intersections

Traffic operations at signalized intersections in the study area were assessed to determine intersection LOS and average vehicle delay. The intersection analysis results are presented for three geographic areas:

- South
- Central
- North

Intersections included in the tables below represent those intersections that meet one or more of the following criteria:

- Intersection was evaluated in the 2004 Draft EIS or 2006 Supplemental Draft EIS.
- Intersection operates at LOS E or worse in either peak period.
- Intersection is new for 2015 Existing Viaduct or the 2015 Project.

4.3.1 South

Exhibit 4-28 presents traffic operations for intersections in the south area. Intersections in the south generally operate at favorable LOS, though the intersection of S. Royal Brougham Way at Fourth Avenue S. is estimated to operate at LOS E in the PM peak hour. The intersection at First Avenue S. and S. Atlantic Street also has been observed to experience relatively long queues, particularly in the PM peak hour.

Exhibit 4-28. Existing (2005) AM and PM Peak Hour Detailed Traffic Operations, South

Street	Cross Street	AM Peak Hour		PM Peak Hour	
		LOS	Avg. Vehicle Delay	LOS	Avg. Vehicle Delay
Alaskan Way S.	S. Royal Brougham Way	B	18	C	30
Alaskan Way S.	S. Jackson Street	A	2	A	3
Alaskan Way S.	S. Main Street	A	3	A	4
Alaskan Way S.	Ferry Holding	A	4	A	6
Alaskan Way	Yesler Way	B	19	C	22
First Avenue S.	S. Atlantic Street	D	46	D	43
First Avenue S.	S. Royal Brougham Way	D	48	C	31
First Avenue S.	S. Jackson Street	B	15	C	24
First Avenue S.	S. Main Street	A	4	A	10
First Avenue	Yesler Way	B	18	C	27
Fourth Avenue S.	S. Royal Brougham Way	D	43	E	68

Note: Delay is reported in seconds.
LOS = level of service

4.3.2 Central

Exhibit 4-29 shows AM and PM peak hour signalized intersection LOS and delay for selected signalized intersections in the waterfront, downtown, and Belltown areas. Most intersections operate at LOS C or better during both peak periods. Exceptions include Elliott Avenue at Bell Street (LOS E during the PM peak) and Elliott Avenue at Broad Street (LOS D during the AM peak). First Avenue at Columbia Street, which provides access to the southbound SR 99 on-ramp from downtown, is particularly congested during the PM peak hour, with LOS F and an average vehicle delay of 148 seconds. Though the intersection of Alaskan Way

at Marion Street operates at LOS B overall during both peaks, short durations with higher levels of congestion occur while traffic exits Colman Dock.

Exhibit 4-29. Existing (2005) AM and PM Peak Hour Detailed Traffic Operations, Central

Street	Cross Street	AM Peak Hour		PM Peak Hour	
		LOS	Avg. Vehicle Delay	LOS	Avg. Vehicle Delay
Alaskan Way	Columbia Street	A	7	A	5
Alaskan Way	Marion Street	B	12	B	15
Alaskan Way	Madison Street	A	10	B	15
Elliott Avenue	Bell Street	A	5	E	62
Elliott Avenue	Wall Street	B	17	C	30
Elliott Avenue	Broad Street	D	36	C	30
Western Avenue	Marion Street	B	17	B	16
Western Avenue	Madison Street	B	17	B	20
Western Avenue	Spring Street	B	11	B	12
Western Avenue	Battery Street/SR 99 off-ramp	B	16	A	10
Western Avenue	Wall Street	B	18	C	27
Western Avenue	Broad Street	B	16	C	22
First Avenue	Columbia Street	C	32	F	148
First Avenue	Marion Street	B	11	B	14
First Avenue	Madison Street	A	9	A	9
First Avenue	Spring Street	A	7	B	13
First Avenue	Seneca Street	B	19	B	17
Second Avenue	Columbia Street	B	16	C	24
Second Avenue	Marion Street	B	15	B	20
Second Avenue	Battery Street	B	19	A	9

Note: Delay is reported in seconds.
LOS = level of service

4.3.3 North

In the Uptown and South Lake Union area, congestion is most evident at three key intersections where major traffic streams converge. As shown in Exhibit 4-30, Fairview Avenue N. at Mercer Street, which provides access to I-5 for the South Lake Union area, operates at LOS F conditions with an average vehicle delay of over 200 seconds in the PM peak hour, and LOS E during the AM peak. During the PM peak hour, several intersections operate at LOS E, including Dexter Avenue N. at Mercer Street and Westlake Avenue N. at Mercer Street.

Exhibit 4-30. Existing (2005) AM and PM Peak Hour Detailed Traffic Operations, North

Street	Cross Street	AM Peak Hour		PM Peak Hour	
		LOS	Avg. Vehicle Delay	LOS	Avg. Vehicle Delay
Western Avenue W.	Elliott Avenue W.	A	9	D	39
Mercer Place	Roy Street	B	17	C	23
First Avenue	Denny Way	C	33	C	33
Second Avenue	Denny Way	A	9	A	8
Broad Street	Denny Way	C	27	C	26
Fifth Avenue	Denny Way	B	17	B	15
Fifth Avenue N.	Broad Street	D	37	C	33
Fifth Avenue N.	Harrison Street	C	26	C	31
Fifth Avenue N.	Mercer Street	C	21	D	36
Fifth Avenue N.	Roy Street	C	35	B	18
Sixth Avenue	Battery Street	A	10	B	18
Sixth Avenue	Denny Way	B	12	B	17
Aurora Avenue SB	Denny Way	B	14	B	20
Aurora Avenue NB	Denny Way	C	25	D	55
Dexter Avenue N.	Denny Way	B	20	C	24
Dexter Avenue N.	Harrison Street	C	25	A	10
Dexter Avenue N.	Mercer Street	D	40	E	63
Dexter Avenue N.	Roy Street	A	7	A	8
Dexter Avenue N.	Aloha Street	B	17	B	11
Ninth Avenue N.	Mercer Street	C	22	C	27
Westlake Avenue N.	Mercer Street	A	8	E	67
Fairview Avenue N.	I-5 off-ramp	E	67	C	23
Fairview Avenue N./ I-5 ramp	Mercer Street	E	68	F	211

Note: Delay is reported in seconds.
LOS = level of service
NB = northbound
SB = southbound

4.4 Transit Services and Facilities

Downtown Seattle is served by a network of bus and rail services as well as vanpool programs. Complementing these services are HOV and transit facilities, including the DSTT and arterial treatments for bus services. Transit services and facilities are further described in the following sections.

4.4.1 Transit Services

Transit service to downtown Seattle is provided by six cooperating agencies using several modes, supplemented by large vanpool programs. Sound Transit,

Community Transit, Pierce Transit, and King County Metro operate transit service to downtown Seattle. In addition, the Washington State Ferries and the King County Ferry District serve Colman Dock with several routes on Puget Sound, providing service to Kitsap County and Vashon Island. Below is a description of transit services within the study area.

Bus Service

King County Metro operates a network of bus routes, over half of which are oriented to downtown Seattle. It uses electric trolleybus, hybrid, and diesel buses in downtown Seattle. The Seattle Monorail connects the Westlake Center and Seattle Center via an elevated guideway on Fifth Avenue; it is operated by a private contractor for the City of Seattle. Community Transit operates a network of I-5-based routes between Snohomish County and downtown Seattle; some of the routes, including all the all-day two-way routes, are funded by Sound Transit. Pierce Transit operates Sound Transit bus service between Pierce County and downtown Seattle via I-5.

Sound Transit Central Link Light Rail Service

Service on the Central Link light rail line began in July 2009 with the 13.9-mile segment between Westlake Station and the Tukwila International Boulevard Station. The 1.7-mile extension to Sea-Tac Airport opened in December 2009. This line serves downtown Seattle, the SODO industrial area, the Beacon Hill and Rainier Valley neighborhoods, Tukwila, and Sea-Tac Airport. Along the SODO Busway and inside the DSTT, joint bus and rail operations are provided. The light rail trains provide two-way service for 20 hours each day, operating every 7.5 minutes during peak periods and every 10 to 15 minutes during midday and evening hours. Each two-car train has the capacity for 400 riders (148 seats and standing room). Until Link is extended farther north, trains will continue to use a stub-end tunnel track under Pine Street to turn back.

Sounder Commuter Rail Service

Sound Transit's commuter rail line, Sounder, serves riders north and south of Seattle. The south line is located between the Tacoma Dome Station and the King Street Station in downtown Seattle and serves Tacoma, Puyallup, Sumner, Auburn, Kent, and Tukwila. The north line travels between Everett and the King Street Station, with stations in Edmonds and Mukilteo. Park-and-ride facilities in these communities further extend the effective reach of the service.

As of September 2009, Sounder operates seven commuter trips between Tacoma and Seattle during the morning (into Seattle) and evening (out of Seattle) commute periods on weekdays. Also, two reverse commute trips operate in the morning (out of Seattle) and evening (into Seattle). Four Sounder trains operate between Everett and Seattle each day as well, traveling to Seattle in the morning, and

returning to Everett in the evening. Occasional weekend or extra trips for special events such as Mariners, Seahawks, and Sounders games also operate.

Commuter rail service at the King Street Station connects with several other forms of transportation, including the waterfront shuttle bus route and stations in the DSTT. The Weller Street pedestrian bridge provides a direct connection between Sounder service at the King Street Station and the DSTT at the International District Station.

South Lake Union Streetcar

The South Lake Union streetcar began operation in 2007. It provides access to businesses, residences, and activities in South Lake Union and the northern part of the CBD. The streetcar line runs from Fairview Avenue N./Yale Avenue N. to Westlake Avenue/Olive Way and includes 11 stops. The streetcars operate every 15 minutes 7 days a week. The service connects with several other public transportation modes, including King County Metro and Sound Transit buses, Link LRT (Westlake Station), and the Monorail.

Waterfront Streetcar

Construction of the Olympic Sculpture Park and the resulting displacement of the vehicle storage and maintenance facility led to the indefinite suspension of the George Benson Line Waterfront Streetcar service in 2008. King County Metro has provided replacement service with fare-free bus service on the Route 99 Waterfront Streetcar Line. The bus routing and stop locations do not exactly duplicate those of the waterfront streetcar; however, Route 99 serves the same neighborhoods—the waterfront, Pioneer Square, and Chinatown/International District.

Vanpools

Transit agencies in the region all operate vanpool programs, with King County Metro's being the nation's largest public vanpool program. The program provides the vans, maintains the vehicles, and provides ride-matching service and support. In turn, Metro collects a fee from vanpool users to cover expenses. As of September 2009, approximately 40 of Metro's active vanpools served destinations in downtown Seattle, including the CBD, First Hill, South Lake Union, and SODO. A substantial volume of vanpools access downtown Seattle via Washington State Ferry routes serving Bainbridge Island and Bremerton. Vanpools depend on the regional highway system for mobility, including HOV facilities where available, as well as local streets. Community Transit and Pierce Transit also have vanpools.

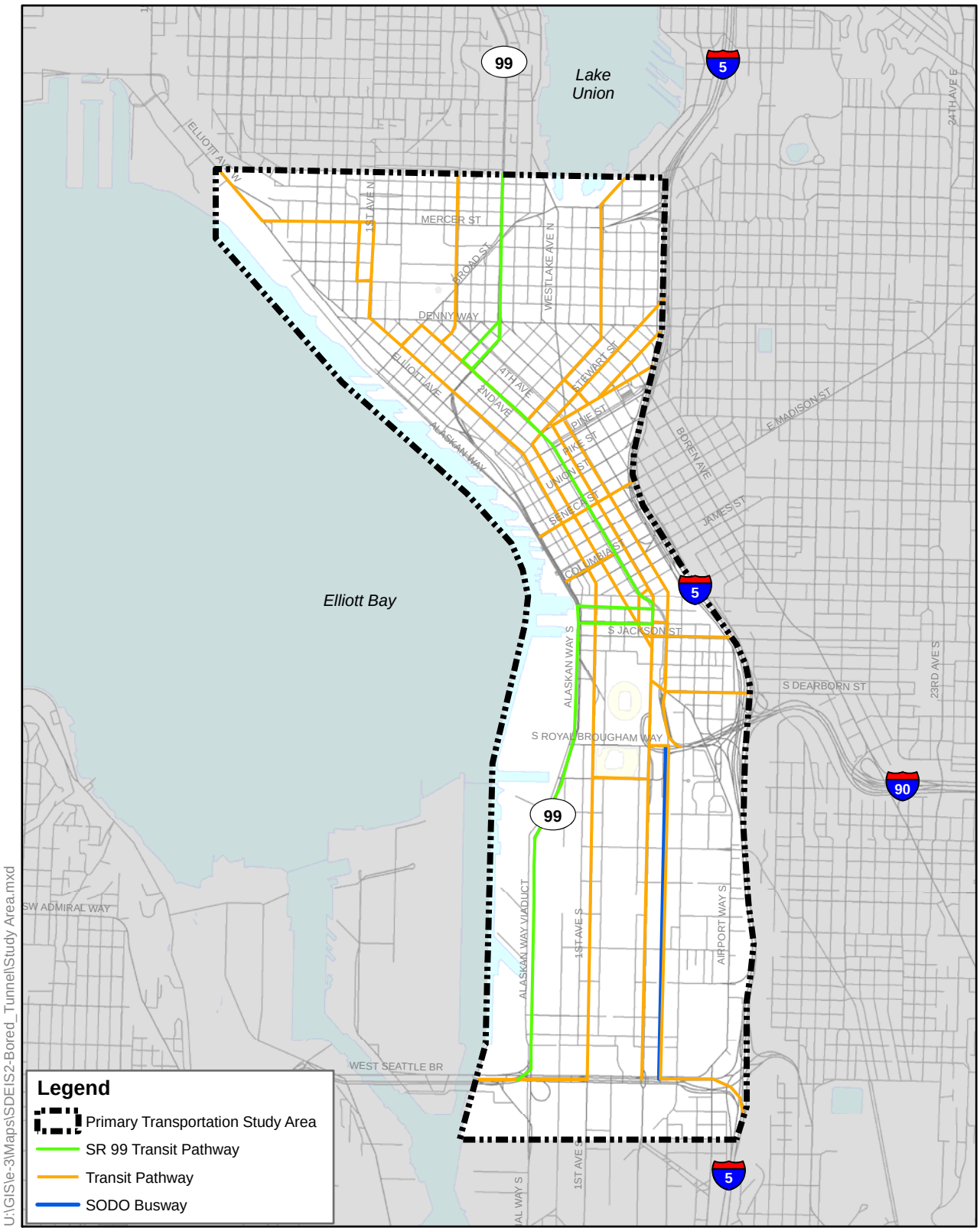
4.4.2 HOV and Transit Facilities

Most of the transit service to downtown Seattle is assigned to pathways that are broadly defined corridors consisting of transit routes that serve common markets. This allows transit priority measures to be implemented and is more easily understood by riders. It also improves the effective service frequency of bus routes.

King County Metro collaborated with the City of Seattle and the other transit agencies to develop a *Draft Transit Blueprint* (King Country Metro 2006) in order to coordinate transit pathways in downtown Seattle. The Transit Blueprint helped set the stage for major planned construction projects such as the Alaskan Way Viaduct and Seawall Replacement Program. The Transit Blueprint is an evolving document, adjusted to various changes of the roadway network configuration. Implementation of the transit priority treatments in the Transit Blueprint has been incremental and continues to evolve as needs arise. The transit pathways within the study area for the Bored Tunnel Alternative are shown in Exhibit 4-31.

All transit pathways in downtown Seattle could be affected by changes in traffic volumes and congestion caused by the Alaskan Way Viaduct Replacement Project. The key north-south facilities in central downtown Seattle that could be affected by this project are as follows:

- Aurora Avenue N. (SR 99) with ramps at Denny Way, serves north-central Seattle. See Exhibit 4-31 for transit routes directly using SR 99.
- SR 99 between Spokane Street and the Seneca/Columbia ramps, serve West Seattle, Delridge, Vashon, White Center, and Burien. See Exhibit 4-31 for transit routes directly using SR 99.
- Dexter Avenue N. and First Avenue S. are transit corridors parallel to SR 99.
- Second and Fourth Avenues operate as a couplet used by routes serving Pierce County, South King County, Snohomish County, and East King County.
- Third Avenue is the downtown Seattle transit spine and is used by many bus lines, including Aurora Avenue N. routes and the electric trolleybus routes serving southeast Seattle, Queen Anne, and Eastlake. Transit volumes on Third Avenue increased in 2005 when the DSTT was closed while it was being retrofitted for joint bus-rail operation, and transit flow on downtown streets was given higher priority. The City of Seattle allowed the increased priority to continue after the DSTT was reopened in 2007. The plan is for the RapidRide BRT C, D, and E Lines to use Third Avenue as they are implemented in the next few years.



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0 2,000 4,000 Feet

Data Source: City of Seattle, 2009.

Exhibit 4-31
Transit Pathways

- Fifth Avenue is used by routes serving east King County and Snohomish County.
- Elliott and Western Avenue are used by transit to serve Magnolia and Ballard to downtown Seattle.

Transit vehicles use several facilities that give priority to transit and/or HOVs in the study area. Exhibit 4-32 summarizes transit priority facilities in the study area.

Exhibit 4-32. Existing Transit and HOV Facilities and Treatments

Arterial	Limits		Description
I-5 express lanes	Northgate	South downtown	Reversible lanes
Restricted reversible ramps	Pike Street, Union Street, and Cherry Street	I-5 reversible lanes	HOV-only ramps from and to the I-5 reversible lanes
I-90	Mount Baker	Airport Way	Reversible lanes
Downtown Seattle Transit Tunnel and ramps	I-5 and Olive Way	I-90 and SODO Busway	Transit tunnel and five stations
E3/SODO Busway	S. Spokane Street	International District Station	Busway with four bus stations and two rail stations
Second Avenue and Second Avenue Extension S.	Stewart Street	S. Jackson Street	Peak period transit lane
Second Avenue Extension S.	North of S. Jackson Street	S. Jackson Street	Transit signal queue bypass
Fourth Avenue	Jefferson Street	Olive Way	Peak period transit lane
Fourth Avenue S.	S. Jackson Street	S. Main Street	Transit lane and passenger waiting island
Fifth Avenue	S. Jackson Street	S. Washington Street	Contraflow transit lane
Fifth Avenue	Terrace Street	Cherry Street	Contraflow transit lane
Prefontaine Place S.	S. Washington Street	Yesler Way	Peak period transit lane
Seneca Street	Second Avenue	Third Avenue	Transit-only lane
Pine Street	Fourth Avenue	Third Avenue	Transit lane and passenger waiting island
S.W. Spokane Street	West of Chelan ramp	Chelan West Seattle Freeway ramp	Bus-only lane
Fairview Avenue N.	North of Valley Street	Valley Street	Southbound left-turn lane for transit
15th and Elliott Avenues W.	W. Armor Street	W. Harrison Street	Peak period BAT lanes
First Avenue	Warren Place	Denny Way	Peak period transit lane
Third Avenue	Stewart Street	Yesler Way	Transit priority corridor: general-purpose traffic restricted in peak periods
Third Avenue	Stewart Street	Yesler Way	Bus bulbs (1990)
Third Avenue	Stewart Street	Cedar Street	Bus bulbs (2010)
Alaskan Way	North of Yesler Way	Yesler Way	Northbound left-turn lane for transit

Exhibit 4-32. Existing Transit and HOV Facilities and Treatments (continued)

Arterial	Limits		Description
Howell Street	Ninth Avenue	Ninth Avenue	Transit queue jump
Stewart Street	Eastlake Avenue	Fifth Avenue	Peak period transit lane
Olive Way	Fourth Avenue	Eighth Avenue	Peak period transit lane
I-5 S.	South 356th Street	I-90	Inside HOV lanes

BAT = business access and transit
HOV = high-occupancy vehicle

Limited Access Highway HOV Facilities

Within the study area, HOV lanes are provided on I-5 on the reversible express lanes, and on the southbound I-5 mainline starting at the Mercer Street on-ramp. The reversible lanes carry both general-purpose and HOV traffic separately from the I-5 mainline and operate southbound on weekday mornings and northbound on weekday afternoons and weekends. Outside the study area, HOV lanes are provided on I-5 north of Northgate and south of I-90, SR 509 south of S. Michigan Street, I-90 leading to/from the International District, and SR 520, westbound only approaching the bridge on the Eastside.

Arterial Transit Facilities

Several transit facilities are provided on arterials in the study area. As listed in Exhibit 4-32, most of these facilities aid transit movement in downtown Seattle. South of the study area, there are HOV lanes on SR 99 on the First Avenue South Bridge. The Seneca Street transit lane takes SR 99 service to Third Avenue from the Seneca Street ramp. The Third Avenue priority measures and bus bulbs discussed below both aid bus routes serving Aurora Avenue.

New Arterial Transit Facilities

Several new arterial HOV and transit-only facilities have been added to the local street system since 2006, when the initial King County Metro *Draft Transit Blueprint* was published. These facilities were associated with the closure of the DSTT while it was being retrofitted for joint bus-rail operation between September 2005 and September 2007. In 2009 and 2010, transit lanes were provided on Olive Way and Stewart Street, and bus bulbs are being constructed on Third Avenue in Belltown.

SODO Busway

In addition to on-street arterial transit facilities, the transit-only SODO Busway on Fifth Avenue S., between S. Spokane Street and the south portal of the DSTT near S. Dearborn Street, carries Link LRT and bus routes serving south King and Pierce Counties. There are two Link stations and four bus stations on the SODO Busway.

Third Avenue Transit Spine

Third Avenue, between Yesler Way and Stewart Street, operates as a transit priority corridor during peak commuter hours (6:00 to 9:00 a.m. and 3:00 to 6:30 p.m.). During those periods, other vehicles have limited circulation and business access. General-purpose vehicles have unlimited access to Third Avenue between the hours of 9:00 a.m. and 3:00 p.m. during evenings and weekends. The restrictions allow increased transit capacity through skip-stop operation and more curb space devoted to bus stops.

Business Access and Transit Lanes

King County Metro and the City of Seattle are working together on roadway and traffic signal improvements to improve the speed and reliability of buses, including bus bulbs, business access and transit (BAT) lanes, transit signal priority, and queue jumps. In 2008, curb lanes along 15th and Elliott Avenues W. in both directions between West Harrison and Armour Streets were converted to BAT lanes. These BAT lanes will be used by the RapidRide D Line (scheduled to be implemented in 2012). BAT lanes already have been provided on segments of Aurora Avenue N. (SR 99) in Shoreline and Seattle.

4.4.3 Transit Connectivity and Coverage

As described in Section 4.4.2, several transit pathways in the Transit Blueprint include SR 99 or adjacent arterials. These pathways would be directly affected by the Project. In 2012, transit service in West Seattle, Uptown, and Ballard may be restructured due to implementation of RapidRide BRT. The extent of route restructuring will be highly dependent on the availability of funding and a public review process that will begin in mid-2011.

Exhibit 4-33 shows various King County Metro routes in the study area as well as the associated market areas they serve. Also shown are the associated SR 99 access ramps and north-south corridors on which the routes operate. Further information about access to the AWV and Aurora Avenue N. is provided in the following sections.

Alaskan Way Viaduct Access

Several King County Metro routes use the AWV to and from destinations in West Seattle and communities south of Seattle via the midtown ramps at Columbia and Seneca Streets. Most trips and passengers are on all-day two-way routes 54, 55, 120, and 125. These ramps are also used by one-way peak-only routes 21X, 54X, 56X, 113, 121, and 122. The majority of inbound routes (e.g., routes 21X, 54, 55, 54x, 56X, and 120) access Third Avenue from the AWV via Seneca Street. About half as many inbound routes (e.g., routes 113, 121, 122, and 125) turn left onto First Avenue instead of Third Avenue. Most outbound routes approach the

Columbia Street ramp from Third Avenue via Columbia Street, and others approach from First Avenue. In 2012, the RapidRide C Line is expected to replace routes 54 and 55. There may be other routes revised at that time.

Exhibit 4-33. Transit Routes Using SR 99 or Adjacent Arterials

Routes	Market Areas	SR 99 Ramp	North-South Avenues
South			
54, 54X, 55	West Seattle	Midtown	Third
56X	Admiral	Midtown	Several
113, 120, 125	White Center, Delridge	Midtown	Third
121, 122	Burien and SR 509	Midtown	Third
15-18 and 21-22-56	Ballard and West Seattle via First Avenue S. in SODO	None	First
37	Alki	None	Second/Third
132	First Avenue S. in SODO	None	Second/Fourth
116, 118, 119	Vashon Island and Fauntleroy Terminal	None	Third
North			
5, 5X, 358X	North Seattle	Denny Way	Third
16	Wallingford	Fifth Avenue N.	Third
26X	Wallingford	Denny Way	Third
28X	Broadview, east Ballard	Denny Way	Third
3, 4	East Queen Anne via Taylor Avenue N.	Fifth Avenue N.	Third

Aurora Avenue Access

Several King County Metro routes use Aurora Avenue N. (SR 99) via the Denny Way ramps to and from the north. Most trips and passengers are on all-day two-way routes 5 and 358X; the ramps are also used by one-way peak-only routes 5X, 26X, and 28X. Northbound routes 5, 5X, and 358X were recently revised to use Battery Street instead of Dexter Avenue N. and John Street to reach SR 99. Two-way all-day routes 26 and 28 serve Dexter Avenue N. adjacent to SR 99. Those routes are through-routed with routes 23 and 124, extending to south Seattle via Fourth Avenue S. in SODO. In 2013, the RapidRide E Line is expected to replace Route 358X. There may be other routes revised in 2012 and 2013 when the RapidRide D and E Lines are implemented.

4.5 Freight

The state of Washington classifies freight routes according to the number of tons of cargo carried on them. Truck freight tonnage on interstate highways and state routes and City of Seattle streets is shown in Exhibit 4-34.

Exhibit 4-34. Freight Tonnage Designations for State and City Routes

Route Name	Segment	Classification
I-5	Oregon border to Canadian border	T-1
I-5	Express lanes	T-1
I-90	Fourth Avenue to Idaho border	T-1
SR 99	E. Marginal Way to Elliott Avenue (includes AWV)	T-1
SR 99	Elliott Avenue to Green Lake Way (includes Battery Street Tunnel)	T-2
SR 519	I-90 to Seattle Ferry Terminal	T-2
West Seattle Bridge	Delridge Way S.W. to I-5/Columbian Way	T-1
First Avenue S.	E. Marginal Way S. to Alaskan Way Viaduct ramps	T-2
Fourth Avenue	Yesler Way to Denny Way	T-2
Fourth Avenue S.	E. Marginal Way S. to Airport Way S.	T-1
Fourth Avenue S.	Airport Way S. to Yesler Way	T-2
Alaskan Way S.	E. Marginal Way S. to S. Royal Brougham Way	T-2
Alaskan Way S.	Columbia Street to Broad Street	T-2
Elliott Avenue W.	W. Denny Way to W. Galer Street	T-2

Source: WSDOT 2008.
Classification: T-1 = more than 10 million tons per year; T-2 = 4 million to 10 million tons per year.

The City of Seattle designates all arterials as truck streets. Certain arterials are classified as Major Truck Streets. By policy, the City will "monitor these streets and make operating, design, access and/or service changes, as well as capital investments, to accommodate trucks and to preserve and improve commercial transportation mobility and access on these major truck streets." Seattle's Major Truck Streets within the study area are shown on Exhibit 4-35. SR 99 is designated as a Major Truck Street, as are all or portions of 15th Avenue W., Elliott Avenue, Western Avenue, Broad Street, Mercer Street, Valley Street, Westlake Avenue N., E. Marginal Way, First Avenue S., Fourth Avenue S., Sixth Avenue S., Airport Way S., S. Spokane Street, S. Lander Street, S. Royal Brougham Way, and Alaskan Way.

4.5.1 Weight and Height Restrictions

Following the Nisqually earthquake of February 2001, weight restrictions were established to prohibit vehicles over 10,000 pounds from using the two left lanes on each level of the viaduct. In addition, vehicles with a gross weight of more

than 105,500 pounds are prohibited. These restrictions remain in place today. These restrictions also limit the use of the southbound exit to First Avenue S., which is located on the left side of the roadway. Further deterioration of the viaduct structure could lead to further restrictions.

There is a height restriction of 14 feet 6 inches for the Battery Street Tunnel.

4.5.2 Alternative Truck Routes in the AWV Corridor

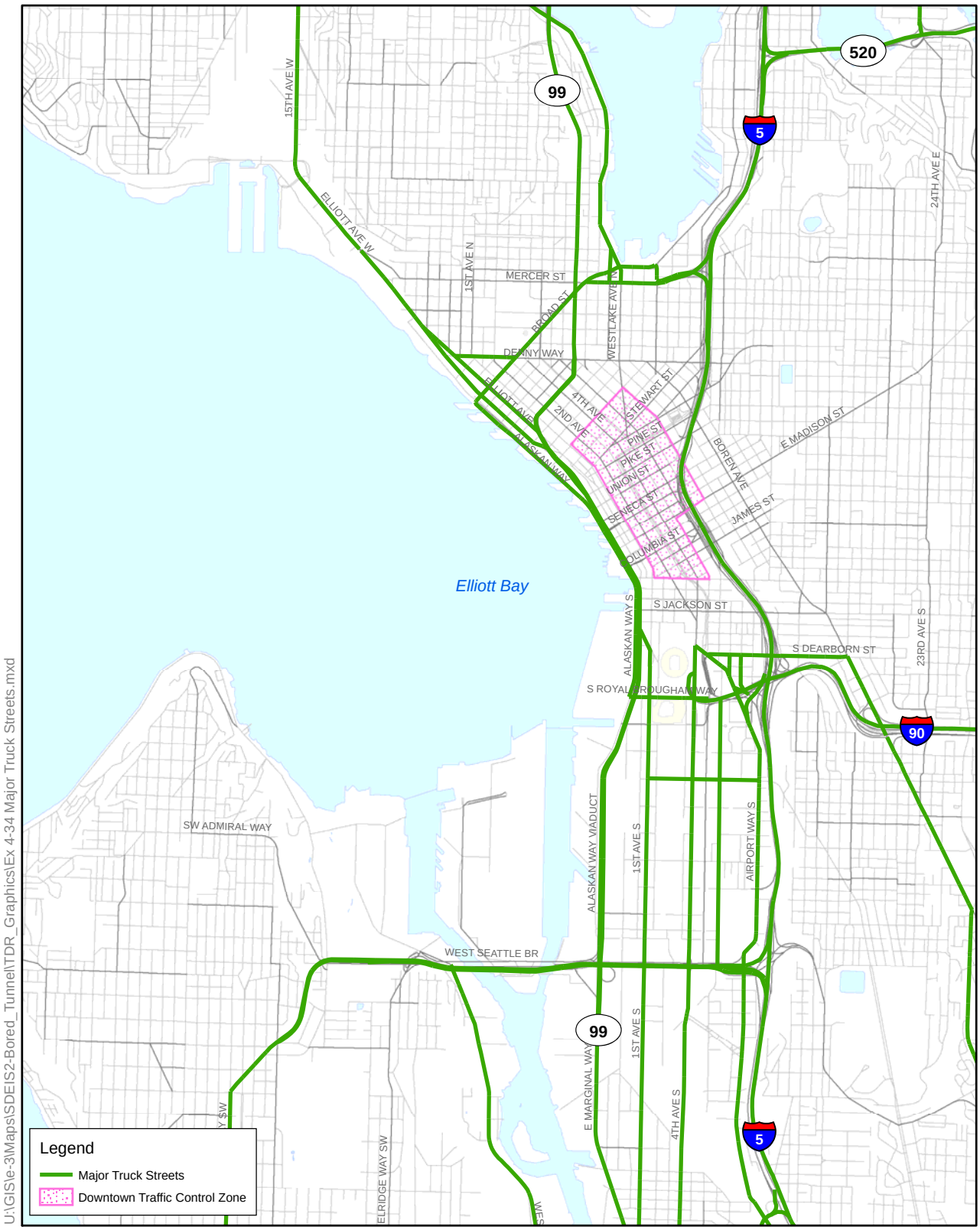
In case of congestion, incidents, or lack of access to the Alaskan Way Viaduct, different trucks have different alternative route options. Oversized or overweight trucks are limited to the designated over-legal route along Alaskan Way and Broad Street, or I-5. For the downtown traffic control zone, trucks 30 feet or larger are precluded from using city streets in the downtown area north of S. King Street from 7:00 a.m. to 7:00 p.m. daily, and therefore have the same options to use Alaskan Way and Broad Street or I-5 instead of the viaduct. The downtown traffic control zone is shown on Exhibit 4-35. Trucks shorter than 30 feet have the option to divert to city streets to get through the downtown area.

The Alaskan Way surface street presents some challenges as a truck route. Alaskan Way contains a number of unsignalized intersections along the central waterfront, where pedestrians can cross at random, rather than be controlled by traffic signals. This can increase the unpredictability of pedestrian crossings, and increase delay for all vehicles. The at-grade rail crossing at Alaskan Way and Broad Street also increases delay for trucks when they must wait for crossing trains.

I-5 also has some drawbacks as a truck route for truckers passing through downtown Seattle. Heavy congestion persists for much of the day. Frequent on- and off-ramps and heavy entering and exiting volumes make truck travel particularly difficult and require trucks to change lanes frequently to make a through movement. The Port of Seattle has identified access to and from the north on I-5 as an important issue resulting from congestion and poor operations on I-5 through downtown Seattle.

4.5.3 Freight and Commercial Traffic

Truck volume and classification counts were collected by video along the SR 99 corridor in downtown Seattle in June 2006. As shown on Exhibit 4-36, an estimated 3,720 trucks use the Alaskan Way Viaduct through central Seattle on a typical weekday. This includes single-unit trucks, combination trucks, and tanker (liquid transport) trucks. Garbage trucks and concrete trucks were classified as single-unit trucks.



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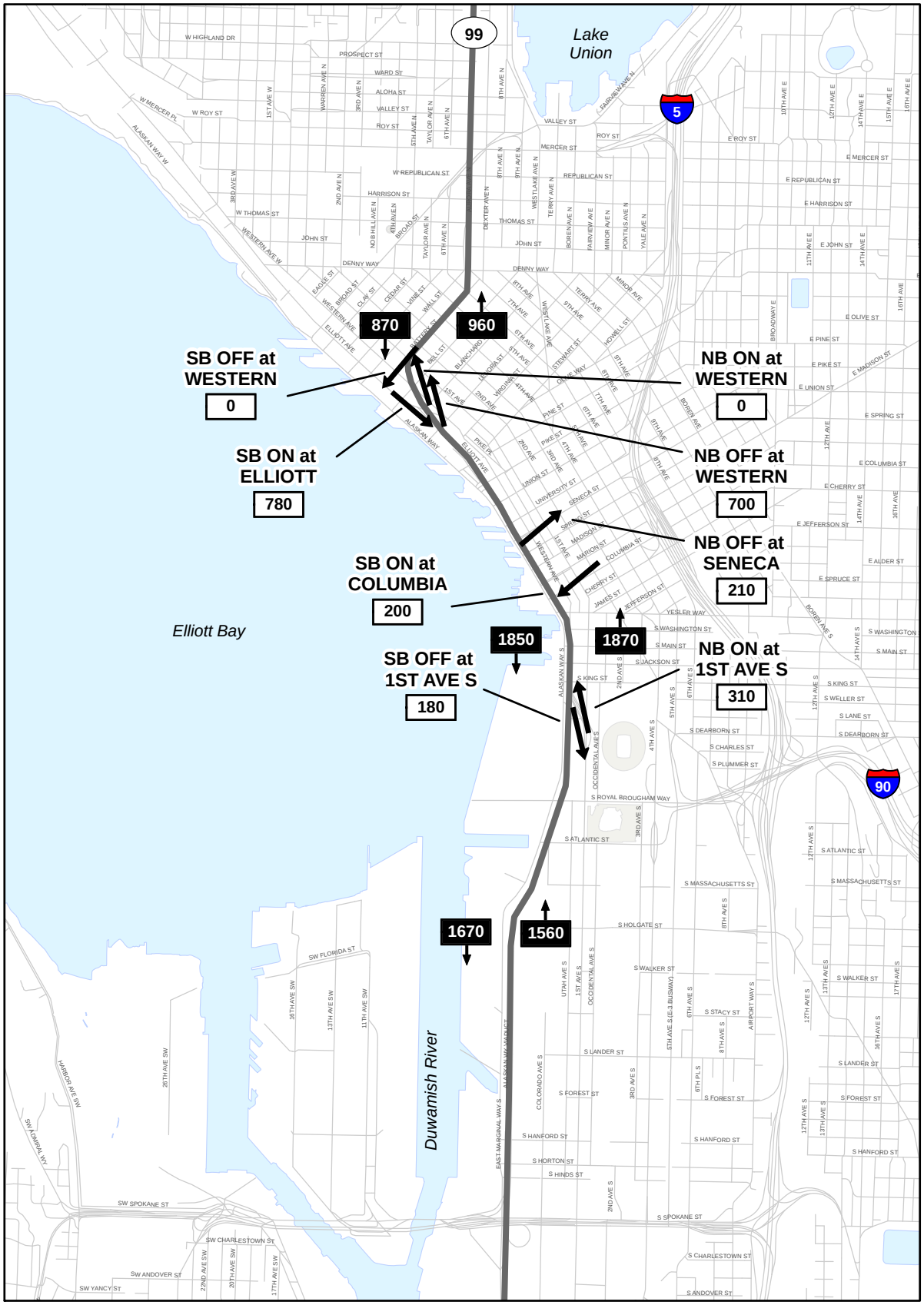
Basemap Data Source: City of Seattle, 2006.

Exhibit 4-35
City of Seattle Designated Major Truck Streets



N

0 2,000
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 4-36
Daily Truck Volumes Using the Alaskan Way Viaduct

Travel Patterns

South of downtown, 10 percent of southbound trucks (180 trucks) exit the corridor, and 17 percent of northbound trucks (310 trucks) enter the corridor at the First Avenue S. ramps. The lower southbound ramp volumes may be partially due to weight restrictions currently in place for the southbound outside lane, which limits access to the left-side off-ramp. Note, however, that mainline truck volumes are balanced (1,870 northbound and 1,850 southbound), which could indicate that trips displaced from the southbound off-ramp by these weight restrictions may be continuing to use the corridor, but exiting farther to the south. The majority of truck trips south of downtown continue south to E. Marginal Way or West Seattle/Harbor Island.

North of downtown, the Elliott/Western ramps provide access to the Ballard/Interbay industrial area (via 15th Avenue N.W.), as well as other areas northwest of downtown. A large share of truck traffic uses the Elliott/Western ramps, though a majority of trucks continue north on SR 99 through the Battery Street Tunnel. A smaller share of traffic accesses downtown directly using the Columbia/Seneca Street ramps.

Northbound, 11 percent of trucks (210 trucks) exit SR 99 at Seneca Street, 37 percent (700 trucks) exit to Western Avenue, and 51 percent (960 trucks) continue through the Battery Street Tunnel. Southbound, 47 percent of trucks (870 trucks) access the viaduct through the Battery Street Tunnel, 42 percent (780 trucks) via the Elliott Avenue on-ramp, and 11 percent (200 trucks) use the Columbia Street on-ramp.

Classification of Truck Types

The composition of trucks on the viaduct along the central waterfront is approximately 88 percent single-unit trucks, 9 percent combination trucks, and 3 percent tanker trucks (single and combination units). A higher share of combination and tanker trucks use the Elliott/Western corridor, hence the composition in the Battery Street Tunnel is 93 percent single units, 6 percent combination trucks, and 1 percent tankers.

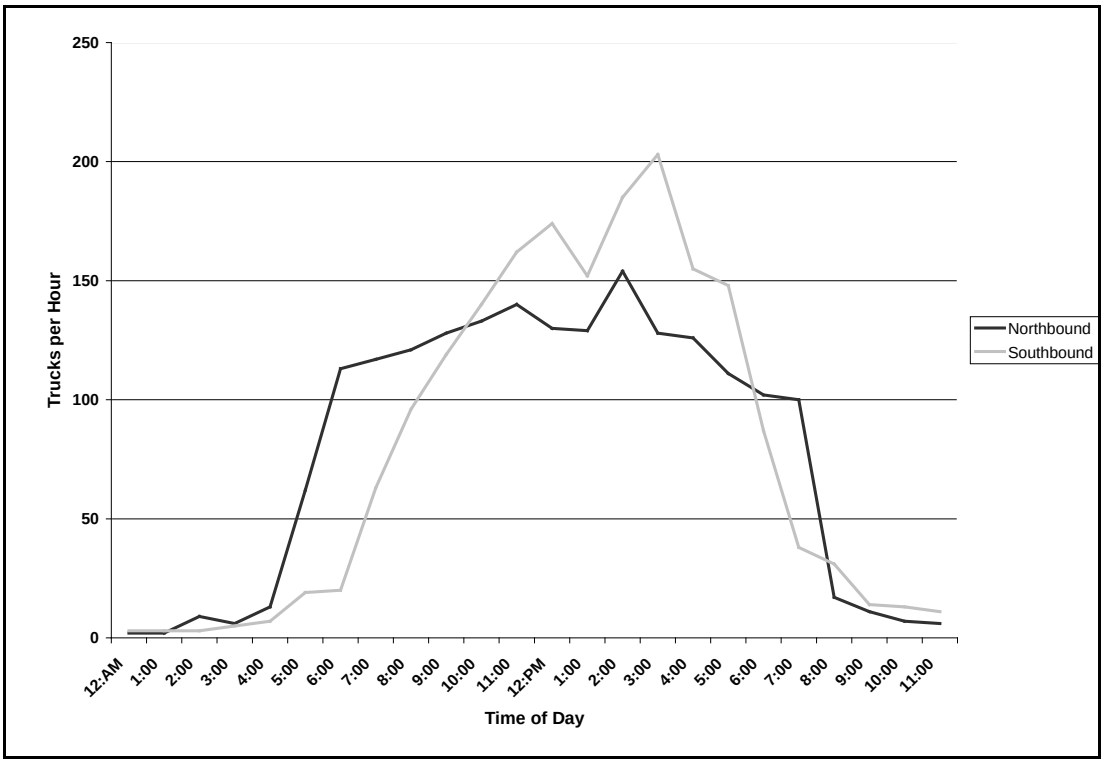
Tanker/Liquid Transport Trucks

Between 80 and 100 tanker trucks are estimated to use the SR 99 corridor each day (40 to 50 per direction). The share of these trucks that are hauling hazardous, combustible, or flammable materials is unknown. However, approximately 15 percent of tankers on the viaduct were observed using the Battery Street Tunnel, where hazardous materials are prohibited. An additional 15 percent of tanker trucks, some of which may carry hazardous cargo, use the viaduct during times when hazardous cargos are prohibited anywhere on the viaduct between 7:00 and 9:00 a.m. and between 4:00 and 6:00 p.m. Up to 70 percent of the observed tanker truck volumes—55 to 70 tankers per day—could therefore be legally carrying hazardous loads on the viaduct.

Hourly Truck Volumes

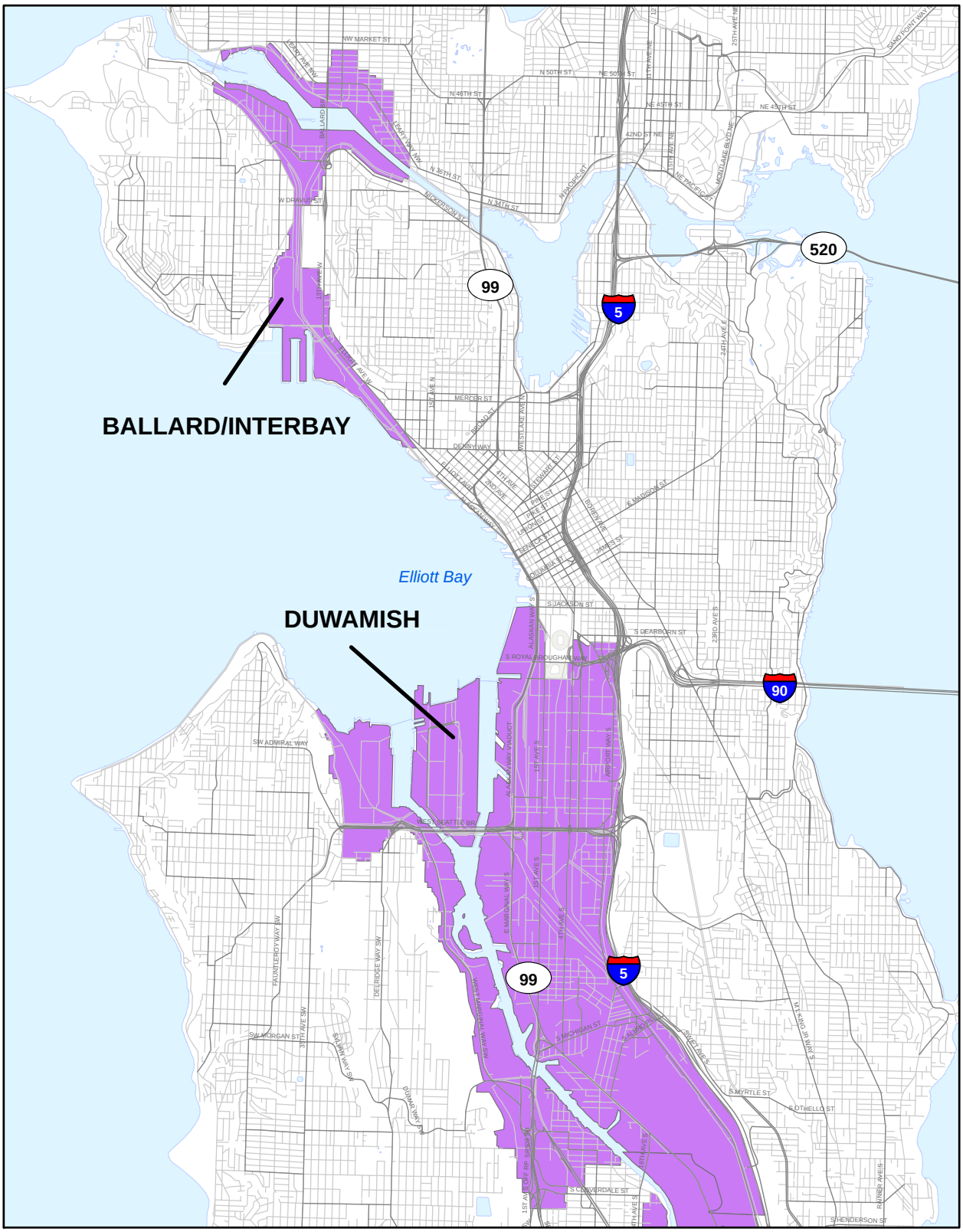
Unlike overall traffic volumes, which peak during the morning and evening commutes, truck volumes peak during the midday and afternoon. Exhibit 4-37 shows hourly truck volumes on the viaduct between the First Avenue S. ramps and Columbia/Seneca Street ramps (this is the busiest segment of the corridor). Northbound truck volumes are quite steady, generally ranging between 100 and 150 trucks per hour between 6:00 a.m. and 8:00 p.m. They peak at 155 trucks per hour between 2:00 p.m. and 3:00 p.m. Southbound truck traffic peaks more sharply (higher volumes, but for fewer hours). Southbound truck volumes don't reach 100 trucks per hour until 9:00 a.m., and fall below that threshold by 6:00 p.m. Peak volumes do, however, range from 150 to 200 trucks per hour between 11:00 a.m. and 5:00 p.m., peaking at 205 trucks between 3:00 p.m. and 4:00 p.m. Use of the viaduct by trucks at other times is low.

Exhibit 4-37. Hourly Truck Volumes on the Alaskan Way Viaduct (Midtown)



Freight Access

Within the project area, SR 99 serves areas that generate substantial freight and truck traffic. Exhibit 4-38 shows the boundaries of the Duwamish/SODO manufacturing and industrial area and the BINMIC, as determined by the City of Seattle. In addition to the industrial areas, trucks using this portion of the SR 99 corridor are destined to consumer markets throughout the city and the region.



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Basemap Data Source: City of Seattle, 2006.

Exhibit 4-38
Ballard/Interbay and Duwamish Manufacturing and Industrial Areas

The southern portion of the study area falls within the Duwamish/SODO manufacturing and industrial area. In addition, freight using the viaduct is often destined for the BINMIC area. Light industrial and warehouse uses north and south of downtown Seattle also generate substantial truck traffic. Historically, freight-related businesses have clustered north and south of downtown Seattle to be near both marine and railroad access.

Duwamish Industrial Area

The Duwamish Manufacturing and Industrial Center stretches over 3,981 acres from the area south of downtown Seattle, following the Duwamish River to unincorporated King County south of the Seattle city limits. It includes Boeing's Plant 2, much of the Port of Seattle, and almost 1,900 businesses just within the city of Seattle. In 2008, approximately 65,300 employees worked in the Duwamish Manufacturing and Industrial Center (City of Seattle 2009a).

Marine access to the Duwamish industrial area is provided through the Port of Seattle and along the Duwamish Waterway. Railroad access is provided at the BNSF SIG and North SIG and UPRR Argo Railyards.

Highway access from this area to I-5 is provided by SR 519 from Fourth Avenue S., at S. Spokane Street from Sixth Avenue S. and the S. Spokane Street surface route, and at Industrial Way. Alternative access routes to I-5 south include SR 99 to SR 599, SR 99 to SR 509 and SR 518, and Airport Road S. Access to I-90 is provided from Fourth Avenue S. at SR 519 or from S. Spokane Street and from I-5 to I-90.

Freight trips in the North Duwamish area, including port-related trips, must share the street system with other uses, including stadium event and ferry access traffic—both of which can overwhelm the street network at times. Roads and rail lines intersect at many locations, and rail traffic preempts use of the roadway when train activity is present. Because trains are assembled at rail switching yards in the area, some train activity consists of switching movements that can block intersections for an extended time. This causes truckers to rely heavily on existing grade-separated facilities to avoid conflicts with rail or heavy traffic conflicts. These facilities include the Alaskan Way Viaduct, the S. Spokane Street Viaduct, and overpasses on Airport Way S., First Avenue S., and Fourth Avenue S. Phase 1 of the SR 519 Intermodal Access Project added a new grade separation at S. Atlantic Street to provide grade-separated access in the eastbound direction between First Avenue S. and Fourth Avenue S., I-90, and I-5. Phase 2 of the SR 519 Intermodal Access Project, completed in spring 2010, added a corresponding westbound connection.

Ballard Interbay Northend Manufacturing and Industrial Center

The BINMIC comprises 866 acres, with over 650 businesses employing approximately 14,500 employees in 2008 (City of Seattle 2009a). Many of these

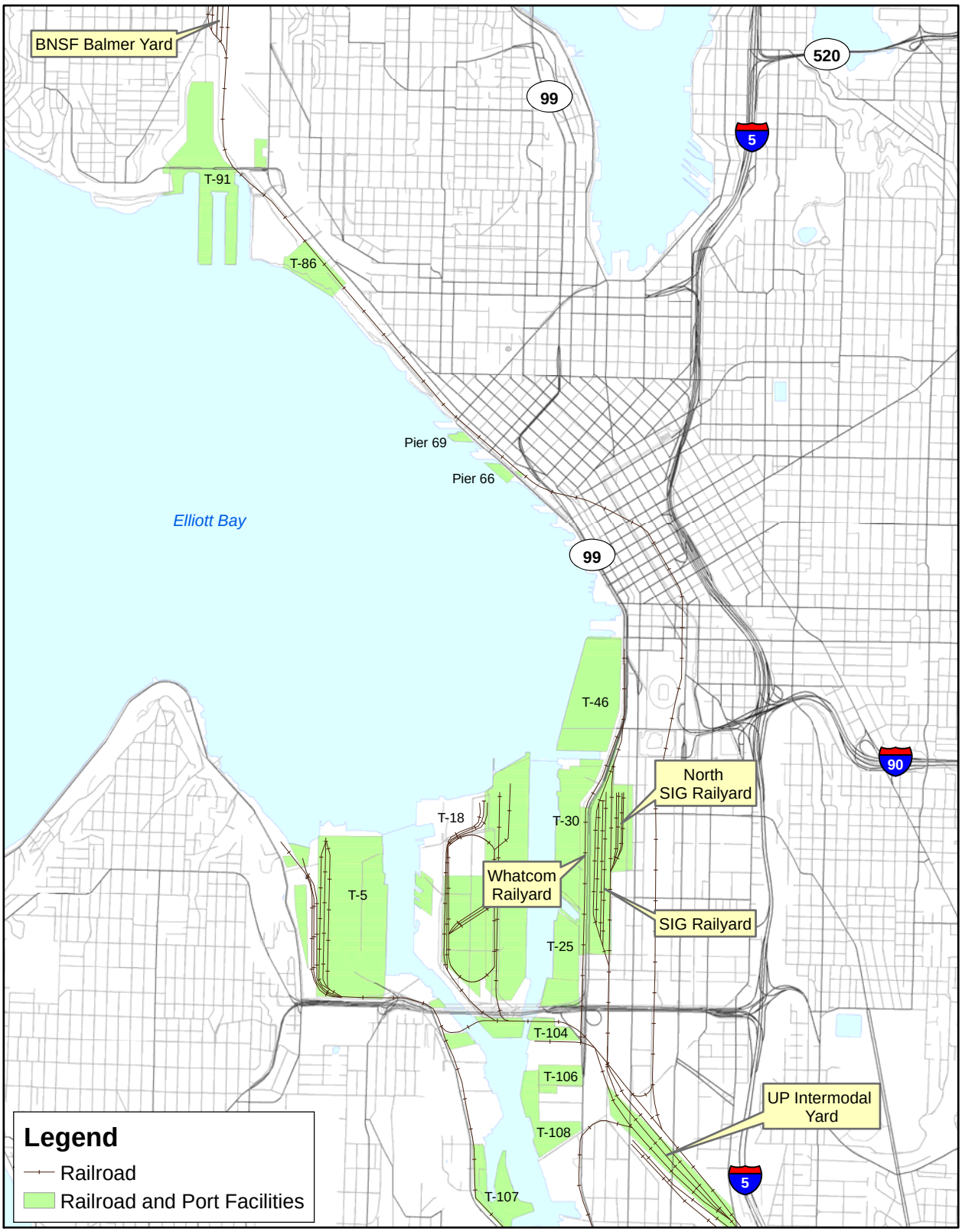
businesses are located in this area due to its marine access. Commercial fishing and marine-related businesses such as ship repair are located here. In 2005, 31 percent of employment in the BINMIC was in manufacturing; 14 percent in wholesale trade (including warehousing), transportation, and utilities; and 13 percent in construction/resources (including fishing). Most BINMIC businesses are small businesses employing 40 or fewer employees. Railcar storage and switching is provided at the BNSF Balmer Yard. Access to BINMIC businesses is provided at the Ballard Terminal Railroad Company, via the railcar distribution and interchange operations located along Shilshole Avenue N.W. on the north side of the Ship Canal. The Port of Seattle also has facilities in the area at Terminals 86 and 91 and Fishermen's Terminal.

The BINMIC is not served directly by the regional highway system. The primary access to regional freeways and industrial areas south of Seattle is via 15th Avenue W., connecting to SR 99 via the Elliott/Western ramps. Alternative routes include 15th Avenue W. or Nickerson Street and Westlake Avenue N. to N. Mercer Street and I-5; however, Mercer Street and I-5 provide a less direct and more congested route during most workdays. Freight generators in Ballard also use arterial east-west streets in Ballard and Fremont to access SR 99, including Leary Way and N. 39th Street, which is not designated as a Major Truck Street by the City of Seattle. Trucks traveling to the north that begin their trip in the Ballard/Interbay area use 15th Avenue N.W. to Holman Road, then east to I-5. N.E. 85th Street also provides a connection to I-5 for freight.

Port of Seattle and Intermodal Railyards

The Port of Seattle is one of the largest west coast cargo centers, serving as the entry and exit point for marine cargo to and from the Pacific Rim and Alaska. Exhibit 4-39 shows Port of Seattle facilities, including marine cargo terminals at Harbor Island and the Southwest Harbor (Terminals 5 and 18), along Alaskan Way in the Southeast Harbor (Terminals 25, 30, 37, and 46), and in the Interbay area north of the study area (Terminals 86 and 91). Terminal 91 is used for processing cargo as well as for staging cruise ships. The BNSF and UPRR intermodal railyards are also shown on Exhibit 4-39.

Most of the freight shipped through the port is in intermodal containers that are transferred to or from railcars or trucks on the dock. The Port of Seattle's container terminals are Terminals 5, 18, 25, 30, and 46. Terminals 25, 30, and 46 are all accessed from East Marginal Way S. between S. Atlantic Street and S. Hanford Street. Terminal 18 on Harbor Island and Terminal 5 in West Seattle are accessed from S. Spokane Street. Terminals 5 and 18 have been upgraded over the past decade to include on-dock rail facilities. Some of the containers are shuttled (called "drayed") by truck to or from the BNSF or UPRR intermodal railyards accessed from E. Marginal Way to be transferred to or from railcars remotely.



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1 0.5 0 1 Miles

Basemap Data Source: City of Seattle, 2006. Port of Seattle, 2008.

Exhibit 4-39
Port and Rail Facilities

Trucks entering or leaving Terminals 5 and 18 use the S. Spokane Street Viaduct to reach I-5, but use surface-level S. Spokane Street to get to and from Duwamish locations since there are no connections from the S. Spokane Street Viaduct to the south on SR 99.

Terminals located along the Southeast Harbor do not have on-dock rail facilities, and when ships are unloaded at these terminals, those containers bound inland by rail must be drayed between the terminal and the railyard. The primary dray route is along E. Marginal Way to S. Atlantic Street, under the Alaskan Way Viaduct to the north entrance of the BNSF SIG Railyard. Other key truck arterials in the north Duwamish area include W. Marginal Way, Alaskan Way, and S. Michigan and S. Hanford Streets.

Bulk (non-containerized) grain shipments are made through Terminal 86, and generally these loads arrive and leave via rail rather than by truck. Bulk cargo also passes through Terminal 91, often as over-legal (oversized) vehicle loads that must use designated over-legal routes to reach their landside destinations. Alaskan Way surface street, Broad Street, and 15th Avenue W. are the streets used for over-legal truck travel to and from the Interbay area.

The Port of Seattle gates are typically open between 7:00 a.m. and 5:00 p.m. Arrival times at the gate are determined by businesses that ship through the Port and are affected by travel distance as well as the delivery schedule to regional warehouse and distribution centers. Peak truck volumes usually occur between 7:00 and 9:00 a.m. as trucks arrive for their first morning trip, and then again midday (12:30 to 2:30 p.m.). Most of the Port gates are closed or partially closed during the noon lunch hour, but trucks continue to arrive in the gate queue areas.

Freeway access to and from I-5 and I-90 are provided at SR 519 and at S. Spokane Street from both the viaduct level and the surface roadway. Access to I-90 from S. Spokane Street requires entering and exiting from I-5 in a bottleneck location. Since I-5 is congested during much of the work day, alternate access to and from I-5 is provided using SR 509 and SR 518, SR 99 and SR 599, or Airport Way S.

4.5.4 Railroads

BNSF maintains two mainline tracks through the study area, paralleling I-5 to the south and running between First and Fourth Avenues S., crossing S. Spokane Street, S. Lander Street, S. Holgate Street, and S. Royal Brougham Way (SR 519) at-grade. North of S. Royal Brougham Way is King Street Station and a tunnel under the downtown area that emerges north of the Pike Place Market and follows the waterfront to points north. This route serves the Interbay switching and engine maintenance and refueling yard, as well as the grain elevator at Terminal 86. The BNSF mainline serves the I-5 corridor south to Long Beach, California, and north to British Columbia, connecting to east-west tracks crossing

the Cascades at Everett, Auburn, and along the Columbia River. BNSF has agreements with the state, Amtrak, and Sound Transit to carry intercity and regional commuter rail passenger trips that are accessed at King Street Station. Passenger train switching and staging occur on switching tracks north and south of SR 519.

UPRR maintains a single mainline track heading south from Seattle, using a shared alignment with BNSF until Tukwila. UPRR also serves the I-5 corridor and connects to east-west tracks at the Columbia River. The UPRR Argo intermodal switching yard is south of S. Spokane Street. The capacity of the combined UPRR and BNSF tracks is reduced due to operational conflicts caused by the need for UPRR trains to cross the BNSF mainline to access the Argo Railyard. Both the UPRR and BNSF tracks serving Terminals 5 and 18 cross E. Marginal Way at-grade, creating delays for heavy truck traffic in that area.

SIG and Whatcom Railyard Operations

The BNSF SIG and North SIG Railyards are located on the east side of SR 99, south of S. Atlantic Street. These intermodal railyards are used to load cargo containers (most of which arrive by sea at the port facilities on the west side of SR 99) onto railcars and switch railcars to build freight trains. A switching track, termed the tail track, extends north from the SIG Railyard, crossing S. Atlantic Street and S. Royal Brougham Way. Switching operations at the SIG Railyard frequently block these streets near their intersections with Alaskan Way S. Results from a recent 5-day video survey of the tail track at S. Atlantic Street and S. Royal Brougham Way showed that the tail track is occupied and blocks traffic along S. Atlantic Street nearly 20 percent of the day. S. Royal Brougham Way blockages were slightly less than those on S. Atlantic Street.

As part of the S. Holgate Street to S. King Street Viaduct Replacement Project, a grade separation from the BNSF tail track will be provided by an h-shaped overcrossing that extends from the S. Atlantic Street/Colorado Avenue S. intersection to the S. Atlantic Street/E. Marginal Way S. intersection. This h-shaped overcrossing will provide a bypass for traffic traveling along S. Atlantic Street when the tail track is blocked. The structure will include an aerial connection with E. Marginal Way S., providing increased north-south mobility through the project area. Alaskan Way S. will connect to the structure and will include a southbound connection from the central waterfront to E. Marginal Way S. and eastbound S. Atlantic Street east of the tail track. The facility will also provide other east-west traffic connections (e.g., to I-90) for freight traveling between the container terminals, railyards, and freeways. The aerial mainline structure and depressed local street will provide both at-grade and grade-separated access across the BNSF tail track.

Two additional BNSF tracks pass through the Whatcom Railyard on the west side of SR 99. One track used for train assembly continues from the SIG Railyard north across S. Royal Brougham Way just west of the viaduct, causing backups for trucks accessing Port terminals along the waterfront. The connection between the Whatcom Railyard and the SIG Railyard will be removed by the S. Holgate Street to S. King Street Viaduct Replacement Project.

4.6 Parking

4.6.1 Parking Space Definitions

This assessment quantifies "public parking," unless otherwise noted. Public parking is defined as (1) parking spaces regulated by the City and (2) pay parking lots from which money is collected by a private entity but parking spaces are available to the public. Parking was grouped and summarized into three main categories of on-street short-term, on-street long-term, and off-street parking. Viaduct demolition poses a special case where restricted parking spaces are discussed.

On-Street Short-Term Parking

Existing short-term parking includes metered spaces (including pay stations) with up to a 2-hour limit; passenger and commercial loading zones; and taxi, bus, and police parking.

On-Street Long-Term Parking

On-street long-term parking includes 10-hour metered spaces plus unmetered, unrestricted, on-street public parking. These types of spaces are found in the south end of the project area under the viaduct and in the north portal area.

Off-Street Parking

Off-street parking includes privately owned parking lots at which the public can park for a fee. In most cases, public parking does not include customer or employee parking for private businesses. The exception is some parking under the viaduct that is restricted during daytime hours on weekdays but used as public parking at other times.

Restricted Parking

As noted previously, this assessment quantifies "public parking." However, viaduct demolition would affect some restricted parking spaces under the viaduct, along the west side of buildings and loading docks. These spaces can generally be categorized as restricted or reserved for private business use, including customer and employee parking, but some of the spaces can be used by the public during non-business hours. The effect of viaduct demolition on

restricted spaces is noted in Chapter 6, Construction Effects and Mitigation, Section 6.1.9, Parking.

4.6.2 Parking Study Boundaries

The parking study was generally limited to the areas within the construction footprint and surface street improvement areas. The parking assessment areas are organized according to south portal, central, and north portal areas. Only the south and north portal areas are associated with the final configuration of the project. The central area is discussed in Chapters 6 and 7 in the context of construction and the larger Program and viaduct demolition activities.

Potential parking effects were estimated for the Bored Tunnel Alternative. The plans for surface street improvements, submitted with the Alaskan Way Viaduct Replacement Project configuration drawings (February 2010), were used as a guide for on-street parking lanes and affected off-street parking areas.

4.6.3 Existing Parking Spaces

Exhibit 4-40 summarizes existing parking in the project footprint, which includes the vicinity of SR 99 and the portal areas that would be affected by the Bored Tunnel Alternative. The S. Holgate Street to S. King Street Viaduct Replacement Project is planning to make some changes to parking along First Avenue S. between S. Royal Brougham Way and S. King Street, compared with today's conditions. These changes are anticipated to be in place by the time construction of the Alaskan Way Viaduct Replacement Project begins and have been previously accounted for, so they are incorporated into the existing conditions.

Near the south portal, about 190 on-street spaces and 250 off-street spaces are within the affected area. In the north portal area, about 370 on-street spaces are within the area affected by the project, and about 200 of these are 10-hour metered spaces. No off-street spaces in public pay lots are anticipated to lose parking in the north portal area.

Exhibit 4-40. Summary of Existing Parking Spaces

	On-Street Spaces			Off-Street Spaces	Total Spaces
	Short-Term	Long-Term	Subtotal		
South portal area	140	50	190	250	440
North portal area	140	230	370	0	370

4.7 Pedestrians

The study area includes several noteworthy pedestrian generators/attractors:

- Two stadiums
- Major employment centers
- Major tourist attractions
- Green space/recreational areas

Sidewalks are found on the majority of streets in the study area and are the primary source of pedestrian access and mobility. Other pedestrian facilities in the study area include the Waterfront Bicycle/Pedestrian Facility and pedestrian facilities to or across Alaskan Way at Marion Street, Pike Street, Lenora Street, and Bell Street that link the downtown and Belltown areas with the waterfront. The following discussion provides information on existing pedestrian facilities for the following portions of the project area:

- South portal area
- Waterfront area
- North portal area

4.7.1 South Portal Area

The south portal area includes the area immediately to the west of the sports stadiums and adjacent to the Port of Seattle and other industrial land uses. Pedestrian activity is highly variable in the south portal area due to the mix of land uses in the area and the stadiums. Most pedestrian traffic is oriented in a north-south direction, mainly due to the lack of east-west roadways and pedestrian facilities.

First Avenue S. and Occidental Avenue S. provide the main north-south pedestrian facilities in the area. First Avenue S. has sidewalks on both sides of the street, whereas Occidental Avenue S. has a large sidewalk area adjacent to Qwest Field, but no sidewalk facilities on the western side of the roadway.

While First Avenue S. has sidewalks on both sides of the roadway, the sidewalks are relatively narrow, there are limited pedestrian-oriented attractors or amenities, traffic volumes on First Avenue S are relatively high, and overall pedestrian flow is interrupted by the ramps to SR 99, where pedestrians are diverted to a narrow, hidden sidewalks behind the ramps.

Conversely, Occidental Avenue S. has very low traffic volumes, virtually no traffic channelization markings, and a broad sidewalk and pedestrian area on the east side of the roadway, which generally leads to the intermingling of pedestrian and vehicle traffic on Occidental Avenue S.

Alaskan Way S. provides intermittent sidewalks in this area, typically on the western edge of the roadway adjacent to the Port of Seattle properties. Of the three north-south roadways, Alaskan Way S. has the least amount of pedestrian traffic due to the lack of pedestrian-oriented facilities and activities, the high volume of truck traffic, and the railroad operations that take place under the Alaskan Way Viaduct.

East-west pedestrian facilities are provided on S. Atlantic Street, S. Royal Brougham Way, Railroad Way S., and S. King Street. Sidewalks exist on both S. Atlantic Street and S. Royal Brougham Way, but they are discontinuous due to entrances to parking facilities and the railroad facilities under the Alaskan Way Viaduct. The Railroad Way S. pedestrian facilities are not sidewalks, but painted lines within the right-of-way between rows of parking spaces located under both the SR 99 ramps to First Avenue S. and the viaduct structure. These two factors, in addition to a confusing roadway configuration under the viaduct, contribute to a generally unfriendly pedestrian environment. As a result, more pedestrians are likely to use S. King Street because it has sidewalks on both sides of the roadway, has more pedestrian-oriented amenities, and is less affected by the viaduct.

During non-event times, pedestrian traffic is relatively light in the south portal area. However, these pedestrian and roadway facilities, particularly Occidental and First Avenues S., experience significant pedestrian volumes during events at either Safeco or Qwest Field. During larger events, such as a Mariners baseball game or a Seahawks football game, thousands of pedestrians crowd the sidewalks and alleys in the stadium and Pioneer Square areas. During these times, Occidental Avenue S. functions as the main pedestrian corridor, and while traffic is maintained on First Avenue S. and Alaskan Way S., there is virtually no vehicle traffic on Occidental Avenue S. Intersections throughout the area become saturated with pedestrian activity, and both the pedestrian and vehicle traffic LOS are considerably degraded. During such events, police officers typically provide traffic control to manage the very high vehicle and pedestrian volumes.

4.7.2 Waterfront Area

The waterfront area includes the Alaskan Way surface street from S. King Street to Broad Street and the SR 99 Alaskan Way Viaduct. In this area, the viaduct is an elevated, double-level structure that runs roughly parallel and to the east of Alaskan Way.

Primary pedestrian traffic generators along the waterfront include tourist activities, businesses, recreational uses, and ferry service. Sidewalks adjacent to east-west streets in this area make up the primary pedestrian access between downtown and the waterfront. However, between University Street and Wall Street, steep grades limit east-west connections under the viaduct, and east-west

pedestrian access is challenging. As a result, a number of grade-separated pedestrian facilities have been constructed over the years to provide access between the downtown and Belltown areas and the waterfront.

Five major pedestrian facilities in the central waterfront area provide connections to the waterfront:

- Marion Street pedestrian bridge, which extends from First Avenue S., over Alaskan Way S., and connects to the Seattle Ferry Terminal at Colman Dock and the west side of Alaskan Way S.
- Harbor Steps, a wide, multilevel pedestrian plaza with stairs that provides access between First and Western Avenues located at University Street.
- Pike Street Hillclimb, which provides access to the east side of Alaskan Way from Pike Place Market, First Avenue, and Western Avenue.
- Lenora Street pedestrian bridge, which provides access from Elliott Avenue to the east side of Alaskan Way.
- Bell Street Skybridge, which extends over Alaskan Way and the BNSF railroad tracks and connects to the Bell Street Pier.

Pedestrian Facilities Along Alaskan Way

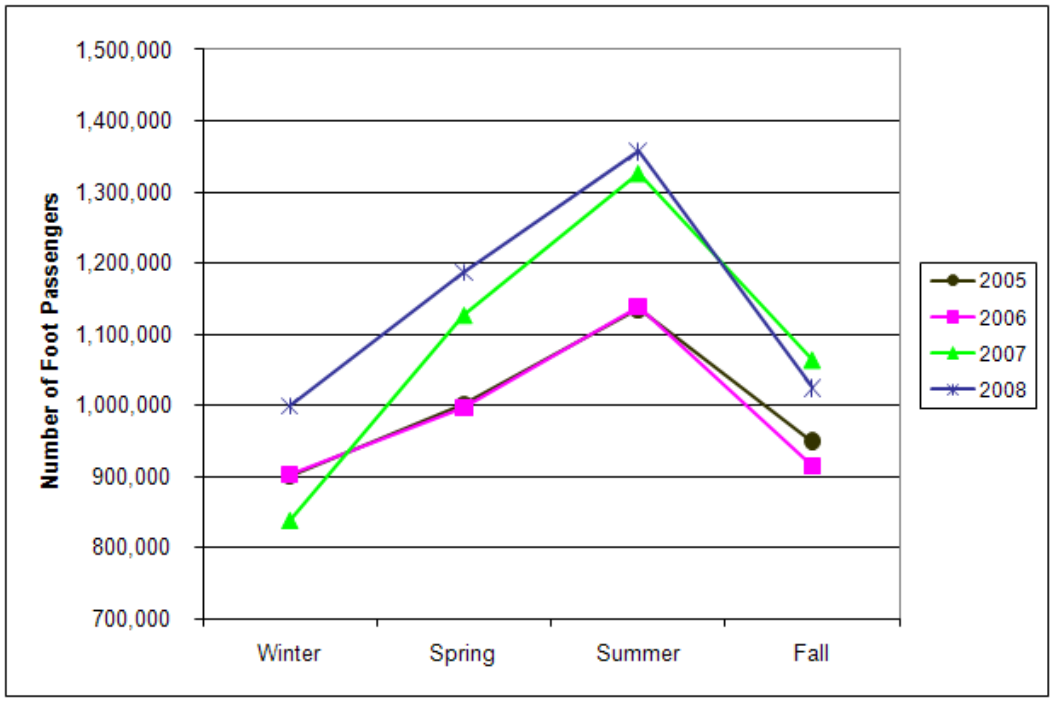
A widened sidewalk on the west side of Alaskan Way fronts waterfront businesses and attractions, acting as a pedestrian promenade. The promenade varies from 16 to 20 feet wide in the central waterfront area. The east side of Alaskan Way is only periodically fronted by sidewalks between S. King Street and Pike Street, primarily at stops for the waterfront streetcar. Farther north, a sidewalk is provided between Pike Street and Clay Street on the east side of Alaskan Way. The Waterfront Bicycle/Pedestrian Facility is a multipurpose asphalt pathway along the east side of Alaskan Way (east of the streetcar tracks) that is used by both pedestrians and cyclists. This facility provides access along the eastern right-of-way from S. Royal Brougham Way to Broad Street, where it connects with the Elliott Bay Trail in Myrtle Edwards Park.

Pedestrians can cross Alaskan Way both at-grade and at two pedestrian bridges within the waterfront area. The Marion Street pedestrian bridge connects the Seattle Ferry Terminal to First Avenue S., allowing commuters and other ferry users to access downtown and First Avenue S. without having to cross Alaskan Way S. at-grade. To the north, the Bell Street Skybridge connects to Elliott and Western Avenues. In addition, the Pike Place Hillclimb and the Lenora Street pedestrian bridge link downtown and the south end of Belltown to the waterfront by providing facilities on the east side of Alaskan Way, where pedestrians can then cross Alaskan Way at-grade.

Surface crossings of Alaskan Way are provided at fairly regular intervals along the roadway. However, not all crossings are at a signalized intersection, which may be difficult for some pedestrians. Signalized intersection crossings are mainly in the southern portion of the waterfront area. In the south end, signalized intersections are located at Yesler Way and Columbia, Marion, and Madison Streets; near the middle at University and Pike Streets; and Wall and Clay Streets to the north. Pedestrians wishing to cross Alaskan Way only at a signalized intersection would face longer travel distances (or out of direction travel), particularly if they are unaware that there are only two signalized crossings between Madison and Wall Streets, a stretch of nearly 1 mile.

Pedestrian traffic along the waterfront experiences substantial variability—both day-to-day and seasonally—due to ferry, tourist, and cruise ship activities. Data from Washington State Ferries show that overall foot passenger volumes are typically higher during the summer months than during the fall and winter months (Exhibit 4-41). Unlike overall pedestrian volumes in the downtown area, which are generally associated with typical workday activities and tend to peak during the weekday PM peak hour, pedestrian volumes along the downtown waterfront tend to peak during the weekend PM peak hour in the summertime.

Exhibit 4-41. Washington State Ferries Seasonal Foot Passenger Traffic at Colman Dock



Source: Washington State Ferries 2009.

4.7.3 North Portal Area

The north portal area consists of the western portion of the South Lake Union neighborhood and the Uptown neighborhood, which contains Seattle Center. North of Denny Way, SR 99 divides the grid system and separates the South Lake Union area from Uptown and the Seattle Center area. This segment of SR 99 is at-grade, and the only pedestrian crossings provided are at Denny Way, Mercer Street, and Broad Street.

Denny Way and Dexter Avenue serve as the primary east-west and north-south pedestrian routes, respectively. Mercer and Broad Streets also serve as east-west pedestrian routes, but these streets pass under SR 99, have quite narrow sidewalks, and do not provide a comfortable or attractive environment for most pedestrians.

Pedestrian activity in the South Lake Union area continues to increase as residential, commercial, and retail development continues. The Seattle Center area also has a relatively high volume of pedestrian traffic, and similar to the stadiums in the south portal area, pedestrian activity increases rather dramatically during the numerous sporting, art, and cultural events that take place at Seattle Center.

4.7.4 Interaction Between Pedestrians and Vehicle Traffic

Pedestrians may encounter heavy traffic and fast-moving vehicles at locations where traffic enters or exits SR 99. The Denny Way ramps are one location where vehicles encounter pedestrians immediately as they exit the highway. These ramps have sidewalks and buses along their outside lanes. This location is an area for potential conflict, because it is an active pedestrian environment that also accommodates high vehicle volumes at potentially higher rates of travel as vehicles transition from a limited-access environment to an arterial environment.

The Battery Street Tunnel and Elliott/Western ramps also introduce highway traffic into a pedestrian environment with little transition. At the southbound on-ramp at Elliott Avenue and the northbound Battery Street Tunnel on-ramp, accelerating traffic entering the highway crosses pedestrian traffic traveling along Western and Elliott Avenues. The northbound off-ramp to Western Avenue accommodates high traffic volumes, which encounter an active pedestrian environment immediately at the base of the ramp. An unsignalized crosswalk at Bell Street crosses the ramp immediately as it joins the street grid. Both Western and Elliott Avenues experience moderate to high levels of pedestrian activity.

The Columbia/Seneca Street ramps are signal-controlled, and due to the sharp exiting curve from SR 99 to the Seneca Street off-ramp, traffic is slowed to arterial speeds prior to reaching the intersection with First Avenue. Conflicts between

pedestrians and vehicles are limited at the southbound SR 99 off-ramp to First Avenue and the northbound SR 99 on-ramp from First Avenue because pedestrians on First Avenue are routed behind the ramp structures to narrow, hidden walkways. While this reduces the conflicts between pedestrians and ramp traffic, the environment behind the ramp does not provide a comfortable or attractive environment for most pedestrians. Safety and collision information is presented in Section 4.10.

4.8 Bicycle Facilities

Bicycles are used in the study area for both recreation and commuting. This section describes existing bicycle facilities and routes, planned facilities and routes, and how these facilities and routes relate to the existing SR 99 facility. The discussion provides information on bicycle facilities in the following portions of the project area:

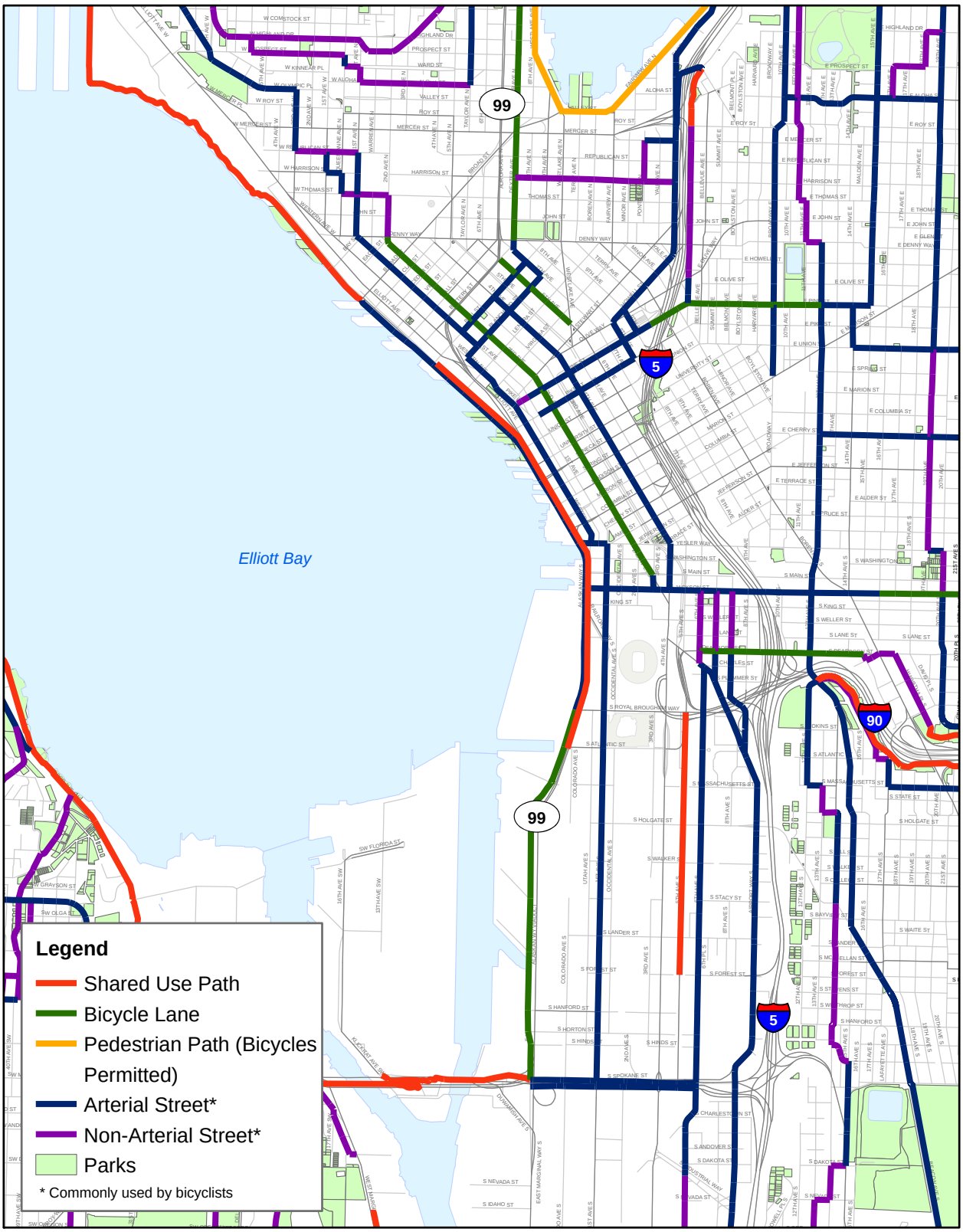
- South portal area
- Waterfront area
- North portal area

4.8.1 Bicycle Facilities and Designated Bicycle Routes

Seattle features an extensive network of bicycle facilities and routes. Bicycle facilities consist of separate, off-street trails or paths, on-street bicycle lanes, and designated routes on both arterials and local streets, some of which are designated by the sharrow symbol. A sharrow is a bicycle symbol that is placed in the roadway lane, indicating that motorists should expect to see and share the lane with bicycles. Unlike bicycle lanes, they do not designate a particular part of the roadway for the use of bicyclists. A substantial number of commuters travel to jobs in the downtown area via these facilities and designated routes. City of Seattle delineated bicycle facilities and routes in the downtown area are shown on Exhibit 4-42.

4.8.2 South Portal Area

E. Marginal Way S. contains an on-street bicycle lane in the south portal area and is considered a regional connection that serves as the main route into and out of downtown for West Seattle residents. The SR 99/E. Marginal Way corridor is considered the primary connection for bicyclists from the West Seattle, White Center, Arbor Heights, and Burien areas to the downtown CBD. The corridor also allows bicyclists access to other neighborhoods and communities in the region.



N

0 0.25 0.5 1 Miles

Basemap Data Source: City of Seattle, 2009.

Exhibit 4-42
City of Seattle Designated Bicycle Routes

4.8.3 Waterfront Area

Major facilities along the waterfront include the Waterfront Bicycle/Pedestrian Facility, which runs from the stadium area to Myrtle Edwards Park, and to the multi-use trail that starts in Myrtle Edwards Park and runs northward through the Interbay area to Magnolia and Ballard. On-street bicycle facilities are not presently provided on Alaskan Way, though cyclists ride either in the street or on the Waterfront Bicycle/Pedestrian Facility.

4.8.4 North Portal Area

Dexter Avenue N. serves as the main northbound and southbound route for bicyclists traveling between downtown and areas north of the Lake Washington Ship Canal. Second Avenue serves as the main route for bicyclists heading southbound through downtown, while First, Third, and Fourth Avenues are used for northbound travel. There are no grade-separated or designated in-street bicycle lanes for east-west crossings of SR 99 in the north portal area. To cross SR 99 in an east-west manner, cyclists must ride in a travel lane on Denny Way, Mercer Street, or Broad Street, all of which are high traffic volume streets with minimal room for error due to curbs, parked cars, and other barriers.

4.8.5 Regional Connections

Near the north portal area, the bicycle lane on Dexter Avenue N. connects to the Fremont Bridge and the Burke-Gilman Trail, which provides regional connections to Ballard, the University District, and points beyond located along the western and northern shores of Lake Washington. As mentioned previously, the trail in Myrtle Edwards Park leads to a trail through the Interbay area to Magnolia, Ballard, and a trail along the south side of the Fremont cut.

To the south, E. Marginal Way connects to S. Spokane Street, along which bicyclists can travel to reach the low West Seattle Bridge and a multi-use trail along the water around Alki Point. Near the stadiums, S. Dearborn Street connects to the I-90 Trail, which provides connections to Mercer Island and areas east of Lake Washington.

4.8.6 Planned Improvements

The City of Seattle adopted a Bicycle Master Plan (City of Seattle 2007a) that was approved May 22, 2007, by the Seattle Bicycle Advisory Board. The plan has informed the development of approximately 450 miles of marked or separated bicycle routes, which will be completed over the next 10 years, including sharrows, bicycle lanes, and multi-use trails.

The Bicycle Master Plan calls for a number of improvements in the stadium area, many of which will be provided as part of the S. Holgate Street to S. King Street Viaduct Replacement Project, as well as this project. These two projects will construct a combined bicycle and pedestrian facility called the Port Side Pedestrian/Bike Trail adjacent to the Port of Seattle property between S. Atlantic Street and S. King Street. To the east of the SR 99 ramp system in the south portal area, the City Side Trail will provide a combined bicycle and pedestrian facility between S. Atlantic and S. King Streets.

The City of Seattle's Bicycle Master Plan also calls for new bicycle facilities on S. Royal Brougham Way from Alaskan Way S. to Fourth Avenue S. (on a new overpass over the BNSF tracks), and on S. Holgate Street east from First Avenue S. A new multi-use path is planned for S. Royal Brougham Way from Fourth Avenue S. east to Beacon Hill, where it would connect with the existing Mountains to Sound/I-90 Trail and a new trail that would continue south along the west side of Beacon Hill.

In the central waterfront area, the Bicycle Master Plan includes a bicycle lane on Alaskan Way with an additional bicycle lane on Western Avenue from Yesler Way to Blanchard Street. In the north waterfront, a new bicycle lane is planned for Alaskan Way from Broad Street to the south, and Elliott, Western, and First Avenues would include sharrows.

In the north portal area, the Lake Union to Elliott Bay Trail project, which connects the South Lake Union area with the Seattle Center and waterfront areas through a series of bicycle lanes and shared-use facilities is being completed by the City of Seattle. Trail facilities in the South Lake Union and north portal area are being completed by the City of Seattle as part of the Mercer Corridor project.

Planned bicycle improvements in the north portal area also include a new bicycle corral planned at Seattle Center as part of redevelopment of Memorial Stadium. The addition of the bicycle corral may have some effect on the amount of bicycle use to and from the area.

4.9 Ferry Services

Ferry service to downtown Seattle is provided by Washington State Ferries and King County. Washington State Ferries provides direct ferry service between downtown Seattle and both Bainbridge and Bremerton. Alternate transportation connections between Seattle and these communities are by highway through Tacoma (via the Tacoma Narrows Bridge), or by ferry to Edmonds. The King County Ferry District provides service to downtown Seattle from West Seattle and Vashon Island (effective September 28, 2009). Alternative transportation connections for the West Seattle route involve the West Seattle Freeway and either SR 99 or surface streets. Alternatives for the Vashon Island service involve

Washington State Ferries service to Fauntleroy and surface streets to the West Seattle Bridge and either SR 99 or surface streets to downtown Seattle.

Colman Dock, located on Piers 50 and 52 on Seattle's downtown waterfront, is the Seattle terminus for the Washington State Ferries. The Vashon Island service also uses Colman Dock, while service from West Seattle uses Pier 55 in the central waterfront. Access to Colman Dock is provided from Alaskan Way at Yesler Way, and exits are provided to Alaskan Way at Yesler Way and Marion Street.

4.9.1 Vehicle and Passenger Ferries

For the Washington State Ferries service, two Jumbo Mark II boats, each with a capacity of 202 vehicles and 2,500 passengers, operate on the Bainbridge Island service between 4:45 a.m. and 1:35 a.m. on weekdays, with departures and arrivals approximately every 50 minutes. Service to Bremerton is generally provided by one Super Class ferry, which has a capacity of 144 vehicles and 2,500 passengers, and one Jumbo Class ferry, which has a capacity of 188 vehicles and 2,000 passengers. Bremerton service operates on approximately 80-minute headways daily between 4:50 a.m. and 12:50 a.m.

4.9.2 Passenger-Only Ferries

The King County Ferry District service from West Seattle currently operates its own passenger-only ferries. The passenger-only boat can accommodate 250 passengers. On weekdays, service is provided approximately every 40 minutes from 6:50 a.m. to 9:30 a.m. and again from 3:00 p.m. to 5:00 p.m., and each hour from 11:00 a.m. to 3:00 p.m. and from 5:00 pm to 11:00 p.m. On weekends, service is offered every hour from 9:00 a.m. to 11:00 p.m. The West Seattle ferry operates from April through October.

Passenger-only ferries also connect downtown Seattle and Vashon Island. While previously operated by Washington State Ferries, the King County Ferry District assumed operations for this route effective September 28, 2009. Service is provided by a vessel with a capacity for 150 people. The Vashon passenger-only ferry provides peak-only service, operating three morning trips to Seattle and three afternoon trips from Seattle.

4.9.3 Characteristics of Ferry-Related Traffic

Arterial intersection analysis estimates that 525 vehicles exit Colman Dock during the AM peak hour, while 200 vehicles arrive to travel westbound during the same time period. During the PM peak hour, the pattern reverses to a degree, with 390 vehicles exiting Colman Dock during the PM peak hour and 540 vehicles arriving at Colman Dock during the PM peak hour under current conditions.

The analysis assumes that there is one Bremerton and two Bainbridge route arrivals and departures, with the eastbound ferries at approximately 60 percent capacity and the westbound ferries at about 90 percent capacity. This estimate is based on existing PM peak hour demand at Colman Dock for the 30th busiest day of the year, which corresponds to a 92nd percentile weekday and is of a magnitude that is consistent with traffic counts taken in the vicinity of Colman Dock. Because these volumes do not represent the most severe peak conditions, it is recognized that there are days throughout the year during which higher volumes may occur.

The traffic signals for traffic exiting Colman Dock at either Marion Street or Yesler Way use queue detection to extend the green time for exiting traffic when there is substantial queuing on Colman Dock. Once the extended green is completed, the north-south movements are allocated their normal split timings. The combined splits result in very long—and uncoordinated—signal cycle lengths. The queue detection continues to trigger extended green time for exiting ferry traffic until the vessel is empty (typically three cycles). While vessels are unloading, approximately 70 to 75 percent of the green time is allocated to traffic exiting Colman Dock. During this time, delay for Alaskan Way traffic increases substantially as ferry traffic movements are prioritized.

Following an unloading event, the signals will attempt to reactivate coordination with neighboring signals and eventually return to normal operation. Once signal recovery is achieved, the north-south flow on Alaskan Way is largely uninterrupted at the Marion Street and Yesler Way cross streets except for pedestrian or occasional automobile crossings. Note that the pattern of regular unloading with such a long preemption often leads to essentially uncoordinated traffic operations on Alaskan Way during a large share of the peak period today. The traffic models used to assess intersection conditions for this EIS do not specifically model the back-and-forth preemption cycles, and instead reflect an estimated "average" condition during the peak hour. Therefore, LOS and delay at these locations may be somewhat understated.

Passenger Connections to the Seattle CBD

The majority of foot passengers arriving at or departing from Colman Dock use the larger vehicle ferries. Loading and unloading is at the upper level of Colman Dock, from which a direct walkway is provided that crosses above Alaskan Way and below the viaduct, connecting to the sidewalk on the south side of Marion Street at First Avenue. Passengers can also enter and exit at Alaskan Way, where they can catch a bus or cross Alaskan Way. Signalized crosswalks crossing Alaskan Way are located at Marion Street, Columbia Street, and Yesler Way. Conflicting traffic volumes are heavy on Alaskan Way, particularly while ferries are unloading at the Marion Street driveway (to northbound and southbound

Alaskan Way, as well as eastbound on Marion Street) and at Yesler Way (to southbound Alaskan Way only). Additionally, pedestrians using the Marion Street pedestrian bridge can face conflicts from turning vehicles as they rejoin the street-level sidewalk system at First Avenue and Marion Street. While the intersection is signalized, exiting ferry traffic that wishes to turn right onto southbound First Avenue would face conflicting pedestrians in the crosswalk.

Automobile Access and Egress

Both Colman Dock access points, Alaskan Way at Yesler Way and at Marion Street, are estimated to operate at an overall average of LOS C or better during both the AM and PM peak hours (Exhibits 4-43 and 4-44). All major movements operate at LOS C or better during either peak. Note, however, that both the Marion Street and Yesler Way intersections experience increased congestion while ferry vessels unload, with decreased congestion at other times. The data presented here are the average for the entire AM and PM peak hours.

Exhibit 4-43. Existing (2005) AM Peak Hour Average Vehicle Delay (Seconds) and LOS by Movement at Colman Dock

Traffic Movement	Average AM Peak Hour Conditions	
	Delay (seconds)	LOS
Marion Street	**12**	**B**
Eastbound (exiting Colman Dock)	19	B
Northbound Alaskan Way	5	A
Southbound Alaskan Way	9	A
Yesler Way	**19**	**B**
Eastbound (exiting Colman Dock)	18	B
Northbound left (entering Colman Dock)	11	B
Northbound through Alaskan Way	31	C
Southbound Alaskan Way	13	B

LOS = level of service

Exhibit 4-44. Existing (2005) PM Peak Hour Average Vehicle Delay (Seconds) and LOS by Movement at Colman Dock

Traffic Movement	Average PM Peak Hour Conditions	
	Delay (seconds)	LOS
Marion Street	**15**	**B**
Eastbound (exiting Colman Dock)	27	C
Northbound Alaskan Way	7	A
Southbound Alaskan Way	12	B
Yesler Way	**22**	**C**
Eastbound (exiting Colman Dock)	19	B
Northbound left (entering Colman Dock)	23	C
Northbound through Alaskan Way	25	C
Southbound Alaskan Way	21	C

LOS = level of service

4.10 Safety

This section summarizes collision data for SR 99 within the transportation study area. The analysis was conducted to describe the collision history on SR 99 in terms of rate of occurrence, collision types, and severity. Collision rates are compared with average rates for similar highway facilities in Washington state to help determine whether SR 99 experiences a higher than typical rate of collisions. The corridor is also analyzed on a segment-by-segment basis to identify specific locations where collisions occur with higher frequency or greater severity.

Collision frequency, type, and severity were assessed for the length of SR 99 between S. Spokane Street in the south and Valley Street in the north.

Collisions on SR 99 occur at higher frequencies than on average for urban, limited-access highways in the state. Collision rates are lower than average rates for urban principal arterials, however.

Individual segments of SR 99 were also assessed to determine where collisions occurred with higher than average frequencies or injury rates, as well as to identify predominant collision types.

Both northbound and southbound directions of the S. Spokane Street to Stadiums segment experience low collision rates and low rates of injury collisions relative to the rest of the corridor.

The southbound Downtown to Stadiums segment experiences high collision rates and a high rate of injury collisions relative to the corridor average.

The northbound and southbound Battery Street Tunnel segments experience much higher rates of collisions than the corridor on average. Northbound, a substantial share of these collisions appears to be associated with the Battery Street Tunnel on-ramp.

The northbound and southbound North of Battery Street Tunnel segments in the South Lake Union area experience different collision types than elsewhere on the corridor, including enter-at-angle collisions involving side-street connections and pedestrian collisions, which are of concern due to the vulnerability of pedestrians in collisions.

4.10.1 Collision Analysis Methodology

WSDOT provided collision data for SR 99 between S. Spokane Street and Aloha Street for the years 2005 to 2007. Data for these 3 years were analyzed to determine important characteristics of collisions both on the mainline and on connecting ramps within 250 feet of the mainline. Several parameters were analyzed to measure and assess collision characteristics:

- Collision rates by segment - To allow comparison of collision rates between corridor segments as well as to average rates on other similar facilities, collisions per MVMT were calculated for each corridor segment.
- Collision types by segment - The share of collisions for major collision types (e.g., fixed-object collisions, rear-end collisions, etc.) relative to total collisions are reported. Comparing the proportion of accident types by segment can help identify possible contributing factors to collisions.
- Collision severity by segment. - The share of injury collisions (injury collisions per MVMT) relative to total collisions is reported.

Segments Analyzed

Collision rates were calculated for the northbound and southbound directions of five primary mainline segments on SR 99. Generally, a segment was defined as beginning either 0.05 mile before an on-ramp or 0.05 mile after an off-ramp, and ending either 0.05 mile after the next off-ramp or 0.05 mile before the next on-ramp. This definition typically results in uniform volumes and lane configurations within a segment. Furthermore, collisions occurring on the first 250 feet of a connecting on-ramp or off-ramp are also considered as having occurred on the mainline.

Northbound

The northbound segments are the following:

- S. Spokane Street to Stadiums: Before the S. Spokane Street on-ramp to before the First Avenue S. on-ramp.
- Stadiums to Downtown: Before the First Avenue S. on-ramp to after the Seneca Street off-ramp.
- Downtown to Battery Street Tunnel: After the Seneca Street off-ramp to after the Western Avenue off-ramp.
- Battery Street Tunnel: After the Western Avenue off-ramp to before the Denny Way on-ramp. Note that this segment includes the Battery Street Tunnel, Battery Street Tunnel ramps, and the connecting mainline sections external to the tunnel.
- North of Battery Street Tunnel: Before the Denny Way on-ramp to after Valley Street.

Southbound

The southbound segments are the following:

- North of Battery Street Tunnel: before Valley Street to after the Denny Way off-ramp.

- Battery Street Tunnel: after the Denny Way off-ramp to before the Elliott Avenue on-ramp (including the Battery Street Tunnel, the Battery Street Tunnel off-ramp, and the connecting mainline sections external to the tunnel).
- Battery Street Tunnel to Downtown: before the Elliott Avenue on-ramp to before the Columbia Street on-ramp.
- Downtown to Stadiums: before the Columbia Street on-ramp to after the First Avenue S. off-ramp.
- Stadiums to S. Spokane Street: after the First Avenue S. off-ramp to after the S. Spokane Street off-ramp.

As noted, the short distance between the Elliott/Western ramps and the Battery Street Tunnel ramps was not considered an independent segment; rather it was grouped with the Battery Street Tunnel segment. The corridor north of the Battery Street Tunnel was considered a single segment (North of Battery Street Tunnel).

4.10.2 Collision Analysis Results by Segment

Collision frequency, expressed as the number of collisions per MVMT, is a standardized measure that is useful in comparing collision rates between different segments or even different highways. This section presents collision rates for the major segments of SR 99 within the project area, and for comparative purposes, average collision rates for other similar highway facilities. Collision rates for other facilities should be compared only in terms of general order of magnitude since variations in methodology are common.

Overview of Collision Analysis Results

Collisions on the SR 99 corridor from S. Spokane Street to Aloha Street occur at a rate of 1.83 to 2.03 collisions per MVMT, compared to a historical average of 1.32 to 1.60 collisions per MVMT for all urban, limited-access corridors in Washington. Conversely, the collision rates on SR 99 are 16 to 38 percent lower than systemwide averages for urban principal arterials in Washington, which are 2.41 to 2.97 collisions per MVMT.

Some segments of SR 99 exhibit elevated collision rates relative to the corridor average. The northbound and southbound Battery Street Tunnel segment (Elliott/Western ramps to Denny Way ramps) shows much higher collision rates than most of the other segments in the corridor. Northbound, a substantial share of these collisions appears to be associated with the Battery Street Tunnel on-ramp. A review of the collision locations also indicates that collision frequencies are higher in the curved section of the tunnel, where excessive speed, limited sight distance, and limited roadside clearance are all possible contributing factors.

The southbound Downtown to Stadiums segment (southbound SR 99 between the Columbia Street on-ramp and the First Avenue S. off-ramp) also experiences a high collision rate and moderately high rate of injury collisions relative to the rest of the corridor. A combination of factors likely contributes to these collision rates, including (1) narrow lanes, (2) little roadside clearance, (3) left-side merging traffic from Columbia Street, (4) left-side diverging traffic to First Avenue S., (5) heavy weaving movements associated with left-side on- and off-ramp traffic, and (6) traffic congestion.

The northbound and southbound North of Battery Street Tunnel segment (between the Denny Way ramps and north of Valley Street) in the South Lake Union area exhibits moderate collision rates but unique collision types. The numerous right-angle street connections to SR 99 are a factor in a large share of collisions in this segment, with a much higher rate of enter-at-angle accidents in the northbound direction and a higher rate of sideswipe accidents in the southbound direction. Both the northbound and southbound directions in this segment exhibit lower rates of fixed-object collisions than the corridor averages, and the northbound direction has considerably lower rear-end collision rates than the southbound direction in this segment or the corridor average. Pedestrian collisions are a particular concern in this segment, as SR 99 is at-grade, and pedestrians crossing the roadway (illegally) have been involved in a number of collisions. These collisions most often tend to involve fatalities or serious injury.

Collision Rates on SR 99

Collision rates are measured in terms of collisions per MVMT and include those collisions occurring on the first 250 feet of any connecting ramps. Exhibits 4-45 and 4-46 summarize collision rates for the corridor.

Exhibit 4-45. Collision Rates for Northbound SR 99 Segments (2000–2003)

Segment	Collisions per MVMT
NB S. Spokane Street to Stadiums	1.07
NB Stadiums to Downtown	1.90
NB Downtown to Battery Street Tunnel	1.54
NB Battery Street Tunnel	5.46
NB North of Battery Street Tunnel	1.60
SR 99 Corridor Average	1.83

Note: Includes collisions on ramps that are located within 250 feet of the mainline.
MVMT - million vehicle miles of travel
NB = northbound

Exhibit 4-46. Collision Rates for Southbound SR 99 Segments (2000–2003)

Segment	Collisions per MVMT
SB North of Battery Street Tunnel	1.51
SB Battery Street Tunnel	4.81
SB Battery Street Tunnel to Downtown	1.02
SB Downtown to Stadiums	4.54
SB Stadiums to S. Spokane Street	1.21
SR 99 Corridor Average	2.03

Note: Includes collisions on ramps that are located within 250 feet of the mainline.
MVMT - million vehicle miles of travel
SB = southbound

In the northbound direction, SR 99 was found to have an overall collision rate of 1.83 collisions per MVMT. The collision rate for the S. Spokane Street to Stadiums segment is very low—about 42 percent lower than the corridor average. The rate of collisions on the Stadiums to Downtown segment is second highest of the five northbound segments, with weaving movements and backups from the Seneca Street and Western Avenue off-ramps likely contributing to higher collision rates on the northbound Stadiums to Downtown segment. In addition, this segment carries the highest volume of traffic on the corridor, which could also be a contributing factor.

The Downtown to Battery Street Tunnel segment has a collision rate lower than the corridor average, despite the fact that backups are regularly observed on this segment. Collisions on the Western Avenue off-ramp—not included in the mainline segment analysis—do occur with higher frequency than on other ramps, however. The northbound Battery Street Tunnel segment has the highest overall collision rate (5.46) on the corridor. Frequent collisions here are associated with a number of factors, including limited sight distance and tight curves within the tunnel, lack of clear distance from the tunnel walls, and merging traffic entering from the Battery Street Tunnel on-ramp, which has limited sight distance and a very short merge area. Collision rates on the North of Battery Street Tunnel segment in the South Lake Union area are moderate in relation to other corridor segments.

Southbound, the overall mainline collision rate is higher than northbound: 2.03 collisions per MVMT, with segments showing a similar pattern of collision occurrences relative to the corresponding northbound segments.

The southbound North of Battery Street Tunnel segment has a moderate collision rate relative to other corridor segments. Though lower than the corresponding northbound segment, the southbound Battery Street Tunnel segment also shows a

very high rate of collisions. Collision rates are quite low on the southbound Battery Street Tunnel to Downtown segment, but jump substantially on the adjacent Downtown to Stadiums segment. This segment includes a left-side merging on-ramp from Columbia Street and a left-side off-ramp to First Avenue S., and experiences recurrent congestion during the PM peak. The southbound Stadiums to S. Spokane Street segment exhibits a relatively low collision rate, as expected given that the segment is largely a uniform configuration with few conflicts between traffic movements.

Comparison of Collision Rates on SR 99 to Other Facilities

Exhibit 4-47 summarizes average systemwide collision rates reported for urban areas in Washington. While general comparisons may be made between collision rates on SR 99 and other facilities, factors such as inconsistencies in methodology, unique driver characteristics, and differences in local conditions may influence results. Furthermore, SR 99 is a somewhat unique facility type and is not fully consistent with the Interstate Freeway designation.

Exhibit 4-47. Average Systemwide Collision Rates Reported for Urban Areas

Segment	Collisions per MVMT
SR 99	
SR 99 Northbound Corridor Average	1.83
SR 99 Southbound Corridor Average	2.03
Comparison of Statewide Collision Rates	
WSDOT Urban Interstate Freeways[1]	1.32–1.60
WSDOT Urban Principal Arterials (2000–2003)[1]	2.41–2.97

MVMT = million vehicle miles of travel
[1] WSDOT unpublished collision data for 2003, and 1996 Washington State Highway Accident Report (WSDOT 1996b).

Collision rates on SR 99 are 14 to 54 percent higher than the average systemwide collision rates historically reported for urban, limited-access freeways in Washington. Note that the most recent available data showed a statewide rate of 1.32 collisions per MVMT in 2003, while rates dating back to 1996 have been as high as 1.60 collisions per MVMT.

Although SR 99 through the study area most closely matches FHWA's "Principal Arterial—Other Freeways and Expressways" category, collision rates for principal arterials are provided for added context as well, since WSDOT classifies SR 99 as an "Urban Principal Arterial," and the City of Seattle classifies SR 99 as a "Principal Arterial." The northern segment of the corridor, north of Denny Way, in some ways operates more like a principal arterial due to the side street connections and adjacent pedestrian activity. Due to the mix of roadway types in

the SR 99 corridor, the collision rates for SR 99 can also be compared to the urban principal arterial collision rates of 2.41 to 2.97 collisions per MVMT.

SR 99 collision rates are 16 to 38 percent lower than systemwide averages for urban principal arterials in Washington.

Collision Type by Segment

To help identify possible factors associated with collisions, the proportion of collisions by type was reviewed for the major corridor segments (Exhibits 4-48 and 4-49). Collisions are categorized into the following types:

- Fixed-object: Collisions with roadside barriers or objects (walls, guardrail, other roadside appurtenance).
- Read-end: Collisions where one or more vehicles strike slower-moving or stopped vehicles from behind.
- Sideswipe: Side-to-side collisions between two vehicles traveling in the same direction, often involving a lane change or straying from the travel lane.
- Enter-at-angle: Collisions with vehicles entering the roadway from side-street connections.
- Pedestrian: Collisions between vehicles and pedestrians or bicycles.
- Other/unknown: All other collision types, including wrong direction of travel, overturned vehicle, and other unknown or unclassified collision types.

Exhibit 4-48 summarizes the share of collisions by collision type for northbound SR 99. Fixed-object (34 percent), rear-end (37 percent), and sideswipe (17 percent) collisions predominate on northbound SR 99. Fixed-object collisions are most prevalent northbound on the following segments:

- 49 percent of collisions are fixed-object on the northbound S. Spokane Street to Stadiums segment.
- 33 percent of collisions are fixed-object on the northbound Stadiums to Downtown segment.
- 34 percent of collisions are fixed-object on the northbound Battery Street Tunnel segment.

Rear-end collisions account for especially high shares of collisions on the northbound Downtown to Battery Street Tunnel segment (57 percent) and adjacent Battery Street Tunnel segment (47 percent). Queuing from the Western Avenue off-ramp is likely a primary factor associated with the high share of rear-end collisions on the first segment, while limited sight distances and merging traffic from the Battery Street Tunnel on-ramp contribute to high shares of rear-end collisions on the Battery Street Tunnel segment.

Exhibit 4-48. Mainline Collision Types for Northbound SR 99 Segments

Segment	Collision Types					
	Fixed-Object	Rear-End	Sideswipe	Enter-at-Angle	Pedestrian	Unknown/ Other[1]
NB S. Spokane Street to Stadiums	49%	31%	11%	0%	0%	9%
NB Stadiums to Downtown	33%	32%	26%	0%	0%	9%
NB Downtown to Battery Street Tunnel	23%	57%	20%	0%	0%	0%
NB Battery Street Tunnel	34%	47%	13%	0%	0%	6%
NB North of Battery Street Tunnel	10%	18%	21%	33%	8%	10%
SR 99 Corridor Average	34%	37%	17%	4%	1%	7%

NB = northbound

[1] Roll over, wrong direction of travel, or unknown/unclassified.

Sideswipe collisions tend to occur more frequently on segments where frequent lane changing occurs to access connections to and from SR 99 (i.e., northbound Stadiums to Downtown, Downtown to Battery Street Tunnel, and North of Battery Street Tunnel segments).

The northbound North of Battery Street Tunnel segment is unique in that enter-at-angle collisions occur frequently (33 percent) as a result of the existing side-street connections. This segment also experiences collisions involving pedestrians (8 percent), which are a particular concern due to the typical severity of such collisions in terms of injury to the pedestrian.

Exhibit 4-49 summarizes the share of collisions by collision type for southbound SR 99. As found in the northbound direction, the southbound North of Battery Street Tunnel segment also experiences enter-at-angle collisions, though at a lower rate (9 percent). Pedestrian collisions (9 percent) are again a concern on this segment.

The share of fixed-object collisions is very high (52 percent) for the southbound Battery Street Tunnel segment, where a combination of excessive speed and limited lateral clearance in the Battery Street Tunnel are likely factors associated with this type of collision. Note that enter-at-angle collisions here are associated with the Battery Street Tunnel off-ramp and street connections to that ramp.

Exhibit 4-49. Mainline Collision Types for Southbound SR 99 Segments

Segment	Collision Types					
	Fixed-Object	Rear-End	Sideswipe	Enter-at-Angle	Pedestrian	Unknown/ Other[1]
SB North of Battery Street Tunnel	15%	35%	24%	9%	9%	9%
SB Battery Street Tunnel	52%	22%	8%	8%	1%	9%
SB Battery Street Tunnel to Downtown	11%	57%	14%	0%	0%	17%
SB Downtown to Stadiums	33%	31%	24%	0%	0%	12%
SB Stadiums to S. Spokane Street	29%	44%	14%	0%	0%	13%
SR 99 Corridor Average	33%	35%	16%	3%	1%	12%

SB = southbound

[1] Roll over, wrong direction of travel, or unknown/unclassified.

Sideswipe collisions again tend to account for a greater share of collisions in locations where ramp locations and configurations lead to more lane-changing activity. This is true on the southbound North of Battery Street Tunnel and Downtown to Stadiums segments.

Rear-end collisions predominate on the southbound Battery Street Tunnel to Downtown and Stadiums to S. Spokane Street segments, though as discussed in the following section, the frequency of collisions in general is low on this segment.

Collision Severity by Segment

Exhibits 4-50 and 4-51 summarize collision severity for the SR 99 corridor segments. Collision severity is classified as either property-damage-only collisions or injury collisions. The latter category includes collisions that were identified in collision reports as possible injury, evident injury, debilitating injury, or fatal collisions.

Exhibit 4-50. Collision Severity for Northbound SR 99 Segments

Segment	Property Damage Only	Injury
NB S. Spokane Street to Stadiums	63%	37%
NB Stadiums to Downtown	63%	37%
NB Downtown to Battery Street Tunnel	59%	41%
NB Battery Street Tunnel	65%	35%
NB North of Battery Street Tunnel	59%	41%
SR 99 Corridor Average	63%	37%

NB = northbound

Exhibit 4-51. Collision Severity for Southbound SR 99 Segments

Segment	Property Damage Only	Injury
SB North of Battery Street Tunnel	59%	41%
SB Battery Street Tunnel	67%	33%
SB Battery Street Tunnel to Downtown	49%	51%
SB Downtown to Stadiums	58%	42%
SB Stadiums to S. Spokane Street	51%	49%
SR 99 Corridor Average	58%	42%

SB = southbound

Northbound, injury collisions account for on average 37 percent of all collisions. Variation by segment is minor, with all segments showing injury rates of between 35 and 41 percent. The northbound Downtown to Battery Street Tunnel and North of Battery Street Tunnel segments shows the highest percentage of injury collisions. While a lower share of collisions on the Battery Street Tunnel segment involve injuries, the number of injury collisions is still relatively high due to the overall higher frequency of collisions here.

Southbound shows a higher variation in severity by segment. About half of collisions on the southbound Battery Street Tunnel to Downtown and Stadiums to S. Spokane Street segments involve injuries, though these segments have lower collision frequencies overall.

4.10.3 Corridor Design Aspects

SR 99 is a multilane, divided highway that travels through downtown Seattle within the study area. SR 99 is not a limited-access facility and does not meet access and other criteria normally associated with a freeway facility. In terms of functional classification, it most closely matches FHWA's "Principal Arterial – Other Freeways and Expressways" category. WSDOT classifies SR 99 as an "Urban Principal Arterial" and also designated an access management classification of "Managed Access – Class 1" south of Denny Way (this is the highest level of access management), and "Managed Access – Class 3" north of Denny Way. The City of Seattle classifies SR 99 simply as a "Principal Arterial."

Access to and from SR 99 is provided by ramp connections between S. Spokane Street and the Battery Street Tunnel and by a combination of ramps and right-angle street connections north of the Battery Street Tunnel. The street connections allow only right turns on and off SR 99 (a center median barrier on SR 99 prevents left turns), and stop signs govern traffic entering from these connections. SR 99 was constructed in the 1950s and was designed to meet geometric standards that are less stringent than those typical for new highways today. Furthermore, anticipated traffic volumes in the 1950s were much lower than those experienced

today. Lane widths, shoulder widths, acceleration and deceleration lanes, and other geometric features on SR 99 generally conform to a lesser standard than those found on newer highway facilities.

4.11 Event Traffic

South Portal Area

During events at Safeco Field or Qwest Field, traffic levels in the general vicinity intensify before and after the event, travel patterns are altered as patrons search for parking, and pedestrian activity increases. As a result, local traffic conditions are typically much more congested prior to and following events compared to typical, non-event conditions (discussed previously). For example, estimates indicate that between 15,000 and 20,000 additional vehicles, beyond background traffic levels, enter and exit the stadium area for a typical Seahawks game.

Regional access to northbound SR 99 and from southbound SR 99 is currently provided for events in the stadium area south of downtown via the on- and off-ramps at First Avenue S. SR 99 connections to and from the south are not currently provided in the stadium area. Instead, the nearest access points are a northbound off-ramp to Seneca Street and a southbound on-ramp from Columbia Street in the downtown area, or connections to E. Marginal Way (from SR 99) or First Avenue S. (from West Seattle) near S. Spokane Street. Other regional access to and from the stadium area is provided by I-5 or I-90 via SR 519.

Explicit detour routing and comprehensive traffic control measures are typically in place on First Avenue S. and critical east-west arterials (e.g., S. Royal Brougham Way and S. Atlantic Street) for large events at Safeco Field and Qwest Field such as Seahawks and Mariners games and Sounders matches. These measures commonly include police-based traffic management commissioned by the City of Seattle.

Use of other travel modes to events is common as well. King County Metro operates bus service on First and Fourth Avenues S. Both Metro buses and Sound Transit's Link LRT operate in the DSTT and E3 Busway to the east of the stadiums. Sound Transit also operates commuter rail service from nearby King Street Station. As services increase and/or are enhanced for transit modes, event-related ridership to and from the stadium area will likely increase over time.

North Portal Area

Seattle Center is the major event facility in the north portal area. This facility is a year-round venue that is home to several annual events, including Bumbershoot, Northwest Folklife Festival, and Seattle Storm Women's National Basketball Association (WNBA) games. Other large-scale events related to holidays, concerts, and children's programs also occur throughout the year.

A primary route to Seattle Center is from I-5 via the Mercer Street exit to Valley Street and Broad Street. From Seattle Center to I-5, Mercer Street provides a connection to northbound and southbound I-5. Additional routes to and from Seattle Center include the following:

- Ballard: via Denny Way, Western Avenue, and Elliott Avenue W.
- To SR 99 southbound: via Broad Street and Thomas Street to Aurora Avenue or via Broad Street and Elliott Avenue.
- To SR 99 northbound: via Second Avenue to Battery Street or via Mercer Street, Dexter Avenue N., and Thomas Street.
- To I-5 southbound: via Second Avenue to Spring Street or via Denny Way to Yale Avenue.
- To I-5 northbound: via Denny Way, Boren Avenue, and Olive Way.

For larger events at Seattle Center, traffic control measures and minor detours are occasionally used to manage access to parking and general circulation. However, due to the smaller scale of events and the capacity of Seattle Center, such measures are not in place as consistently nor are they required as frequently compared to the larger sporting venues in the south (Safeco Field and Qwest Field). Transit service for events at Seattle Center are not well-served compared to the south end stadium area. However, local bus and monorail service is provided to and from the downtown core (and to and from some neighborhoods on the periphery).

Chapter 5 OPERATIONAL EFFECTS, MITIGATION, AND BENEFITS

This chapter describes the changes in travel patterns and traffic volumes for the 2015 Existing Viaduct, 2015 Viaduct Closed (No Build Alternative), 2015 Project (Bored Tunnel Alternative), and 2030 Project (Bored Tunnel Alternative).

5.1 Regional Context and Travel Patterns

The discussion of the regional context and travel patterns illustrates how travel patterns might change in the future; it includes AM and PM peak period and daily estimates of various travel parameters (e.g., VMT) for routes that represent major movements accommodated by the SR 99 corridor.

5.1.1 Vehicle Miles of Travel

VMT for this study is defined as the total number of miles traveled in either the four-county Puget Sound region or Seattle's Center City area for a given time period. The discussions below describe estimated VMT for AM and PM peak periods and daily totals for the 2015 Existing Viaduct, 2015 Viaduct Closed (No Build Alternative), 2015 Project, and 2030 Project. These estimates were derived using the project's travel demand model. Exhibit 5-1 provides a summary table of VMT.

Exhibit 5-1. Vehicle Miles of Travel

Performance Measure	Existing (2005)	Year 2015			2030 Project
		Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	
Seattle's Center City					
AM	394,200	433,100	392,500	427,000	443,800
PM	484,500	537,500	490,700	530,600	557,400
Daily	2,170,000	2,432,700	2,239,500	2,406,700	2,533,900
Four-County Region					
AM	15,767,300	18,028,300	17,963,800	18,020,100	20,292,700
PM	18,432,500	21,233,700	21,183,700	21,227,300	24,008,900
Daily	84,458,000	97,233,000	96,982,000	97,213,100	109,718,600

Key Findings

AM, PM, and daily VMT are about equal for all 2015 modeled conditions for the four-county Puget Sound region because the impacts of the various modeled conditions for SR 99 would have little effect on overall multicounty trip making. However, changes to VMT are more notable for the Center City area because changes to SR 99 would cause greater impacts at this sub-area level.

The 2015 Viaduct Closed (No Build Alternative) shows substantially lower VMT for the Center City area than the other 2015 modeled conditions (Existing Viaduct, Project, and Program), regardless of time period. This is likely due to a disincentive of trip making either to or through the Center City area caused by increased traffic and congestion on city streets. With the 2015 Viaduct Closed (No Build Alternative), roughly 100,000 daily trips that use SR 99 to access or travel through downtown Seattle would have to be accommodated by local street capacity, I-5, transit, or bicycling and walking modes.

The 2015 Project shows a slight decrease in daily VMT compared to the 2015 Existing Viaduct. The slight decrease is likely due to the removal of the Elliott/Western ramps that currently link SR 99 and the Magnolia/Interbay/Ballard areas. Removal of the midtown ramps at Seneca and Columbia Streets in the 2015 Project may also contribute to the reduced VMT in the Center City area compared to the 2015 Existing Viaduct.

For the 2015 Viaduct Closed (No Build Alternative), daily and AM and PM peak period VMT for the four-county region are about the same as those for the 2015 Existing Viaduct and the 2015 Project. However, in the Center City area, AM peak period VMT for the 2015 Viaduct Closed (No Build Alternative) is over 9 percent lower than VMT for the 2015 Existing Viaduct and over 8 percent lower than VMT for the 2015 Project. In the PM peak period, VMT for the 2015 Viaduct Closed (No Build Alternative) is almost 9 percent lower than VMT for the 2015 Existing Viaduct and over 7 percent lower than VMT for the 2015 Project. Lower VMT in the Center City area for the 2015 Viaduct Closed (No Build Alternative) is probably the result of increased congestion and delay due to the closure of the viaduct and redistribution of trips from this facility to congested surface streets, which would tend to discourage travel in this area.

For the 2015 Existing Viaduct, daily VMT for the four-county Puget Sound region increases by about 15 percent (about 12.8 million miles) over existing conditions (2005 levels), which is a result of the forecasted growth in regional population and employment within the four-county region. Comparable increases in VMT are shown for the AM and PM peak periods. The 2015 Project shows a very slight decrease in daily VMT in comparison with the 2015 Existing Viaduct, both regionwide and for the Center City area. The slight decrease is likely due to the removal of access to the Magnolia/Interbay/Ballard areas via the Elliott/Western

ramps in the Bored Tunnel Alternative. The 2015 Existing Viaduct assumes continued use of the Elliott/Western ramps that currently provide access to trips to and from northwest Seattle.

For the 2030 Project, in the AM peak period, VMT is expected to grow by about 4 percent over 2015 Project levels and by more than 2 percent over 2015 Existing Viaduct levels for the Center City area. For the PM peak period, VMT is expected to grow by more than 3 percent over 2015 Existing Viaduct levels and by 5 percent over 2015 Project levels. Daily VMT for the 2030 Project for the four-county region increases by almost 13 percent (around 12.5 million miles) over the levels for the 2015 Existing Viaduct and the 2015 Project. The 2030 daily VMT increase in the Center City area is expected to be less, however, at approximately 5 percent (about 127,000 miles) over the 2015 Project level. The lower growth rate for VMT in the Center City area is a result of expanded transit service, higher parking and automobile operating costs, and a street network that has limited capacity for growth. Also, despite the low growth rate, the absolute level of VMT in the Center City area remains substantial.

5.1.2 Vehicle Hours of Travel

VHT is defined as the calculated total number of hours traveled in either the four-county Puget Sound region or Seattle's Center City area for a given time period. The VHT estimates discussed below were derived using the project's travel demand model. The evaluation describes AM and PM peak period and daily VHT totals for the 2015 Existing Viaduct, 2015 Viaduct Closed (No Build Alternative), 2015 Project, and 2030 Project, and Exhibit 5-2 summarizes VHT.

Exhibit 5-2. Vehicle Hours of Travel

Performance Measure	Existing (2005)	Year 2015			2030 Project
		Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	
Seattle's Center City					
AM	13,700	16,800	18,200	17,200	18,700
PM	18,300	23,800	26,500	24,500	30,700
Daily	71,000	87,200	91,800	88,500	101,400
Four-County Region					
AM	566,600	747,200	745,400	747,600	1,104,500
PM	656,800	858,100	860,700	858,900	1,232,700
Daily	2,666,700	3,311,300	3,312,500	3,312,900	4,428,000

Note: The VHT estimates do not include centroid connectors in the calculations.

Key Findings

For the 2015 Existing Viaduct, daily VHT for the four-county Puget Sound region is projected to grow by more than 24 percent (about 645,000 hours) over existing conditions (2005 levels). Comparable levels of growth in daily VHT are found in the Center City area, as well as in the AM and PM peak periods for both the four-county and Center City areas.

With the 2015 Viaduct Closed (No Build Alternative), the increased traffic congestion brought about by the closure of the viaduct with no replacement in capacity is likely causing the increased VHT relative to the VHT for the 2015 Existing Viaduct and the 2015 Project.

By 2030, the greatest percentage growth in VHT is expected to occur outside of Seattle due to increased growth in VMT in those areas. Growth in VHT in the Center City is offset by an increasing transit mode share and a limited capacity for accommodating additional vehicles.

With the 2015 Existing Viaduct, daily VHT for the four-county region increases by about 24 percent (644,600 hours) over the comparable existing conditions. The AM peak period VHT for the 2015 Existing Viaduct is also forecasted to grow by almost 32 percent over existing conditions (2005 levels). The PM peak period VHT for the 2015 Existing Viaduct is forecasted to increase similarly, by more than 30 percent over the comparable existing conditions. For the 2015 Existing Viaduct, VHT during the daily and AM and PM peak periods for the four-county region is about equal to VHT forecasted for the 2015 Project.

For the 2015 Viaduct Closed (No Build Alternative), VHT during the daily and AM and PM peak periods for the four-county region is forecasted to be about the same as VHT for the 2015 Existing Viaduct and the 2015 Project. In the Center City area during the AM peak period, VHT for the 2015 Viaduct Closed (No Build Alternative) is 8 percent higher than VHT for the 2015 Existing Viaduct and almost 6 percent higher than VHT for the 2015 Project. During the PM peak period, the 2015 Viaduct Closed (No Build Alternative) shows VHT over 11 percent higher than VHT for the 2015 Existing Viaduct and 8 percent higher than VHT for the 2015 Project. Daily VHT is slightly higher for the 2015 Viaduct Closed (No Build Alternative) than for the 2015 Existing Viaduct (4,600 hours, or 5 percent) and the 2015 Project (3,300 hours, or almost 4 percent). Increased traffic congestion brought about by the closure of the Alaskan Way Viaduct and no replacement in capacity (assumed under the Viaduct Closed [No Build Alternative]) is likely causing the measurable increase in VHT for the 2015 Viaduct Closed (No Build Alternative) over that for the 2015 Existing Viaduct and the 2015 Project.

For the 2030 Project, daily VHT for the four-county region is expected to grow from the level for the 2015 Project by over 33 percent (over 1.1 million hours). AM peak period VHT is forecasted to increase by almost 48 percent, and PM peak period VHT is forecasted to increase by 43 percent. In the Center City area, however, VHT is expected to grow by only 9 percent in the AM peak period, 25 percent in the PM peak period, and over 14 percent (12,900 hours) on a daily basis between the 2015 Project and the 2030 Project. The percentage growth in VHT is higher for the four-county region than for the Center City, which corresponds with the lower growth in VMT in the Center City area for reasons noted in the discussion of VMT, primarily the increased transit mode share, increased parking and automobile operating costs, and a limited capacity to carry additional traffic.

5.1.3 Vehicle Hours of Delay

VHD is defined as the calculated total number of hours of delay incurred (i.e., travel time above that incurred during free-flow operations) by traffic on roadways in either the four-county Puget Sound region or Seattle's Center City area for a given time period. This measure is often used as an indicator of overall traffic congestion. The VHD estimates were derived using the project's travel demand model. The evaluation describes AM and PM peak periods and daily totals for the 2015 Existing Viaduct, 2015 Viaduct Closed (No Build Alternative), 2015 Project, and 2030 Project. Exhibit 5-3 provides a summary table of VHD.

Exhibit 5-3. Vehicle Hours of Delay

Performance Measure	Existing (2005)	Year 2015			2030 Project
		Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	
Seattle's Center City					
AM	3,500	5,300	7,100	5,700	6,700
PM	5,300	9,100	12,400	9,900	15,200
Daily	14,400	22,700	30,000	24,300	33,300
Four-County Region					
AM	137,700	253,500	252,700	254,000	533,100
PM	149,900	271,700	274,800	272,600	549,900
Daily	385,200	678,200	682,600	679,700	1,374,900

Key Findings

Looking at activity in the Center City area, for the 2015 Viaduct Closed (No Build Alternative), increased traffic congestion brought about by the closure of the viaduct with no replacement in capacity) is likely causing the large increase in VHD over VHD for the 2015 Existing Viaduct and the 2015 Project.

VHD is slightly higher for the 2015 Project as compared to the 2015 Existing Viaduct, which is likely because the Elliott/Western ramps and the midtown ramps are not provided in the Bored Tunnel Alternative, resulting in more travel on City streets under this alternative.

By 2030, a higher percentage growth in VHD is projected to occur outside Seattle, reflecting the fact that a larger number of new trips to and from downtown are expected to be accommodated by transit in the future.

In 2015, during the AM peak period, VHD for the 2015 Existing Viaduct in the four-county region increases by about 84 percent over the comparable VHD under existing conditions (2005). The 2015 Existing Viaduct PM peak period VHD increases by 81 percent over the VHD under existing conditions, and daily VHD for the 2015 Existing Viaduct increases by about 76 percent (293,000 hours) over the comparable VHD under existing conditions. The 2015 Existing Viaduct shows daily and AM and PM peak period VHD generally equal to VHD forecasted for the 2015 Project, both regionwide and for the Center City area. The 2015 Project is slightly higher, reflecting the absence of the Elliott/Western and midtown ramps and the additional traffic that would use City streets as a result.

The 2015 Viaduct Closed (No Build Alternative) shows about the same levels of VHD as those for the 2015 Existing Viaduct and the 2015 Project for the daily and AM and PM peak periods in the four-county region. Looking at the Center City area, however, the daily VHD for the 2015 Viaduct Closed (No Build Alternative) is substantially higher than that for the 2015 Existing Viaduct (7,300 hours, or 32 percent) and the 2015 Project (5,700 hours, or 23 percent). In the AM peak period, the 2015 Viaduct Closed (No Build Alternative) also shows similar VHD increases over those for the 2015 Existing Viaduct (34 percent) and the 2015 Project (over 24 percent), whereas in the PM peak period, the 2015 Viaduct Closed (No Build Alternative) continues to show higher VHD than the 2015 Existing Viaduct (36 percent) and the 2015 Project (25 percent).

For the 2030 Project , daily VHD levels for the four-county region are expected to grow from levels for the 2015 Project by approximately 102 percent (695,200 hours). AM peak period VHD is forecasted to increase by 110 percent, and PM peak period VHD by 102 percent. However, VHD growth within the Center City area between the 2015 Project and the 2030 Project is expected to be lower, at 18 percent, 54 percent, and 37 percent (9,000 hours) for the AM peak, PM

peak, and daily periods, respectively. The lower rate of increase expected within the Center City area is likely because with the proposed enhancements to transit serving downtown, much of the growth in trips is expected to be accommodated by transit as opposed to additional vehicle trips. Furthermore, increased parking and automobile operating costs and a limited capacity for vehicle growth in the downtown region enhance the attractiveness of alternative modes of travel.

5.1.4 Alaskan Way Viaduct (SR 99) Users

The following sections present data that describe users of SR 99 within the study area for the 2015 Existing Viaduct and the 2015 Project.

Key Findings

Traffic patterns of SR 99 users for the 2015 Existing Viaduct are expected to be similar to those described for existing conditions (2005), except that less traffic is expected to use the midtown ramps due to a shift to the stadium area ramps. The stadium area ramps are also expected to attract some traffic to SR 99 that would have otherwise used First Avenue S. to reach destinations in the SODO area.

The Bored Tunnel Alternative would serve a higher percentage of through traffic (i.e., traffic that travels on SR 99 through the length of the study area) than the current facility does. Of the 86,600 trips projected to use the bored tunnel, 64 percent are expected to come from Aurora Avenue north of Aloha Street. This compares to current through trips on SR 99 of roughly 46 percent from Aurora Avenue north of Aloha Street.

Some traffic that would have otherwise used the Elliott/Western ramps to access SR 99 is expected to use Mercer Street to access SR 99 at the South Lake Union area ramps instead. This contributes to the relatively high percentage of bored tunnel traffic (36 percent) accessing SR 99 from the South Lake Union area.

The new stadium area ramps to and from the south are expected to serve both traffic destined for downtown (i.e., the traffic that currently uses the midtown ramps) as well as a large share of the traffic destined for the Interbay area, Magnolia, and northwest Seattle (i.e., traffic that currently uses the Elliott/Western ramps).

SR 99 Daily Traffic Patterns – 2015 Existing Viaduct

Traffic patterns of SR 99 users for the 2015 Existing Viaduct are expected to be similar to those described for 2005 existing conditions, except that less traffic is expected to use the midtown ramps due to a shift to the stadium area ramps. The stadium area ramps are also expected to attract some traffic to SR 99 that would have otherwise used First Avenue S. to reach destinations in the SODO area.

SR 99 Daily Traffic Patterns – 2015 Project

Exhibit 5-4 shows the projected daily traffic patterns on SR 99 within the study area for the 2015 Project. Blue lines indicate trips that use the bored tunnel, red lines show trips that use SR 99 (Aurora Avenue) but enter or exit north of the bored tunnel, and purple lines show trips that travel on SR 99 but enter or exit south of the bored tunnel. Arrows indicate locations where traffic enters or exits the corridor, with each arrow representing a ramp movement. Access points in the South Lake Union area are grouped together.

At S. Spokane Street, 34,900 vehicles are projected to exit and enter the corridor to and from the west via either the West Seattle high bridge or the low bridge to Harbor Island. About two-thirds of those vehicles (23,800) are estimated to be vehicles emerging from or destined for the bored tunnel, while the remainder are vehicles that would enter or exit south of the CBD. Approximately 63,000 trips would exit and enter the corridor to and from SR 99 south of S. Spokane Street. Again, around two-thirds of these vehicles would be coming from or going to the bored tunnel, while the remainder would be vehicles entering or exiting south of the CBD.

At the south end of the downtown area, 31,100 vehicles are anticipated to travel between SR 99 south of the project area and the ramps to Alaskan Way S. (near S. King Street). Because ramps would no longer connect to Elliott and Western Avenues, an increase in vehicles accessing SR 99 at the Alaskan Way S. ramps is anticipated. Approximately 19,800 vehicles would exit SR 99 southbound or enter it northbound using the S. Royal Brougham Way ramps. This is a reduction compared to the 2015 Existing Viaduct, as trips between the stadium area and Belltown would no longer use SR 99.

Some 86,600 vehicles are projected to use the bored tunnel on a typical weekday. Sixty-four percent of the bored tunnel traffic (55,400 trips) consists of Aurora Avenue trips; the 31,200 remaining trips (or 36 percent of the bored tunnel traffic) enter and exit the corridor in the South Lake Union area. With the lack of ramps at Elliott and Western Avenues and the conversion of Mercer Street to two-way operation between Fifth Avenue N. and Dexter Avenue N., higher volumes are anticipated to access the bored tunnel in the South Lake Union area in the 2015 Project compared to the 2015 Existing Viaduct.

At the north end of the study area (on Aurora Avenue), about 41 percent of trips using SR 99 are expected to enter and exit the corridor north of the bored tunnel. Of the 94,400 daily vehicle trips on Aurora Avenue, 39,000 trips would enter and exit in the South Lake Union area.

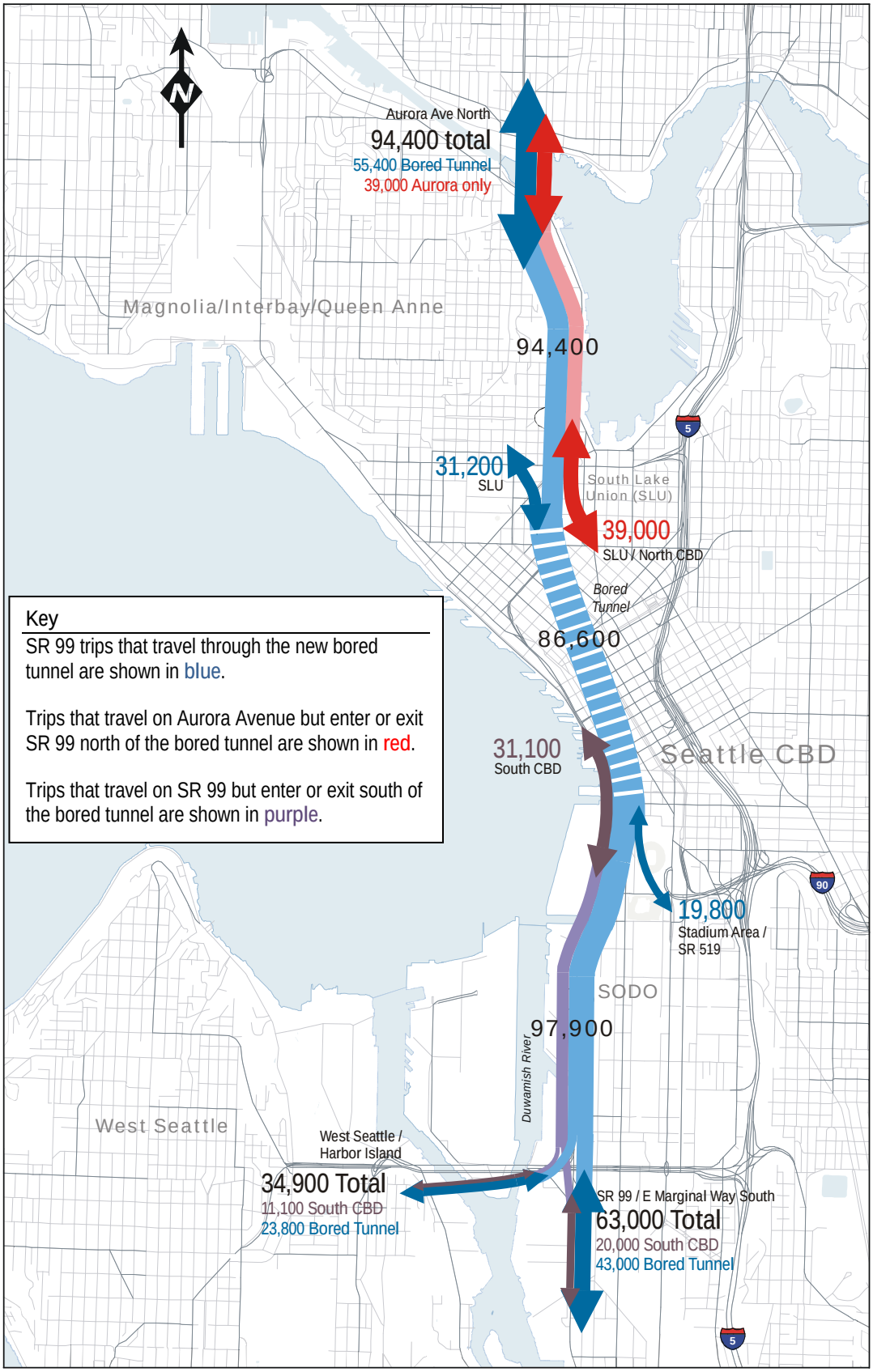


Exhibit 5-4
Daily SR 99 Traffic Patterns - 2015 Project

5.1.5 Vehicle Volumes on Screenlines and Key Facilities and Arterials

AM and PM peak period and daily traffic volumes were assessed to gauge the general impacts to parallel streets and highways. Traffic volume forecasts from the project were measured at four screenline locations:

- A south screenline north of S. Spokane Street (referred to as the Spokane screenline), representing traffic entering and exiting the study area from and to the south.
- A south screenline south of S. King Street, representing traffic entering and exiting the study area at the south end of downtown.
- A central screenline north of Seneca Street, capturing north/south traffic flows in the center of the study area.
- A north screenline located north of Thomas Street, representing traffic entering and exiting the study area to the north.

Additionally, daily volumes along key facilities (Alaskan Way, SR 99, and I-5) and arterial screenline volumes at locations generally similar to the above screenlines were compared across the modeled conditions.

Key Findings

For all screenlines assessed, both the 2015 Project and the 2015 Existing Viaduct carry about the same amount of traffic (they show a 2 percent or less difference), which shows that the Bored Tunnel Alternative would accommodate a similar number of trips as the 2015 Existing Viaduct, even though access points in the corridor would have changed.

The 2015 Project shifts additional trips to the Alaskan Way surface street, which is projected to experience 14 to 54 percent heavier traffic volumes (3,400 to 5,500 daily trips) than with the 2015 Existing Viaduct, but still 26 to 34 percent less than with the 2015 Viaduct Closed (No Build Alternative) (5,600 to 13,800 daily trips). This shift is due to the changes to the Ballard/Interbay access to SR 99 and to a lesser extent the removal of the midtown ramps.

For the Spokane and south screenlines, the 2015 Viaduct Closed (No Build Alternative) would have lower vehicle volumes than the 2015 Existing Viaduct and the 2015 Project. This is likely the result of an overall redistribution of trips and a reduction in trip-making through downtown Seattle due to reduced capacity through the central waterfront.

As reflected in the central screenline, in the 2015 Viaduct Closed (No Build Alternative), dramatic increases are expected in Alaskan Way traffic and, to a lesser extent, other downtown north-south arterials due to closure of the viaduct and many of the viaduct trips shifting to parallel arterials.

New east-west connections across Aurora Avenue contained in the 2015 Project provide greater mobility in the South Lake Union area and promote better utilization of the street grid.

East-west traffic volumes on arterials both east and west of Aurora Avenue north of the Ship Canal are expected to be similar among the 2015 Existing Viaduct and the 2015 Project, indicating that minimal diversion from the 15th Avenue N.W./Elliott Avenue corridor to SR 99 or I-5 north of the Ship Canal is expected to occur.

Screenline Vehicle Volumes

Screenline volume results are presented in Exhibit 5-5 and discussed below.

Exhibit 5-5. Model-Estimated Vehicle Volumes at Screenlines

	2005 Existing	2015 Existing Viaduct	2015 Viaduct Closed (No Build Alternative)	2015 Project	2030 Project
Spokane Screenline (North of S. Spokane Street)					
AM	31,110	33,340	30,320	33,040	34,680
PM	33,650	37,270	33,680	36,770	38,590
Daily	423,100	473,700	435,200	469,000	497,300
South Screenline (South of S. King Street)					
AM	33,500	36,670	32,440	36,150	37,540
PM	37,670	42,730	37,640	42,110	43,640
Daily	470,800	543,300	490,200	536,500	561,400
Central Screenline (North of Seneca Street)					
AM	30,970	33,250	28,420	32,790	33,970
PM	34,550	37,270	31,790	36,710	37,810
Daily	435,500	483,100	428,000	477,700	496,600
North Screenline (North of Thomas Street)					
AM	36,720	39,500	35,910	39,050	40,440
PM	39,810	43,130	39,920	43,460	46,070
Daily	503,000	544,700	505,600	550,200	582,300

Spokane Screenline

For the Spokane screenline, volumes for the 2015 Existing Viaduct and the 2015 Project are projected to be similar, indicating that the same number of trips would be accommodated under both modeled conditions. Volumes under both modeled conditions were also higher than those under existing conditions (2005), with an

increase of 6 to 7 percent in the AM peak period, 9 to 11 percent in the PM peak, and 12 percent (50,600 trips) and 11 percent (45,900 trips) in the daily periods.

With the 2015 Viaduct Closed (No Build Alternative), peak demand at this screenline was about 9 percent less and the daily volume was 8 percent less than that for the 2015 Existing Viaduct (38,500 trips) and 7 percent less than that for the 2015 Project (33,800 trips). This was likely the result of an overall redistribution of trips and a reduction in trip-making through downtown Seattle due to reduced capacity through the central waterfront.

South Screenline

For the south screenline, volume for the 2015 Existing Viaduct is projected to be slightly higher in the AM peak period (over 9 percent) and in the PM peak period (over 13 percent) than for the volumes under existing conditions (2005). Daily screenline totals are expected to increase by over 13 percent (63,300 trips).

The 2015 Project is estimated to have overall volumes similar to those of the 2015 Existing Viaduct, indicating that it accommodates the same number of trips.

With the 2015 Viaduct Closed (No Build Alternative), peak period demand at this screenline was 10 to 12 percent less than the 2015 Existing Viaduct and the 2015 Project. This was likely the result of an overall redistribution of trips and a reduction in demand to and through downtown Seattle due to reduced capacity through the central waterfront. Overall, daily screenline volumes were about equal between the 2015 Existing Viaduct and the 2015 Project, and 8 to 10 percent lower in the 2015 Viaduct Closed (No Build Alternative).

Central Screenline

Vehicle volumes at this screenline for the 2015 Project are very close to those for the 2015 Existing Viaduct during the peak and daily travel periods (within 2 percent), which indicates that the Bored Tunnel Alternative provides capacity comparable to that of the Alaskan Way Viaduct (2015 Existing Viaduct). However, similar to the south screenline, the volumes are expected to be redistributed such that the surface arterials with the 2015 Project carry a higher proportion of the overall screenline traffic, and SR 99 a lower proportion, in comparison to the 2015 Existing Viaduct. This is primarily because Ballard/Interbay access would be relocated from the Elliott/Western ramps to the stadium area ramps with the 2015 Project, which directs more traffic to Alaskan Way than the 2015 Existing Viaduct.

As shown in Exhibit 5-5, the modeled condition with the highest peak period and daily volumes is the 2030 Project. For the 2030 Project, volumes are about 3 percent higher than those for the 2015 Project during all time periods. They are also 1 to 3 percent higher than those for the 2015 Existing Viaduct, indicating that

the 2030 Project would experience very marginal growth in vehicle volumes at this location.

The modeled condition with the lowest total daily and peak period screenline vehicle volumes is the 2015 Viaduct Closed (No Build Alternative). With the 2015 Viaduct Closed (No Build Alternative), volumes are lowest due to the removal of the Alaskan Way Viaduct and the resulting redistribution of traffic on already congested roadways, which results in some trips not traveling through the downtown area.

North Screenline

Similar to the screenlines discussed above, vehicle volumes at the north screenline for the 2015 Project are anticipated to be very similar to those for the 2015 Existing Viaduct during the peak and daily travel periods. With the 2015 Viaduct Closed (No Build Alternative), demand at this screenline is expected to be 7 to 9 percent less than demand with the 2015 Existing Viaduct and the 2015 Project for all time periods. Volumes for the 2030 Project are projected to be slightly higher than those for the 2015 Project , with about a 6 percent increase in daily volumes (32,100 trips).

Vehicle Volumes on Key Facilities and Arterial Screenlines

Daily volumes along key facilities (Alaskan Way, SR 99, and I-5) and arterial screenline volumes at locations generally similar to the above screenlines are shown graphically in Exhibits 5-6 and 5-7. Daily traffic volumes at two additional screenlines, east and west of Aurora Avenue in north Seattle, are shown graphically in Exhibit 5-8.

S. Spokane Street Area Facilities

As discussed in the previous section, the total volumes across all facilities in the S. Spokane Street area are projected to decrease with the 2015 Viaduct Closed (No Build Alternative) in comparison to the 2015 Existing Viaduct and the 2015 Project. However, as shown in Exhibit 5-7, the arterials handle much of the demand, with increases in volume over those of the 2015 Existing Viaduct and the 2015 Project of 27 percent and 22 percent, respectively.

South Area Facilities

As discussed earlier, the 2015 Project is estimated to have overall volumes similar to those of the 2015 Existing Viaduct. However, as can be seen in Exhibit 5-7, for the south arterial screenline and for Alaskan Way volumes south of S. King Street, the volumes are expected to be redistributed such that the surface arterials with the 2015 Project carry a higher proportion of the overall screenline traffic, and SR 99

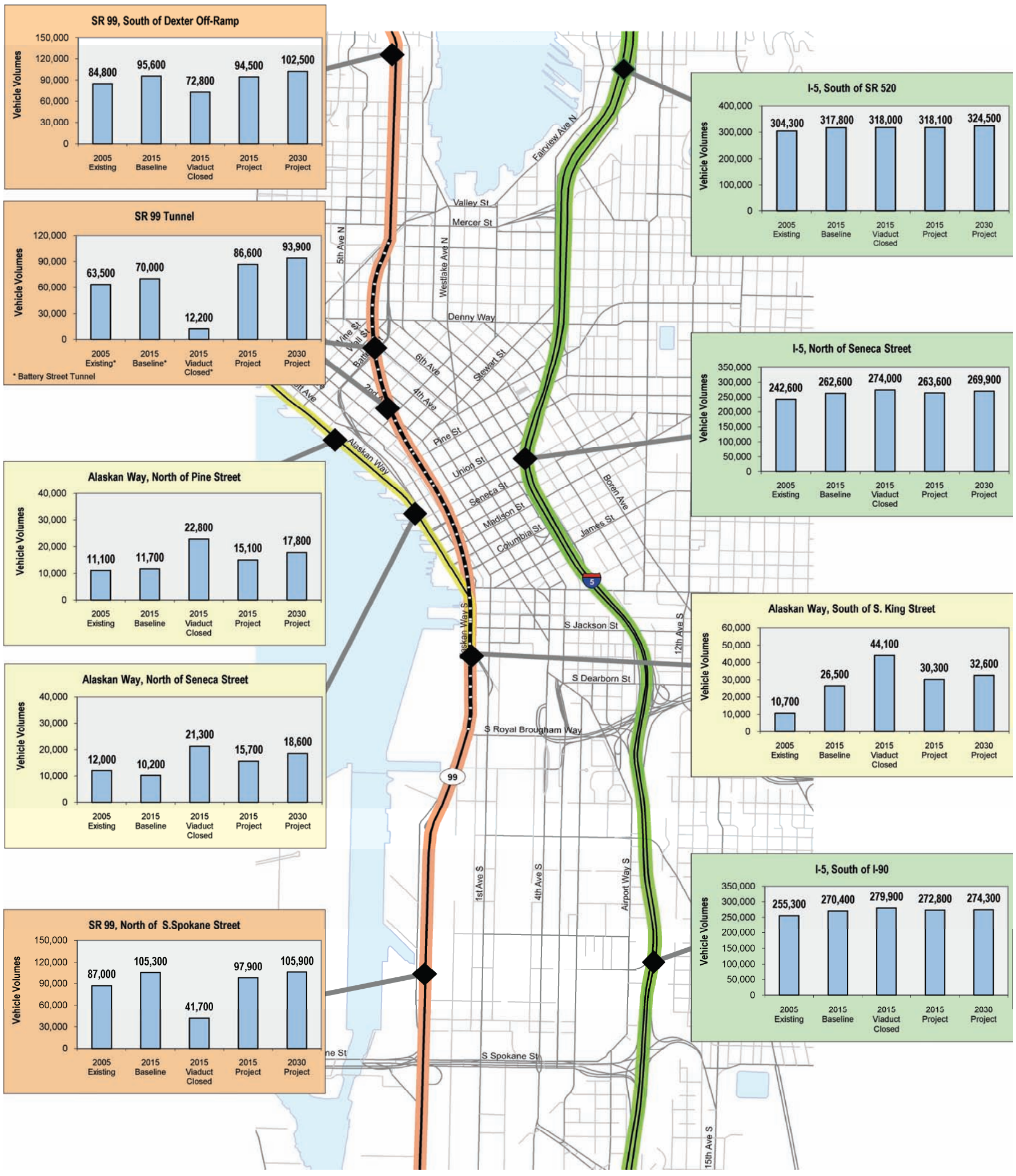


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Exhibit 5-6
Daily Vehicle Volumes on I-5, SR 99, and Alaskan Way

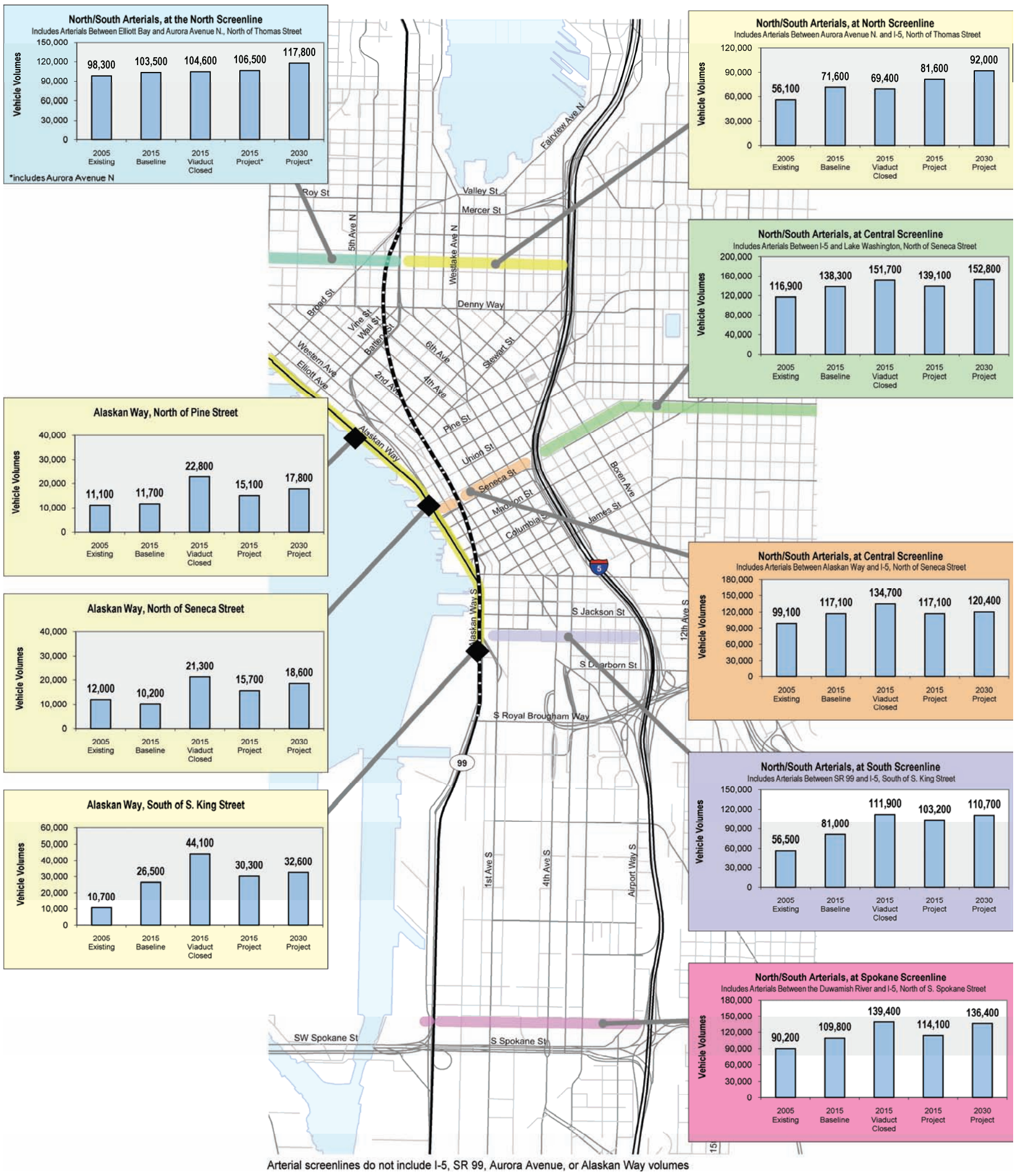

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Exhibit 5-7
Daily Vehicle Volumes on Arterials

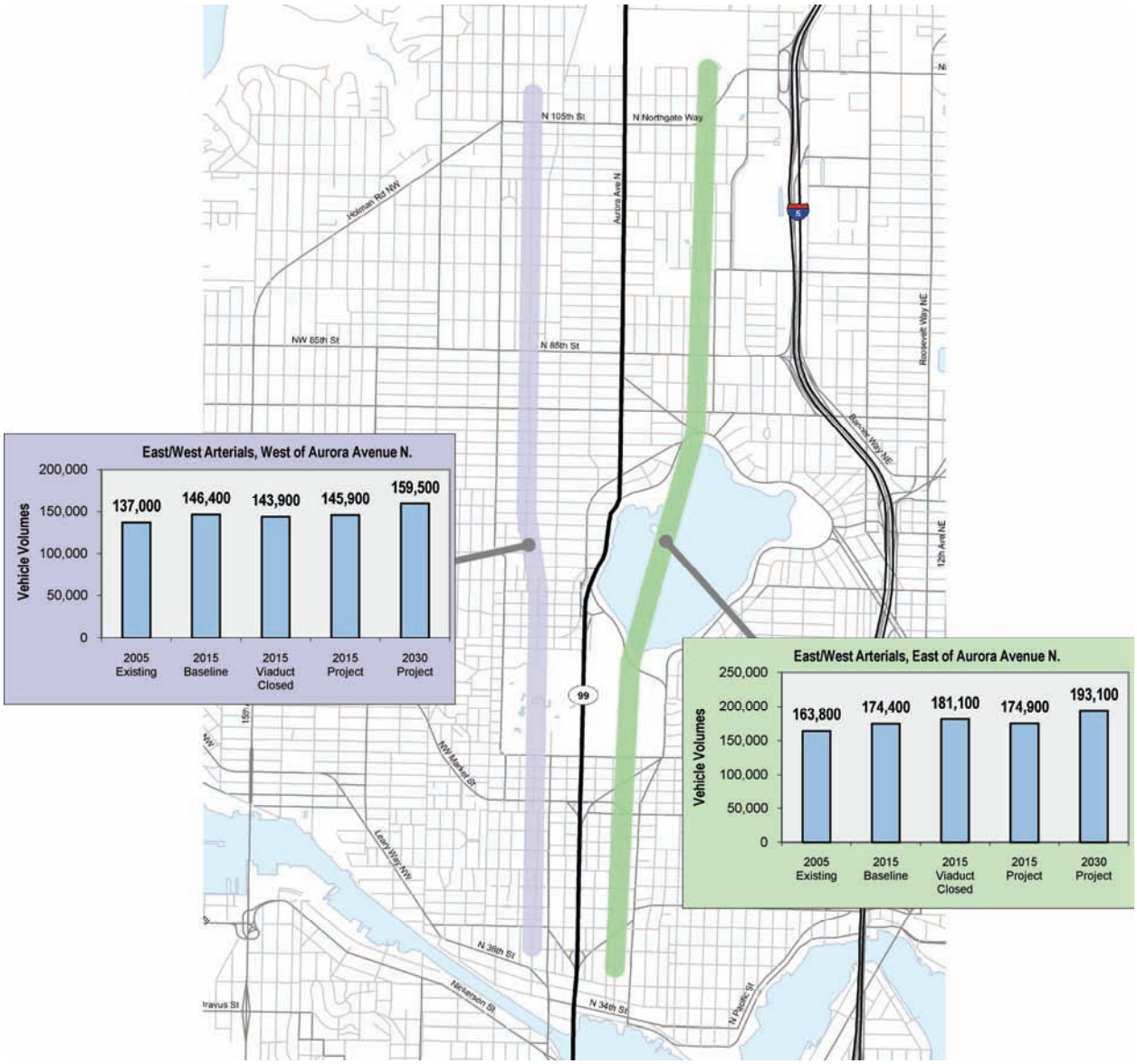

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Exhibit 5-8
Daily Vehicle Volumes on Arterials
In North Seattle

a lower proportion, in comparison to the 2015 Existing Viaduct. This is due to the relocation of the downtown access from the midtown ramps to the stadium area ramps, and the Ballard/Interbay access from the Elliott/Western ramps also to the stadium area ramps; the 2015 Project directs more traffic to the surface arterials at this location than the 2015 Existing Viaduct.

With the 2015 Viaduct Closed (No Build Alternative), vehicle demand displaced from the Alaskan Way Viaduct shows up on parallel arterials, such as Alaskan Way S. With the 2015 Viaduct Closed (No Build Alternative), daily vehicle volumes on Alaskan Way S. increase by about 66 percent over those of the 2015 Existing Viaduct. Peak period vehicle volumes here are over 63 percent higher with the 2015 Viaduct Closed (No Build Alternative) than with the 2015 Existing Viaduct.

Central Area Facilities

Volumes are about the same on north-south arterials east of I-5 for both the 2015 Project and the 2015 Existing Viaduct. Both of these modeled conditions showed almost the same amount of traffic on I-5 for both the peak and daily travel periods as well, indicating little shift in traffic to I-5.

While the estimated vehicle volumes at screenlines in the aggregate reflect one picture of vehicle demand on downtown streets, individual streets behaved much differently. As shown in Exhibit 5-6, Alaskan Way consistently carried the most traffic during the AM and PM peak and daily periods with the 2015 Viaduct Closed (No Build Alternative). This was the case at all the locations evaluated along the waterfront. As shown in Exhibit 5-7, this phenomenon also carried to the north-south screenline west of I-5 (north of Seneca Street), as these streets also carried higher vehicle volumes than were found in any other modeled condition. The higher volumes on Alaskan Way and the other north-south arterials for the 2015 Viaduct Closed (No Build Alternative) are because these streets would need to absorb all traffic diverted from the (now closed) Alaskan Way Viaduct.

Vehicle volume differences were less pronounced for north-south arterials located east of I-5 than for those located on the west side of the freeway. As shown in Exhibit 5-7, daily vehicle volumes were 15 percent higher for the 2015 Viaduct Closed (No Build Alternative) than for the 2015 Existing Viaduct for arterials west of I-5, while daily vehicle volumes for the 2015 Viaduct Closed (No Build Alternative) were slightly less than 10 percent higher than those for the 2015 Existing Viaduct for the arterials east of I-5.

North Area Facilities

With the 2015 Project, daily vehicle volumes on north-south arterials on the west side of SR 99 (see Exhibit 5-7) show a 3 percent increase from the volumes for the 2015 Existing Viaduct. The increase is due to the inclusion of Aurora Avenue N.

in the arterial screenline for the 2015 and 2030 Project. However, the increase is offset by the increased directness of trips traveling in Uptown and South Lake Union (i.e., east-west oriented trips previously had to travel either north or south to access east-west streets, causing them to cross the Thomas Street screenline at least once, and often twice). With the 2015 Existing Viaduct, many trips between the South Lake Union area and Queen Anne use Broad Street and Denny Way and then travel north on First Avenue N. or Fifth Avenue N., effectively crossing the north screenline twice. Because the 2015 Project removes Broad Street between Ninth Avenue N. and Taylor Avenue N., and Mercer Street becomes two-way between Ninth Avenue N. and Fifth Avenue N., these same trips between the South Lake Union area and Queen Anne are projected instead to stay on Mercer and Roy Streets in the 2015 Project and would not be counted at all in the north screenline volumes.

Daily volumes vary greatly on north-south arterials east of SR 99. The 2015 Project daily volumes are about 14 percent higher than those for the 2015 Existing Viaduct and 18 percent higher than those for the 2015 Viaduct Closed (No Build Alternative). This is likely due to improved east-west connections across Aurora Avenue (i.e., John, Thomas, and Harrison Streets as well as two-way Mercer Street), which allows for greater use of the grid network in the South Lake Union area. This is the only location where the 2015 Viaduct Closed (No Build Alternative) volumes are lower than those for the 2015 Existing Viaduct and the 2015 Project. This is primarily because the viaduct would be closed south of the Battery Street Tunnel, but Aurora Avenue would remain open. With no traffic arriving at Aurora Avenue from the south, the excess capacity would result in diversion from local streets to Aurora Avenue. This results in a decrease in trips across the screenline with the 2015 Viaduct Closed (No Build Alternative) because Aurora Avenue is not included in the screenline.

North Seattle Area Facilities

Vehicle volumes on east-west arterials north of the Ship Canal are very similar across all 2015 modeled conditions (see Exhibit 5-8). Volume changes across these screenlines are projected to be less than 0.5 percent between the 2015 Existing Viaduct and the 2015 Project, indicating that diversion from the 15th Avenue N.W./Elliott Avenue corridor to SR 99 or I-5 is not expected to occur. The largest impact on vehicle volumes is with the 2015 Viaduct Closed (No Build Alternative), which shows a 4 percent increase over the 2015 Existing Viaduct levels on arterials between Aurora Avenue and I-5, likely due to diversion of vehicles to I-5 from SR 99 to access destinations south of downtown.

5.1.6 Person Throughput

Person throughput is a measure of the total number of persons traveling on a given transportation facility. Analysts use person-trips to measure the number of people, rather than vehicles, traveling on the transportation system. Increased use of transit or carpools can increase the overall number of people conveyed, even if vehicle traffic does not increase.

This evaluation compares the total number of persons carried by the three major east-west screenlines in the study area. The evaluation describes AM and PM peak periods and daily totals for the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project. Exhibit 5-9 provides a summary table of the person throughput by screenline for the study area.

Exhibit 5-9. Model-Estimated Daily Person Throughput (Person-Trips)

	2005 Existing	2015 Existing Viaduct	2015 Viaduct Closed (No Build Alternative)	2015 Project	2030 Project
South Screenline (South of S. King Street)					
AM	45,750	55,120	49,950	54,250	65,420
PM	55,270	67,860	61,110	66,800	79,080
Daily	645,100	788,880	718,300	777,400	883,500
Central Screenline (North of Seneca Street)					
AM	46,040	53,080	46,970	52,350	60,560
PM	54,420	62,430	54,900	61,550	70,070
Daily	630,500	734,400	658,600	725,300	805,300
North Screenline (North of Thomas Street)					
AM	53,130	59,330	55,440	58,790	67,550
PM	61,360	69,140	65,200	69,760	80,400
Daily	708,400	794,600	747,200	803,700	902,800

Key Findings

All screenlines indicate a 6 to 10 percent reduction in person throughput for the 2015 Viaduct Closed (No Build Alternative) in comparison to the 2015 Existing Viaduct and the 2015 Project, respectively. This is likely the result of the removal of the capacity provided by the Alaskan Way Viaduct and redistribution of some trips away from downtown to avoid traveling on already congested parallel facilities through downtown (i.e., downtown arterials and I-5).

Trips through downtown, as well as between downtown and areas south, are expected to be reduced substantially as a result of the relative difficulty in

traveling through downtown with the 2015 Viaduct Closed (No Build Alternative).

South Screenline

During the 2015 Existing Viaduct AM peak period, this screenline would carry over 55,000 person-trips, while during the PM peak period, this screenline is forecasted to carry almost 68,000 person-trips. There are over 782,000 daily person-trips forecasted to be carried on the south screenline with the 2015 Existing Viaduct. Both the 2015 Existing Viaduct and the 2015 Project would carry virtually the same number of persons at this screenline location (less than 2 percent difference for all time periods). The 2015 Viaduct Closed (No Build Alternative) would carry 7 to 9 percent fewer daily person-trips than the 2015 Existing Viaduct and the 2015 Project. This is likely the result of the removal of the Alaskan Way Viaduct and redistribution of its traffic onto already congested north-south arterials and I-5. By 2030, with the 2030 Project, the south screenline would carry almost 884,000 daily persons, which is about 13 percent over the volume for the 2015 Existing Viaduct. The AM and PM peak periods would carry 17 to 19 percent more person-trips for the 2030 Project than for the 2015 Existing Viaduct.

Central Screenline

The central screenline would carry over 734,000 daily person-trips with the 2015 Existing Viaduct. During the AM peak period, this screenline would carry over 53,000 person-trips, while during the PM peak period it is forecasted to carry over 62,000 person-trips. For both the 2015 Existing Viaduct and the 2015 Project, virtually the same number of persons was forecasted at this screenline location, varying by less than 2 percent in all time periods. By 2030, the 2030 Project would carry over 805,000 daily persons, which is about 10 percent over the number for 2015 Existing Viaduct. During the AM peak period, the 2030 Project would carry over 14 percent more people than the same period for the 2015 Existing Viaduct. In the PM peak period, the 2030 Project would carry over 12 percent more people than the same period for the 2015 Existing Viaduct.

North Screenline

The north screenline would carry about 795,000 daily person-trips with the 2015 Existing Viaduct. During the AM peak period, this screenline would carry over 59,000 persons, while during the PM peak period it would carry over 69,000 person-trips. Both the 2015 Existing Viaduct and the 2015 Project would carry virtually the same number of persons at this screenline location, varying by about 1 percent for all time periods. By 2030, with the 2030 Project , this screenline would carry almost 903,000 daily person-trips, which is about 14 percent over the volume for the 2015 Existing Viaduct. During the AM peak

period with the 2030 Project, this screenline would carry almost 14 percent more people than during the same period with the 2015 Existing Viaduct. In the PM peak period with the 2030 Project, this screenline would carry over 16 percent more people than during the same period with the 2015 Existing Viaduct.

5.2 Traffic Operations on SR 99

Mainline traffic conditions and ramp interactions for the SR 99 corridor in terms of AM and PM peak hour volumes, travel speeds, and LOS are presented in this section for key mainline segments and related on- and off-ramps. This discussion focuses on the three applicable modeled conditions for operational impacts represented by the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project.

Key Findings

- Baseline volumes show peak period directionality, with higher volumes inbound to downtown during the AM peak hour, and the reverse during the PM peak hour.
- The function of the midtown ramps in the 2015 Existing Viaduct is supplemented by the stadium area ramps to and from the south, resulting in less traffic using the midtown ramps as compared to existing conditions.
- Because of the reduced capacity for corridor through trips, the 2015 Viaduct Closed (No Build Alternative) is expected to have considerably lower volumes on SR 99 just north and south of downtown as compared to the 2015 Existing Viaduct and the 2015 Project.
- The Bored Tunnel Alternative would change access to and from SR 99 and downtown. Ramps to Alaskan Way S. near S. King Street would provide the connection to downtown from the south, while the ramps to and from Aurora Avenue at Harrison Street would provide the access route in the north end. The Alaskan Way S. ramps would see increased use compared to the 2015 Existing Viaduct because ramps at Columbia and Seneca Streets are not provided under the Bored Tunnel Alternative. Some trips that formerly used the Elliott and Western ramps are likely to use the Alaskan Way S. ramps as well. However, the volumes expected to use the Alaskan Way S. ramps are considerably less than the combined volumes of the Elliott/Western, Columbia/Seneca, and Alaskan Way S. ramps with the 2015 Existing Viaduct.
- Volumes on SR 99 through the midtown area are projected to be lower than those for the 2015 Existing Viaduct. However, as described previously, screenline analysis shows that these trips are accommodated elsewhere in the system, with the result that the total volume of trips carried by the system is approximately the same. While some increases in arterial traffic in the southern portion of downtown are expected, leading

to some increases in arterial congestion, north-south arterial traffic volumes through downtown are generally expected to be similar between the 2015 Existing Viaduct and the 2015 Project.

- Midtown segments of the SR 99 mainline with the 2015 Existing Viaduct are generally expected to operate in congested conditions, at speeds slower than segments north and south of downtown. Conditions with the 2015 Viaduct Closed (No Build Alternative) are expected to be worse, with extremely slow speeds and high travel times for those travelling through the CBD.
- Travel speeds for the 2015 Project are expected to be similar to or higher than speeds with the 2015 Existing Viaduct, with particular improvement in the speeds through midtown. Speeds for the 2015 Project are expected to be substantially higher than those for the 2015 Viaduct Closed (No Build Alternative).
- Travel speeds for the 2030 Project are also expected to be similar or slightly decreased compared to those for the 2015 Project.

5.2.1 Alaskan Way Viaduct Mainline and Ramp Volumes

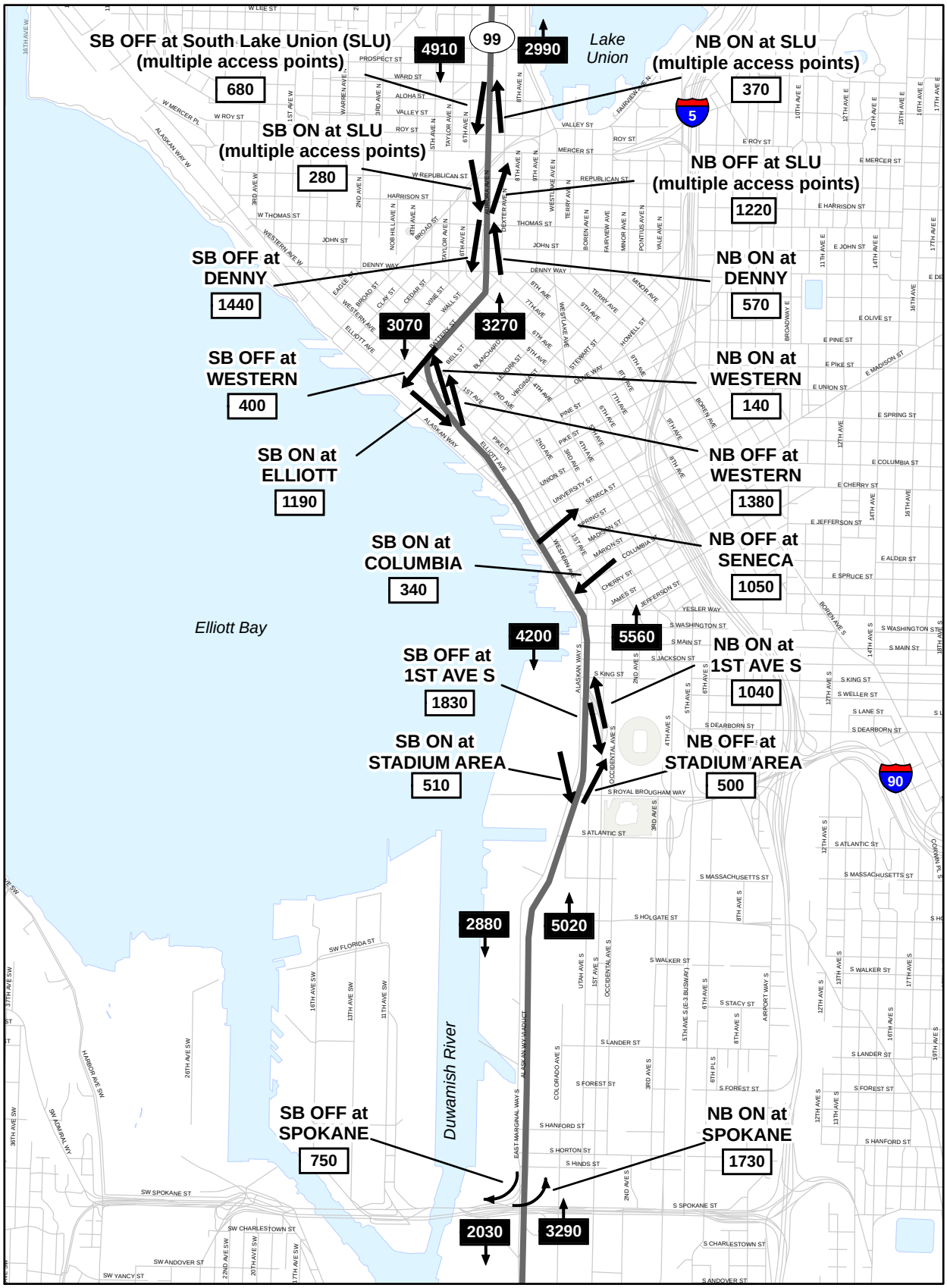
This section describes the AM peak hour, PM peak hour, and daily traffic volume estimates for the 2015 Viaduct Closed (No Build Alternative), the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project; specifically, these estimates for each connection to and from SR 99 (ramps or side streets) and for each mainline segment (section of SR 99 between connections) are discussed in detail below. These estimates account for all vehicle types on the corridor. Additional information specific to truck movement is presented in Section 5.7, Truck Traffic and Freight, while transit services are discussed in Section 5.6, Transit Services.

AM Peak Hour

As with most urban transportation facilities, traffic volumes on the SR 99 corridor are generally the most pronounced during weekday commuting hours. In the morning, peak hour traffic volumes on SR 99 are fairly directional, with heavier volumes entering the central downtown area from all directions. Exhibits 5-10, 5-11, and 5-12 show the volumes in the AM peak hour for the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project, respectively.

2015 Existing Viaduct

AM peak hour mainline ramp volumes forecasted for the 2015 Existing Viaduct are shown in Exhibit 5-10. At S. Spokane Street, volumes entering northbound SR 99 from West Seattle (1,730 vehicles) are more than double those exiting southbound SR 99 to West Seattle (750 vehicles). South of downtown and the



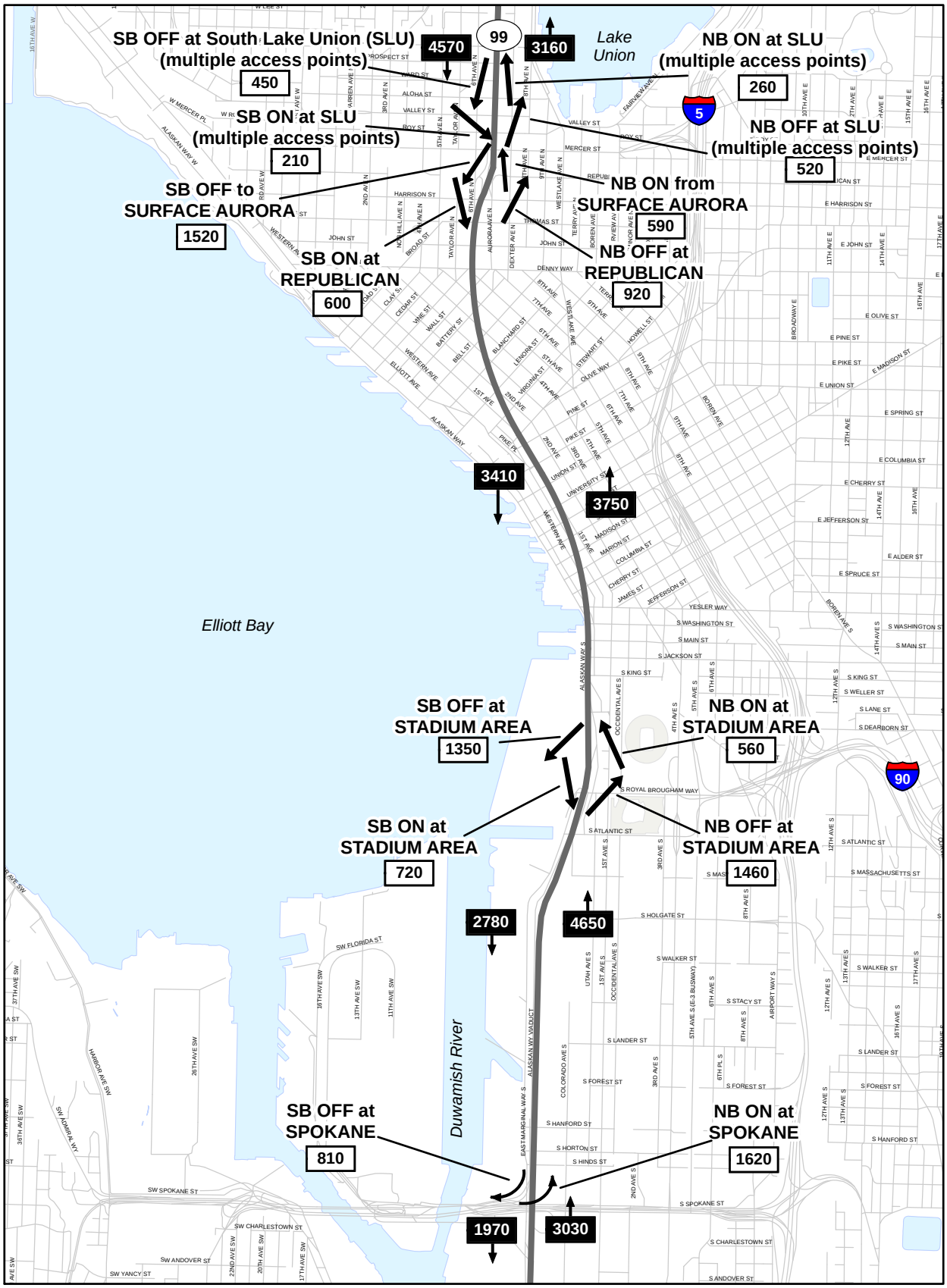
N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 5-10
AM Peak Hour Mainline and Ramp Volumes - 2015 Existing Viaduct



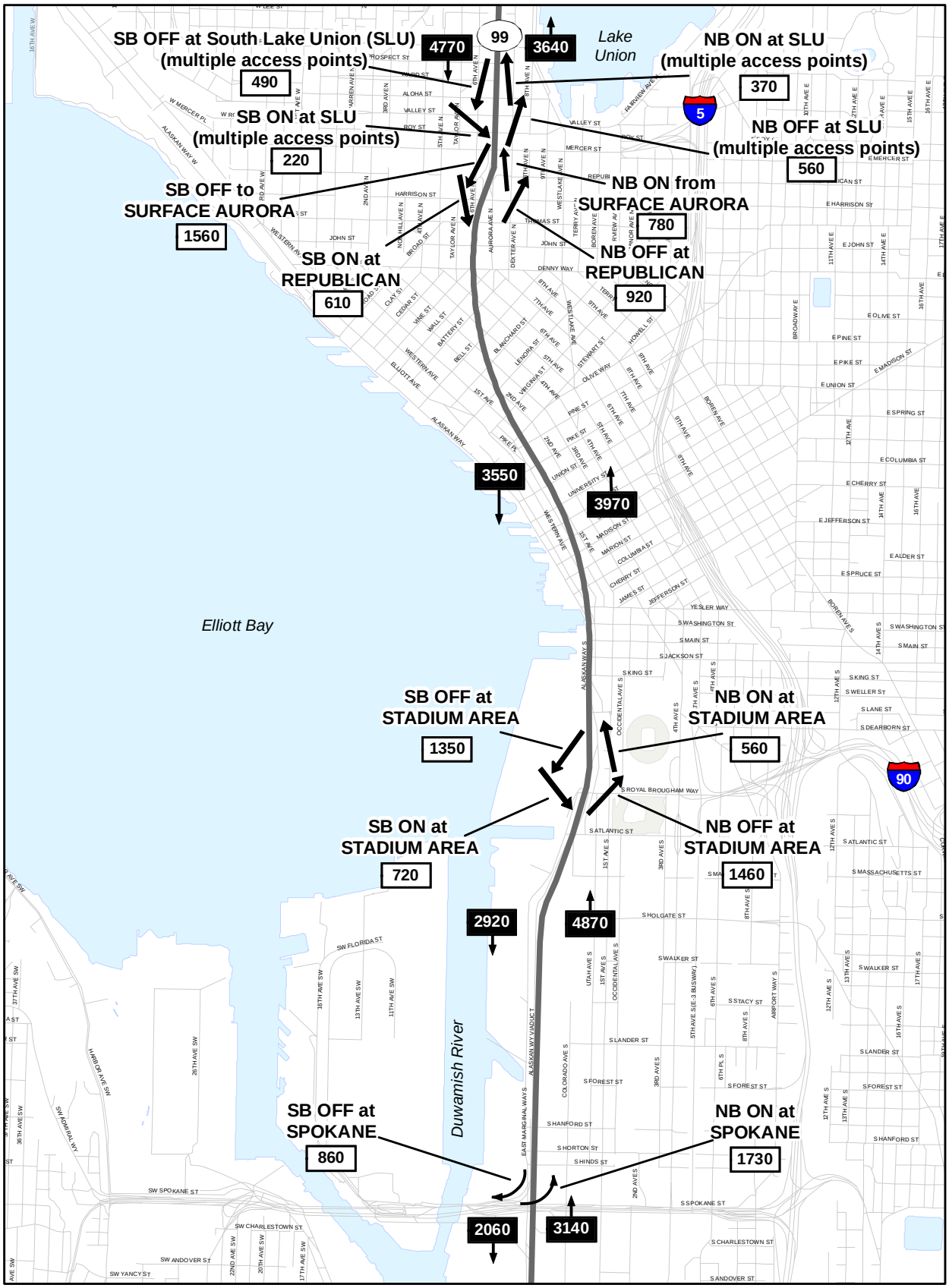
N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 5-11
AM Peak Hour Mainline and Ramp Volumes - 2015 Project



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0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 5-12
AM Peak Hour Mainline and Ramp Volumes - 2030 Project

stadium area, mainline SR 99 volumes are considerably higher in the northbound direction (5,020 vehicles) than in the southbound direction (2,880 vehicles). The First Avenue S. ramps show some directional difference, with 1,830 vehicles exiting southbound SR 99 in the morning but only 1,040 vehicles entering northbound. The downtown ramps providing access to and from the south show more vehicles exiting northbound SR 99 at Seneca Street (1,050 vehicles) than entering southbound at Columbia Street (340 vehicles). The volumes on the Seneca and Columbia ramps are projected to be generally lower than under existing conditions because of the new ramps to Alaskan Way S., which would serve a similar function.

The First Avenue S. ramps show some directional difference, with 1,830 vehicles exiting southbound SR 99 in the morning but only 1,040 vehicles entering northbound. The downtown ramps providing access to and from the south show more vehicles exiting northbound SR 99 at Seneca Street (1,050 vehicles) than entering southbound at Columbia Street (340 vehicles). The volumes on the ramps at Seneca and Columbia Streets are projected to be generally lower than under existing conditions because of the new ramps to Alaskan Way S., which would serve a similar function.

The Elliott/Western ramps to and from the south do not show the same level of directionality, with 1,190 vehicles entering southbound SR 99 and 1,380 vehicles exiting northbound SR 99. The ramps at the south end of the Battery Street Tunnel that provide access to and from the north show directionality, with 400 vehicles exiting southbound SR 99 and only 140 vehicles entering northbound SR 99. In the Battery Street Tunnel, the northbound flow (3,270 vehicles) exceeds the volume of southbound vehicles (3,070 vehicles). Southbound SR 99 off-ramp volumes at Denny Way (1,440 vehicles) exceed those on the northbound on-ramp (570 vehicles). At the north end of the study area, AM peak hour mainline volumes are projected to be higher in the southbound direction (4,910 vehicles) than in the northbound direction (2,990 vehicles), as more vehicles are entering the South Lake Union and downtown areas.

2015 Viaduct Closed (No Build Alternative)

Because the viaduct is assumed to be closed with the Viaduct Closed (No Build Alternative), it is assumed that there would be no northbound or southbound traffic on the facility between the Alaskan Way S. ramps and the Battery Street Tunnel ramps.

2015 Project

The 2015 Project changes access to and from SR 99 and downtown relative to the existing viaduct with the 2015 Existing Viaduct. Ramps in the stadium area would provide the connection to downtown from the south, while the ramps to

and from SR 99 at Harrison Street (ultimately connecting to and from Denny Way) would provide the access route in the north end. The southbound Alaskan Way S. on-ramp would serve vehicles that would formerly have used the on-ramp at Columbia Street. Additionally, with the absence of the southbound on-ramp from Elliott Avenue, some traffic traveling through the corridor from points northwest of the CBD would use this entrance to SR 99. AM peak hour mainline ramp volumes forecasted for the 2015 Project are shown in Exhibit 5-11.

The northbound Alaskan Way S. off-ramp would continue to serve those trips that use the ramp with the 2015 Existing Viaduct, but it would also attract trips that would have used the Seneca Street off-ramp and, to a lesser degree, the Western Avenue off-ramp with the 2015 Existing Viaduct. Both directions of the mainline south of the stadium area are anticipated to carry lower volumes with the 2015 Project than with the 2015 Existing Viaduct. One reason for this is that the improvements constructed as part of the S. Holgate Street to S. King Street Viaduct Replacement Project are expected to attract additional traffic to this segment with the 2015 Existing Viaduct due to the provision of new access to Alaskan Way coupled with maintaining the current ramps to downtown at Columbia and Seneca Streets. With the 2015 Project, downtown access is consolidated near the stadium area, which is expected to attract less traffic alone than the combined ramps provided with the 2015 Existing Viaduct. Another factor may be that some portion of the traffic using the Elliott/Western ramps with the 2015 Existing Viaduct would instead use alternative routes through downtown Seattle with the 2015 Project.

The new downtown ramps providing access to and from the south show more vehicles exiting northbound SR 99 to Alaskan Way S. south of S. King Street (1,460 vehicles) than entering southbound SR 99 (720 vehicles). The S. Royal Brougham Way ramps to and from the north show similar directionality, with 1,350 vehicles exiting southbound SR 99 but only 560 vehicles entering northbound SR 99. As with the 2015 Existing Viaduct, in the areas south of downtown and near the stadiums, mainline volumes are considerably higher in the northbound direction (4,650 vehicles) than the southbound direction (2,780 vehicles). At S. Spokane Street, volumes entering northbound from West Seattle (1,620 vehicles) are double those exiting southbound to West Seattle (810 vehicles).

The bored tunnel is projected to carry 3,410 vehicles southbound and 3,750 vehicles northbound during the AM peak hour. These volumes are lower than the volumes for the 2015 Existing Viaduct, with 3,860 southbound and 4,510 northbound vehicles through midtown between the Elliott/Western and Seneca/Columbia ramps. Again, this is because of the absence of the ramps at Elliott and Western Avenues. Many of the trips that would have used those

ramps with the 2015 Existing Viaduct are anticipated to instead travel along the surface on Alaskan Way and other parallel streets. However, the bored tunnel volumes are higher than the volumes in the Battery Street Tunnel with the 2015 Existing Viaduct (3,070 vehicles southbound and 3,270 vehicles northbound), as some through traffic that would otherwise use parallel routes is attracted to the tunnel, including some vehicles that would have used the Elliott/Western ramps and are anticipated to access SR 99 north of downtown via Mercer Street.

At the north end of the study area, southbound mainline volumes are anticipated to be lower with the 2015 Project, with 4,570 vehicles entering downtown with the 2015 Project, compared to 4,910 vehicles with the 2015 Existing Viaduct. Northbound mainline volumes are fairly similar between the 2015 Existing Viaduct and the 2015 Project. The Bored Tunnel Alternative does not include on- and off-ramps at Elliott and Western Avenues, generally resulting in slightly higher ramp volumes in the South Lake Union area in both directions compared to those for the 2015 Existing Viaduct. The higher volumes to and from the south in this area result because some of the traffic from northwest Seattle that previously used the Elliott/Western ramps to travel through the corridor are expected to take Mercer Street to access the bored tunnel at the Republican Street ramps.

2030 Project

The 2030 Project volume estimates are generally similar to the 2015 Project forecasts, with modest increases in volumes for some mainline and ramp segments. Vehicle volumes in the bored tunnel are expected to increase to approximately 3,550 vehicles southbound and 3,970 vehicles northbound. AM peak hour mainline ramp volumes forecasted for the 2030 Project are shown in Exhibit 5-12.

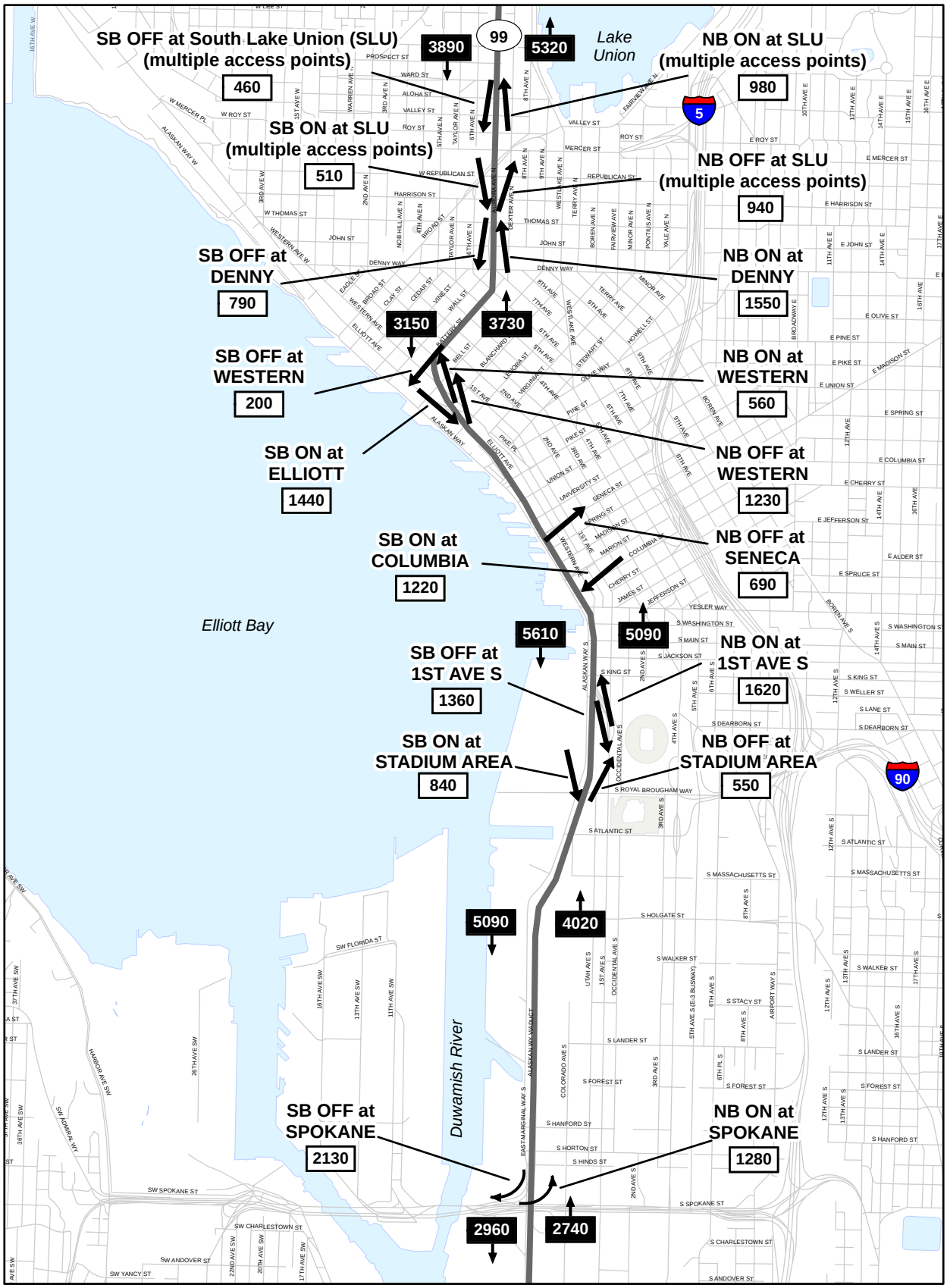
PM Peak Hour

Exhibits 5-13, 5-14, and 5-15 show the volumes in the PM peak hour for the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project, respectively.

2015 Existing Viaduct

Similar to the AM peak, the PM peak hour traffic volumes along SR 99 are directional (though generally not as pronounced as AM peak volumes), with heavier volumes leaving the central downtown. PM peak hour mainline ramp volumes forecasted for the 2015 Existing Viaduct are shown in Exhibit 5-13.

At S. Spokane Street, volumes exiting southbound to West Seattle (2,130 vehicles) are higher than those entering northbound from West Seattle (1,280 vehicles). South of downtown and the stadium area, mainline volumes are noticeably higher in the southbound direction (5,090 vehicles) than in the northbound



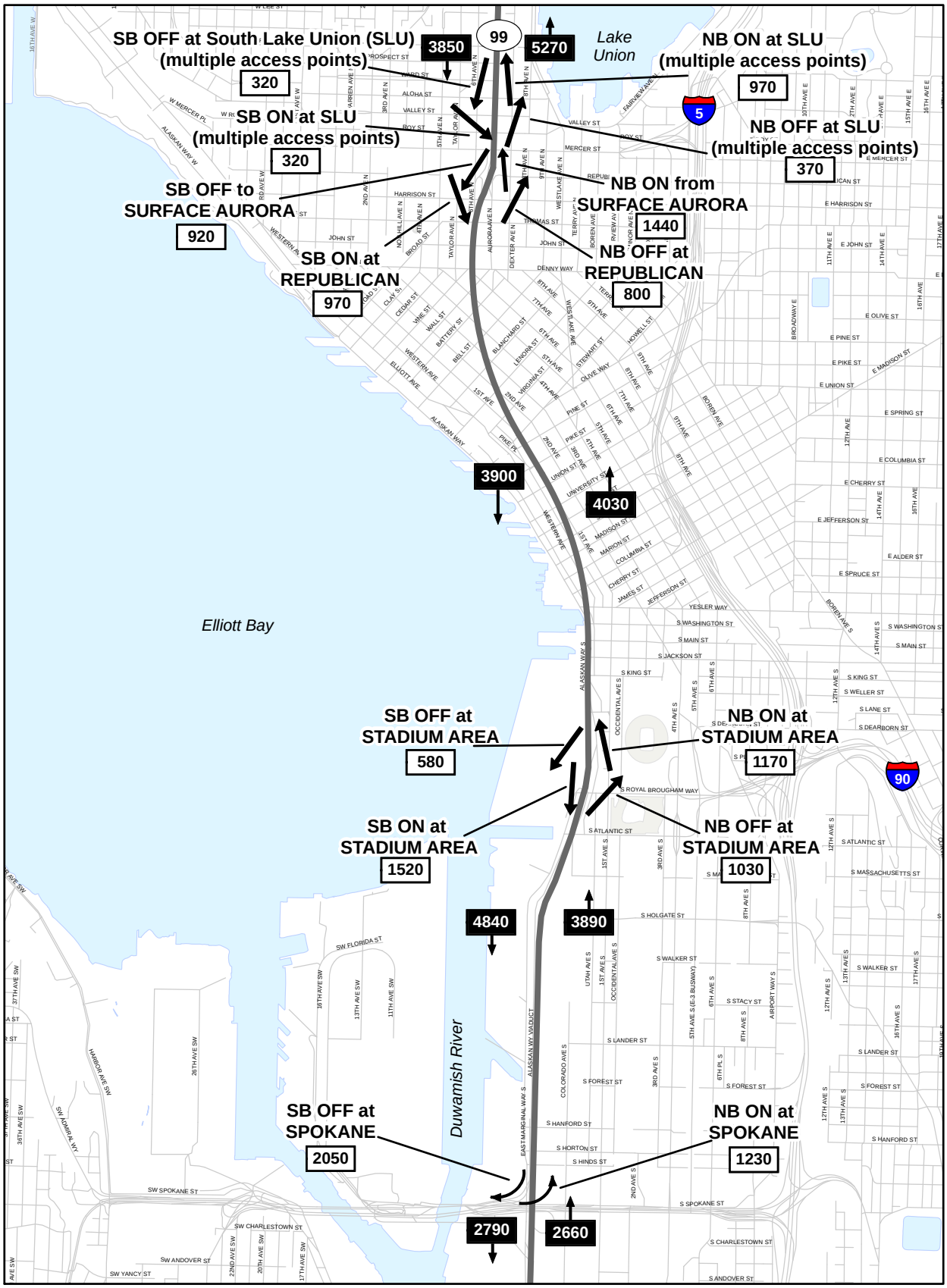
N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 5-13
PM Peak Hour Mainline and Ramp Volumes - 2015 Existing Viaduct



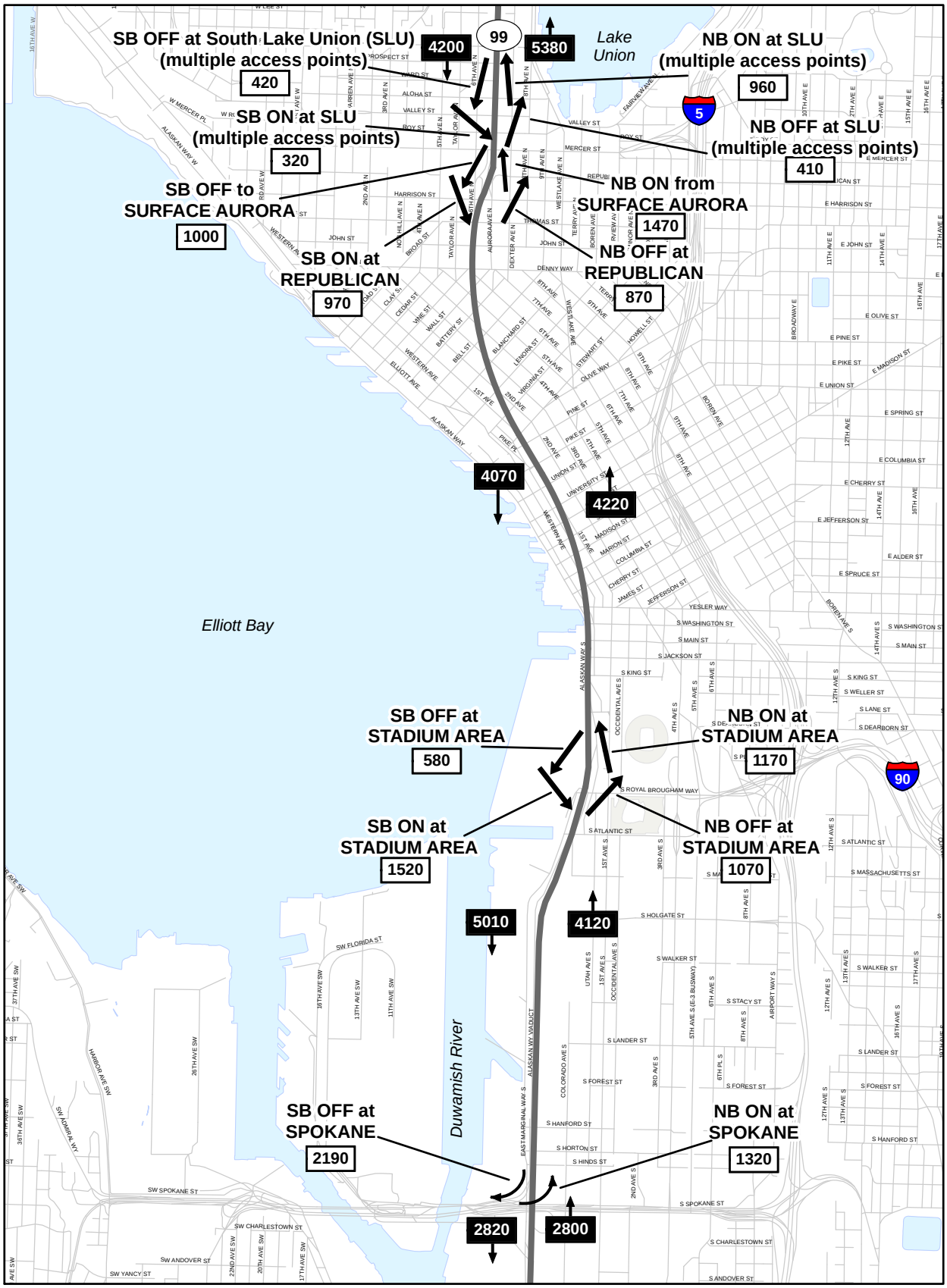
N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 5-14
PM Peak Hour Mainline and Ramp Volumes - 2015 Project



N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 5-15
PM Peak Hour Mainline and Ramp Volumes - 2030 Project

direction (4,020 vehicles). The First Avenue S. ramps show different directionality, with 1,620 vehicles entering northbound SR 99 but only 1,360 vehicles exiting southbound. The downtown ramps to and from the south show more vehicles entering southbound SR 99 at Columbia Street (1,220 vehicles) than exiting northbound at Seneca Street (690 vehicles). As in the AM peak hour, the volumes on the Seneca/Columbia Street ramps are lower than under existing conditions because of the new ramps to Alaskan Way S., which serve a similar function.

The Elliott/Western ramps to and from the south show little directional difference, with 1,440 vehicles entering southbound and 1,230 vehicles exiting northbound. The ramps at the south end of the Battery Street Tunnel that provide access to and from the north show directionality, with 560 vehicles entering northbound but only 200 vehicles exiting southbound. In the Battery Street Tunnel, the volume of northbound vehicles (3,730 vehicles) again exceeds the volume of southbound vehicles (3,150 vehicles). Northbound on-ramp volumes at Denny Way (1,550 vehicles) exceed those of the southbound off-ramp (790 vehicles). At the north end of the study area, PM peak hour mainline volumes are higher in the northbound direction (5,320 vehicles) than in the southbound direction (3,890 vehicles), as more vehicles are leaving the downtown area than are entering.

2015 Viaduct Closed (No Build Alternative)

Because the viaduct is assumed to be closed with the 2015 Viaduct Closed (No Build Alternative), it is assumed that there would be no northbound or southbound traffic on the facility between the Alaskan Way S. and Battery Street Tunnel ramps.

2015 Project

As in the AM, the southbound Alaskan Way S. on-ramp would carry higher volumes than the volumes with the 2015 Existing Viaduct but less than the combined total of that ramp plus the Columbia Street and Elliott Avenue ramps. The same is true for the northbound Alaskan Way S. ramp. Similar to the AM peak, the mainline in both directions south of the stadium area is anticipated to have lower volumes with the 2015 Project than with the 2015 Existing Viaduct. Again, this is expected to occur because of consolidation of downtown access in the south end, which is expected to attract less traffic alone than the combined downtown area ramps provided with the 2015 Existing Viaduct, as well as the potential for some portion of the traffic using the Elliott/Western ramps with the 2015 Existing Viaduct to instead use alternative routes through downtown Seattle with the 2015 Project.

The bored tunnel would carry approximately 3,900 vehicles southbound and 4,030 vehicles northbound during the PM peak hour. This is slightly fewer than the

number for the 2015 Existing Viaduct, with 4,390 vehicles southbound and 4,400 vehicles northbound through midtown between the Elliott/Western and Seneca/Columbia ramps. However, as described for the AM peak hour, the bored tunnel would likely carry more traffic than the Battery Street Tunnel with the 2015 Existing Viaduct, with 3,150 southbound and 3,730 northbound vehicles during the PM peak hour. At the north end of the study area, mainline volumes are anticipated to be similar to those for the 2015 Existing Viaduct. Entering and exiting volumes from the South Lake Union area, including the ramps at Denny Way, are expected to be slightly higher than those for the 2015 Existing Viaduct. PM peak hour mainline ramp volumes forecasted for the 2015 Project are shown in Exhibit 5-14.

2030 Project

As was the case for the AM peak conditions, the 2030 Project volumes would be generally similar to the 2015 Project volumes, with only minor increases noted. PM peak hour mainline ramp volumes forecasted for the 2030 Project are shown in Exhibit 5-15.

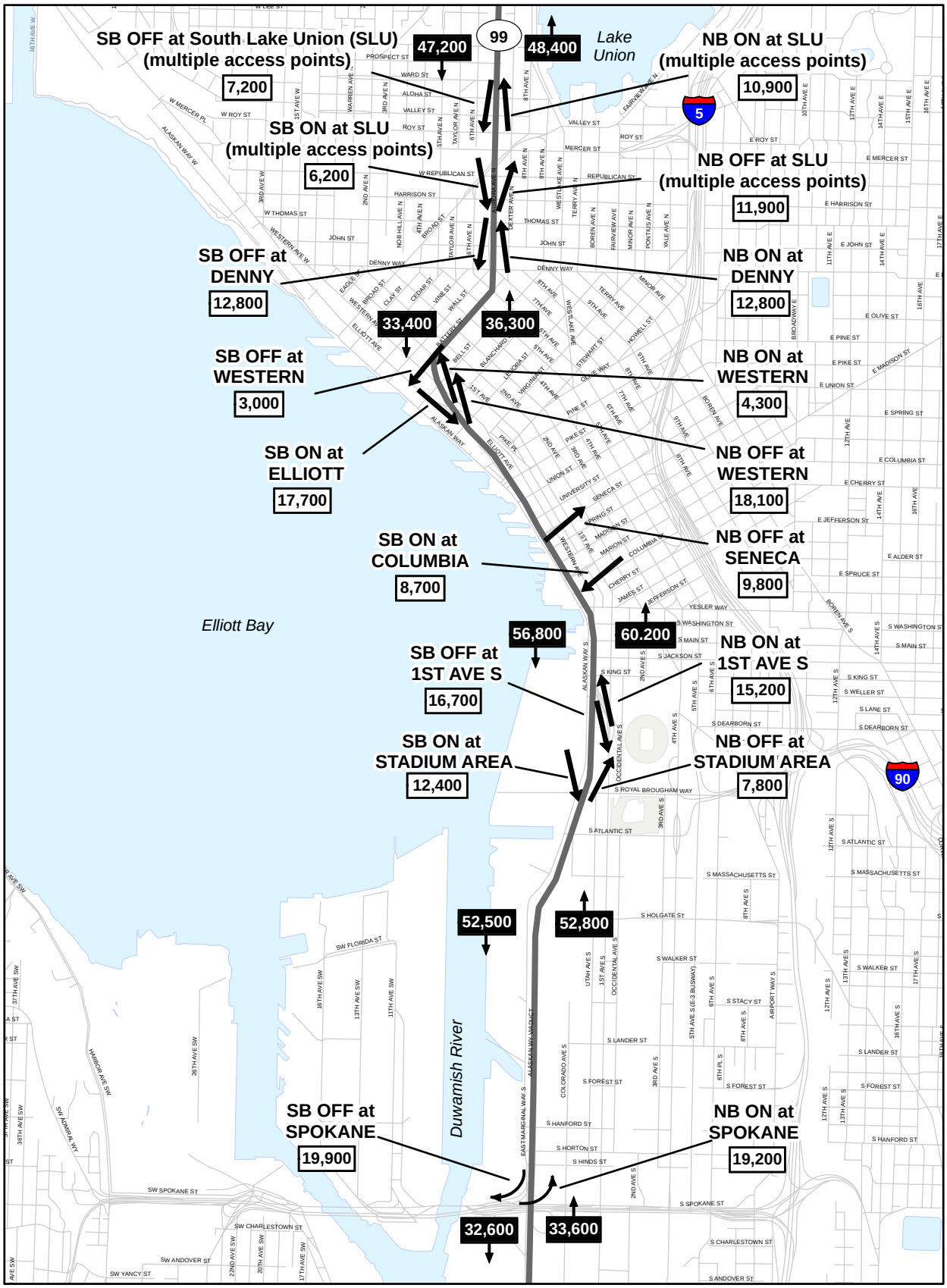
Daily

Daily volumes for each of the modeled conditions are shown in Exhibits 5-16, 5-17, and 5-18.

2015 Existing Viaduct

Daily mainline and ramp volumes are shown in Exhibit 5-16. Similar to existing conditions, projected daily traffic volumes along SR 99 for the 2015 Existing Viaduct are generally balanced by direction, with similar volumes leaving and entering the central downtown area. At S. Spokane Street, volumes exiting southbound to West Seattle (19,900 vehicles) are similar to those entering northbound from West Seattle (19,200 vehicles). South of downtown and the stadium area, mainline volumes are generally balanced by direction. The new ramps at Alaskan Way S. are somewhat unbalanced, with more vehicles entering southbound (12,400 vehicles) than exiting northbound (7,800 vehicles). The volumes on the First Avenue S. ramps are similarly balanced, with 15,200 vehicles entering northbound and 16,700 vehicles exiting southbound. The downtown ramps providing access to and from the south are relatively balanced, with 8,700 vehicles entering southbound at Columbia Street and 9,800 vehicles exiting northbound at Seneca Street. As in the AM and PM peak hours, the volumes on the ramps at Seneca and Columbia Streets are lower than existing conditions because of the new ramps at Alaskan Way S., which serve a similar function.

Traffic volumes at the Elliott/Western ramps to and from the south are relatively balanced, with 17,330 vehicles entering southbound and 18,210 vehicles exiting northbound. Similar to existing conditions, the ramps at the south end of the Battery Street Tunnel providing access to and from the north are not as balanced



N

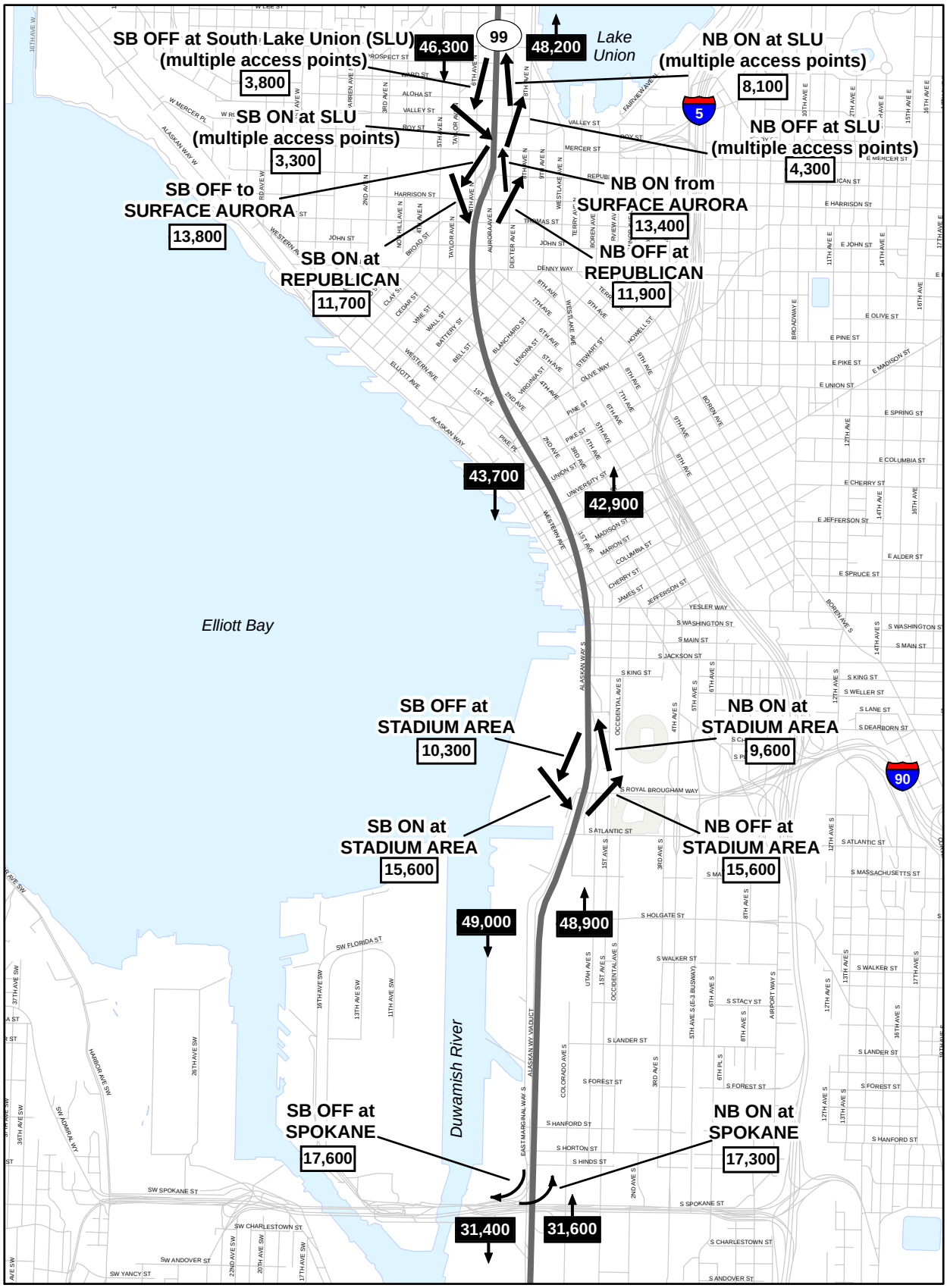
0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Note: Totals may not sum due to rounding.

Exhibit 5-16
Daily Mainline and Ramp Volumes - 2015 Existing Viaduct



N

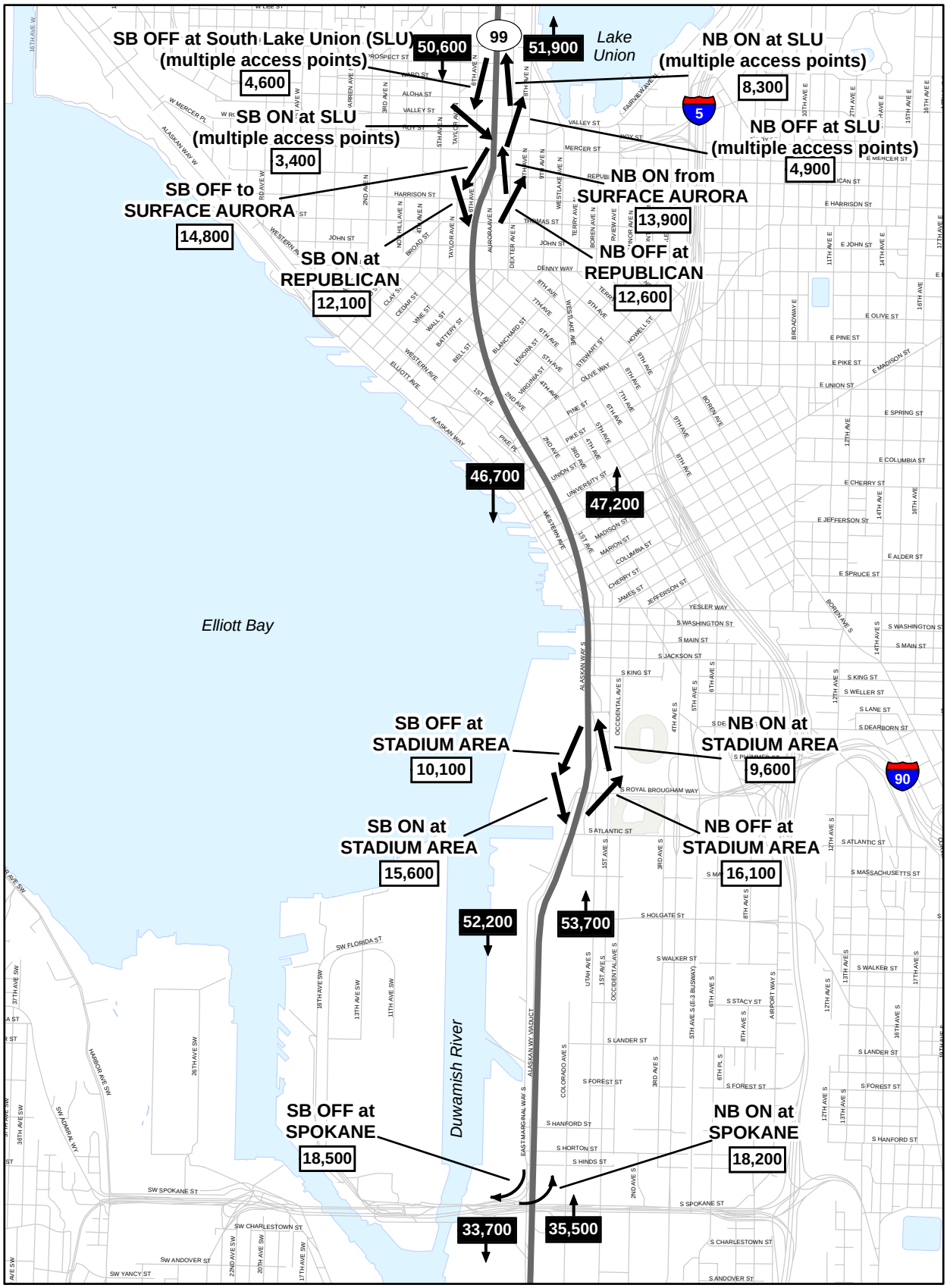
0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Note: Totals may not sum due to rounding.

Exhibit 5-17
Daily Mainline and Ramp Volumes - 2015 Project



N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Note: Totals may not sum due to rounding.

Exhibit 5-18
Daily Mainline and Ramp Volumes - 2030 Project

as other ramps in the study area on a daily basis, with 4,040 vehicles entering northbound but only 3,010 vehicles exiting southbound. In the Battery Street Tunnel, the volume of northbound vehicles (36,310 vehicles) is somewhat higher than the volume of southbound vehicles (33,800 vehicles). At the north end of the study area, about 14,120 northbound vehicles enter SR 99 at Denny Way, with 8,480 entering at other South Lake Union access points. Similarly, the majority of southbound vehicles leaving SR 99 exit at Denny Way (13,020), with a little more than half that many (7,560) exiting at the multiple access points in South Lake Union. Truck traffic is expected to increase at a rate similar to that of general-purpose traffic. See Section 5.7 for discussion on how truck and freight traffic would be accommodated with the 2015 Existing Viaduct.

2015 Viaduct Closed (No Build Alternative)

Because the viaduct is assumed to be closed with the 2015 Viaduct Closed (No Build Alternative), it is assumed that there would be no northbound or southbound traffic on the facility between the Alaskan Way S. and Battery Street Tunnel ramps.

2015 Project

As with the AM and PM peak hours, the southbound stadium area on-ramp is expected to have substantially higher daily volumes (15,600 vehicles) than the ramp at Columbia Street would have with the 2015 Existing Viaduct (8,700 vehicles). Traffic patterns for the Alaskan Way S. ramps mirror those for the peak periods.

The bored tunnel would carry approximately 43,700 vehicles southbound and 42,900 vehicles northbound on a daily basis. This is lower than with the 2015 Existing Viaduct, with 48,100 southbound and 50,400 northbound vehicles through midtown between the Elliott/Western and Seneca/Columbia ramps. However, as described for the AM and PM peak hours, the bored tunnel would likely carry more daily traffic than the Battery Street Tunnel with the 2015 Existing Viaduct, with 33,400 southbound and 36,300 northbound vehicles. In general, although SR 99 volumes through midtown are projected to be lower than in the volumes for the 2015 Existing Viaduct, screenline analysis shows that approximately the same number of trips would be accommodated by the overall system, including I-5 and parallel arterials. At the north end of the study area, mainline volumes are anticipated to be similar to those for the 2015 Existing Viaduct. Entering and exiting volumes from the South Lake Union area, including the ramps at Denny Way, are expected to be slightly higher than those for the 2015 Existing Viaduct. Daily mainline ramp volumes forecasted for the 2015 Project are shown in Exhibit 5-17.

2030 Project

As was the case for the AM and PM peak hour conditions, the 2030 Project daily volumes would be generally similar to those for the 2015 Project, with only minor

increases noted. Daily mainline ramp volumes forecasted for the 2030 Project are shown in Exhibit 5-18.

5.2.2 SR 99 Mainline Level of Service

This section describes the AM and PM peak hour LOS for corridor segments for the 2015 Existing Viaduct and the 2015 Project. While LOS provides a general gauge of how a facility performs overall, it is not considered a comprehensive measure for comparing for the modeled conditions on the SR 99 mainline because the ramp locations and segment arrangements may vary considerably among the modeled conditions. Additionally, as described in Chapter 2, the LOS estimates presented here are based on the Transportation Research Board's HCM density ranges for freeways, which presume faster free-flow speeds than planned for corridor segments under any of the modeled conditions. As a result, the perceived level of traffic congestion on mainline segments may be somewhat less than the level that would typically be estimated by the HCM method. Mainline LOS results are therefore better suited to providing relative comparisons between the modeled conditions as opposed to a precise indication of congestion. Projected speeds and travel times along the facility are better indicators of expected performance. SR 99 mainline LOS is summarized by segment for the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project in Exhibits 5-19 through 5-22, reflecting both directions in the AM and PM peak hours.

Exhibit 5-19. AM Peak Hour Southbound SR 99 Segment LOS

Southbound – AM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
Stadium on to S. Spokane Street	C	C	C
First Avenue S. off to Stadium on	B	N/A	N/A
Midtown			
Columbia on to First Avenue S. off (SB)	F	N/A	N/A
Elliott on to Columbia on (SB)	E	N/A	N/A
Bored Tunnel	N/A	E[1]	E[1]
Battery Street Tunnel	E	N/A	N/A
North Corridor			
North of Battery Street Tunnel	F	N/A	N/A
North of Bored Tunnel	N/A	E	F

HCM = *Highway Capacity Manual*
LOS = level of service
N/A = not applicable
SB = southbound
[1] LOS shown for the bored tunnel was calculated using the HCM analysis method, based on 55 mph free-flow speed. The actual bored tunnel would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, the LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

Exhibit 5-20. AM Peak Hour Northbound SR 99 Segment LOS

Northbound – AM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
S. Spokane Street to Stadium off	F	E	E
Stadium off to First Avenue S.	F	N/A	N/A
Midtown			
First Avenue S. on to Seneca off (NB)	F	N/A	N/A
Seneca off to Western off (NB)	F	N/A	N/A
Bored Tunnel	N/A	E[1]	E[1]
Battery Street Tunnel	E	N/A	N/A
North Corridor			
North of Battery Street Tunnel	C	N/A	N/A
North of Bored Tunnel	N/A	D	E

HCM = *Highway Capacity Manual*
LOS = level of service
N/A = not applicable
NB = northbound
[1] LOS shown for the bored tunnel was calculated using the HCM analysis method, based on 55 mph free-flow speed. The actual bored tunnel would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, the LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

Exhibit 5-21. PM Peak Hour Southbound SR 99 Segment LOS

Southbound – PM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
Stadium on to S. Spokane Street	F	E	F
First Avenue S. off to Stadium on	E	N/A	N/A
Midtown			
Columbia on to First Avenue S. off (SB)	F	N/A	N/A
Elliott on to Columbia on (SB)	D	N/A	N/A
Bored Tunnel	N/A	E[1]	F[1]
Battery Street Tunnel	F	N/A	N/A
North Corridor			
North of Battery Street Tunnel	E	N/A	N/A
North of Bored Tunnel	N/A	E	E

HCM = *Highway Capacity Manual*
LOS = level of service
N/A = not applicable
SB = southbound
[1] LOS shown for the bored tunnel was calculated using the HCM analysis method, based on 55 mph free-flow speed. The actual bored tunnel would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, the LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

Exhibit 5-22. PM Peak Hour Northbound SR 99 Segment LOS

Northbound – PM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
S. Spokane Street to Stadium off	D	D	D
Stadium off to First Avenue S.	E	N/A	N/A
Midtown			
First Avenue S. on to Seneca off (NB)	F	N/A	N/A
Seneca off to Western off (NB)	F	N/A	N/A
Bored Tunnel	N/A	E[1]	F[1]
Battery Street Tunnel	F	N/A	N/A
North Corridor			
North of Battery Street Tunnel	F	N/A	N/A
North of Bored Tunnel	N/A	F	F

HCM = *Highway Capacity Manual*
LOS = level of service
N/A = not applicable
NB = northbound
[1] LOS shown for the bored tunnel was calculated using the HCM analysis method, based on 55 mph free-flow speed. The actual bored tunnel would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, the LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

2015 Existing Viaduct LOS

As shown in Exhibits 5-19 to 5-22, the majority of the evaluated corridor is expected to operate at LOS E or LOS F conditions for the 2015 Existing Viaduct during the AM and PM peak hours, with some exceptions at the north and south ends of the corridor.

The high levels of congestion identified for the 2015 Existing Viaduct are primarily due to merging and weaving friction associated with on-ramp and off-ramp areas within the SR 99 study segment, as well as geometric constraints such as narrow lanes and limited sight distance. Current traffic flow conditions in the downtown area show similarly high levels of congestion during peak commute periods. Key friction areas related to northbound ramp merging and weaving include the on-ramp from First Avenue S. in the south end, the Seneca Street off-ramp in midtown, and the off-ramp to Western Avenue. The northbound on-ramp from Denny Way also causes some congestion north of the Battery Street Tunnel.

For the southbound direction, queues on the off-ramp to Denny Way would spill back to the SR 99 mainline, while downstream friction from the Elliott Avenue on-ramp, Columbia Street on-ramp, and off-ramp to First Avenue S. also create

pockets of congestion that would affect peak period mainline flow. These merging and weaving areas are expected to collectively affect SR 99 corridor operations and are reflected in the LOS estimates shown in Exhibits 5-19 to 5-22.

2015 Viaduct Closed (No Build Alternative) LOS

Traffic conditions in the corridor with the 2015 Viaduct Closed (No Build Alternative) are anticipated to be highly congested compared with the 2015 Existing Viaduct. These congested conditions are expected to result in extremely high travel times for vehicles travelling through the CBD. For example, the travel time between Woodland Park and S. Spokane Street with the 2015 Viaduct Closed (No Build Alternative) is estimated to be approximately three times greater than the travel time for the 2015 Existing Viaduct. LOS on SR 99 both north and south of the closed viaduct would likely be degraded at the point where traffic starts to back up from the transition from expressway to surface arterial system.

2015 Project LOS

The bored tunnel is projected to operate at LOS E in both directions during both the AM and PM peak hours in the 2015 Project. This is generally improved over the 2015 Existing Viaduct for SR 99 through midtown, with the exception of the southbound section between the Elliott and Columbia on-ramps, which is projected to operate at LOS E in the AM peak hour and at LOS D in the PM peak hour in the 2015 Existing Viaduct.

In the south end from approximately S. Spokane Street to the stadium off-ramp area, southbound SR 99 speeds and densities would remain at LOS C in the 2015 Project during the AM peak hour, while northbound operations would improve to LOS E from LOS F in the 2015 Existing Viaduct. During the PM peak hour, southbound operations would improve from LOS F to LOS E, while northbound LOS results are similar to those shown for the 2015 Existing Viaduct. In the north end during the AM peak hour, northbound conditions are expected to become slightly more congested at LOS D, while southbound conditions would improve to LOS E. In the PM peak hour, speeds and densities would remain similar to 2015 Existing Viaduct in both directions.

LOS on SR 99 is projected to be the same with either south end option (the New Dearborn Intersection option or New Dearborn and Charles Intersections option).

2030 Project LOS

Traffic demand for SR 99 is expected to increase by approximately 7 percent between 2015 and 2030. This would have some impact on LOS. As with the 2015 Project, the bored tunnel is projected to operate at LOS E in both directions during the AM peak hour. However, in the PM peak hour, due to the increase in traffic

demand, SR 99 operations are projected to decline from LOS E in 2015 to LOS F in 2030 in both directions.

In the south end from approximately S. Spokane Street to the stadium off-ramp area, southbound SR 99 speeds and densities would remain at LOS C, while mainline performance in the northbound direction would remain at LOS E in the AM peak hour. In the PM peak hour, SR 99 operations would degrade from LOS E in 2015 to LOS F in 2030 in the southbound direction, while remaining at LOS D in the northbound direction.

In the north end during the AM peak hour, southbound conditions are expected to degrade from LOS E in 2015 to LOS F in 2030, while northbound conditions would degrade from LOS D to LOS E. During the PM peak hour, LOS is expected to remain the same as for the 2015 Project for both directions.

5.2.3 SR 99 Mainline Speeds

This section discusses the AM and PM peak hour travel speeds for corridor segments with the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project. As with LOS, comparing travel speeds between the modeled conditions can present certain challenges since the ramp and segment arrangements vary among the modeled conditions. The speeds are presented in Exhibits 5-23 to 5-26. To assist in comparison, the results are presented side-by-side graphically on Exhibits 5-27 and 5-28.

Exhibit 5-23. AM Peak Hour Southbound SR 99 Segment Speeds (Miles per Hour)

Southbound – AM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
Stadium on to S. Spokane Street	48	48	48
First Avenue S. off to Stadium on	49	N/A	N/A
Midtown			
Columbia on to First Avenue S. off (SB)	24	N/A	N/A
Elliott on to Columbia on (SB)	36	N/A	N/A
Bored Tunnel	N/A	45	45
Battery Street Tunnel	33	N/A	N/A
North Corridor			
North of Battery Street Tunnel	25	N/A	N/A
North of Bored Tunnel	N/A	36	34

N/A = not applicable
SB = southbound

Exhibit 5-24. AM Peak Hour Northbound SR 99 Segment Speeds (Miles per Hour)

Northbound – AM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
S. Spokane Street to Stadium off	37	44	41
Stadium off to First Avenue S.	27	N/A	N/A
Midtown			
First Avenue S. on to Seneca off (NB)	22	N/A	N/A
Seneca off to Western off (NB)	17	N/A	N/A
Bored Tunnel	N/A	45	44
Battery Street Tunnel	33	N/A	N/A
North Corridor			
North of Battery Street Tunnel	35	N/A	N/A
North of Bored Tunnel	N/A	33	32

N/A = not applicable
NB = northbound

Exhibit 5-25. PM Peak Hour Southbound SR 99 Segment Speeds (Miles per Hour)

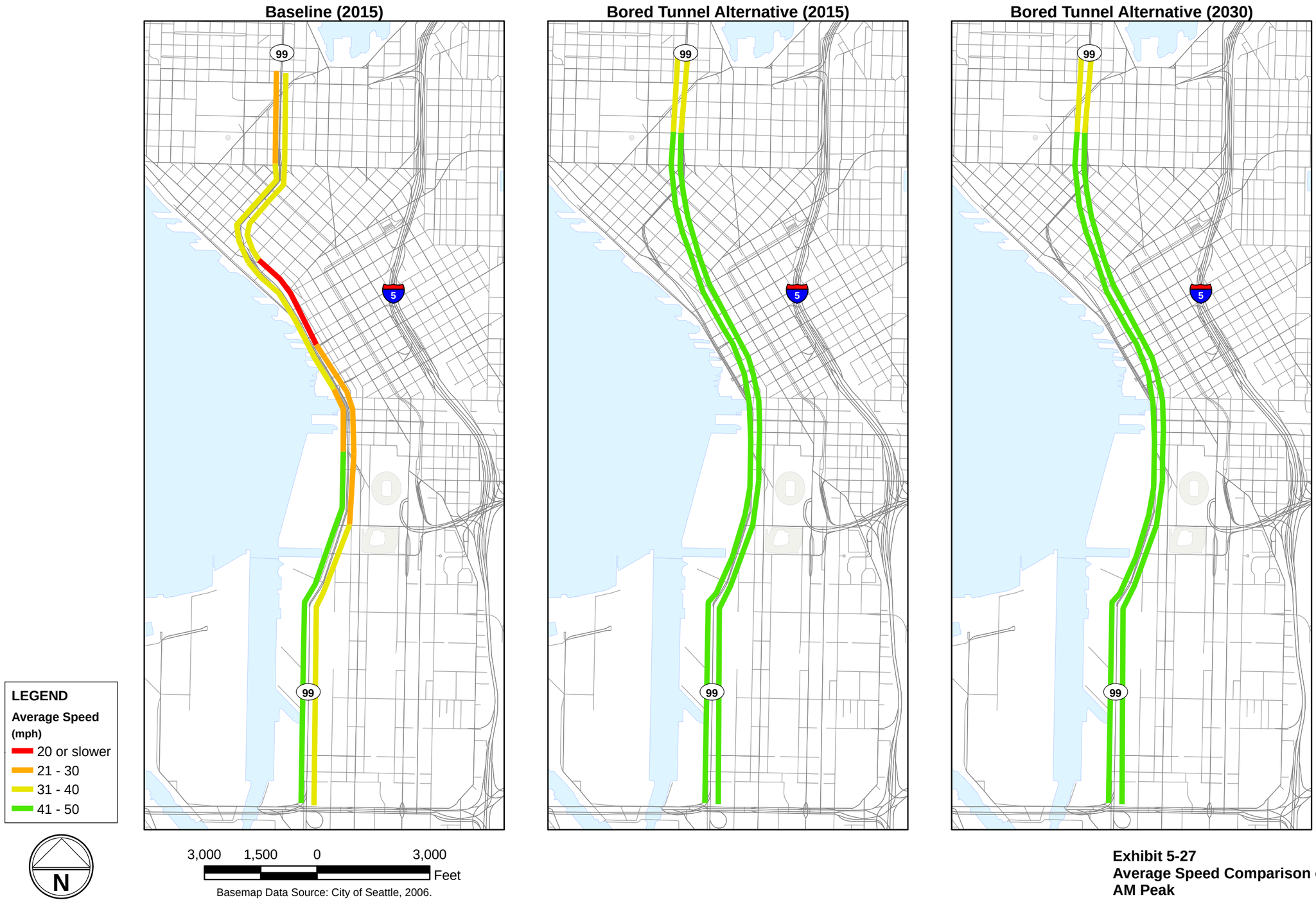
Southbound – PM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
Stadium on to S. Spokane Street	32	44	30
First Avenue S. off to Stadium on	42	N/A	N/A
Midtown			
Columbia on to First Avenue S. off (SB)	31	N/A	N/A
Elliott on to Columbia on (SB)	43	N/A	N/A
Bored Tunnel	N/A	46	43
Battery Street Tunnel	33	N/A	N/A
North Corridor			
North of Battery Street Tunnel	33	N/A	N/A
North of Bored Tunnel	N/A	37	36

N/A = not applicable
SB = southbound

Exhibit 5-26. PM Peak Hour Northbound SR 99 Segment Speeds (Miles per Hour)

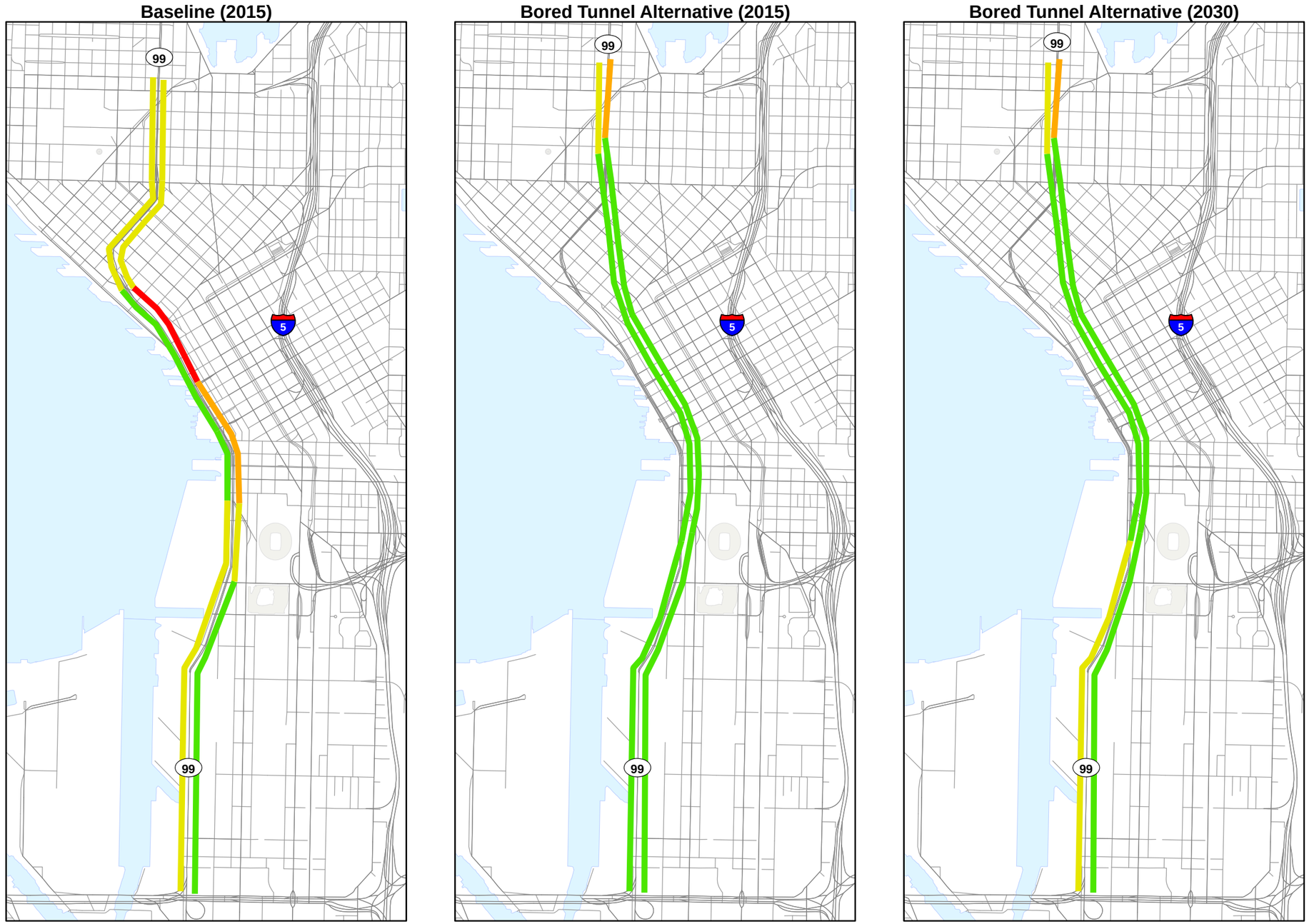
Northbound – PM	2015 Existing Viaduct	2015 Project	2030 Project
South Corridor			
S. Spokane Street to Stadium off	46	48	47
Stadium off to First Avenue S.	35	N/A	N/A
Midtown			
First Avenue S. on to Seneca off (NB)	21	N/A	N/A
Seneca off to Western off (NB)	14	N/A	N/A
Bored Tunnel	N/A	44	41
Battery Street Tunnel	33	N/A	N/A
North Corridor			
North of Battery Street Tunnel	33	N/A	N/A
North of Bored Tunnel	N/A	29	27

N/A = not applicable
NB = northbound



Basemap Data Source: City of Seattle, 2006.

Exhibit 5-27
Average Speed Comparison on SR 99 Segments
AM Peak



Basemap Data Source: City of Seattle, 2006.

Exhibit 5-28
Average Speed Comparison on SR 99 Segments
PM Peak

Segment travel speed results confirm LOS findings, with congested conditions causing slower speeds on SR 99 through midtown with the 2015 Existing Viaduct. As indicated previously, the 2015 Viaduct Closed (No Build Alternative) is expected to result in highly congested conditions on the mainline at the transition points between expressway and surface arterial system, with corresponding speeds much lower than those estimated for the 2015 Existing Viaduct. Speeds in the bored tunnel would be approximately 44 to 46 mph in both directions in both the AM and PM peak hours in 2015, and between 41 and 45 mph in 2030. This compares with speeds ranging from 14 to 43 mph for SR 99 through midtown with the 2015 Existing Viaduct, depending on segment and time period.

In the south end of the corridor from S. Spokane Street to the stadium off-ramp area with the 2015 Project, speeds for northbound SR 99 would be higher than those for the 2015 Existing Viaduct, while speeds in the southbound direction would be similar to those for the 2015 Existing Viaduct in the AM peak hour. In the PM peak hour, 2015 Project speeds would be higher in both directions compared with those for the 2015 Existing Viaduct. In 2030, speeds would be similar to those for the 2015 Project in the southbound direction during the AM peak hour, but they are anticipated to degrade significantly from 44 mph to 30 mph during the PM peak hour. In the northbound direction, speeds are anticipated to degrade slightly to as low as 41 mph during the AM peak hour, while remaining similar to speeds for the 2015 Project in the PM peak hour.

In the north end during the AM peak hour, southbound conditions for the 2015 Project are expected to be slightly better, at 36 mph, compared to 25 mph for the 2015 Existing Viaduct. While northbound speeds within the bored tunnel would be higher than speeds for the 2015 Existing Viaduct, northbound speeds north of the tunnel portal would be slightly lower for the 2015 Project. However, northbound vehicles would be able to take advantage of higher speeds for a greater distance, as the portal for the bored tunnel would be located farther north than that of the existing Battery Street Tunnel. In the PM peak hour, speeds north of the tunnel portal would again be slightly higher for the 2015 Project in the southbound direction and slightly lower for the 2015 Project in the northbound direction (see Exhibits 5-27 and 5-28). Speeds for the north end in 2030 are anticipated to be similar or slightly lower than those for the 2015 Project during both AM and PM peak hours.

Differences in travel speeds on SR 99 between the New Dearborn Intersection option and New Dearborn and Charles Intersections option are projected to be negligible.

5.3 Traffic Operations at Key Arterial Intersections

To assess the impacts of each of the modeled conditions on other streets within the transportation system, a description of intersection operations at selected locations is presented in this section. Intersection performance is discussed and summarized for four applicable modeled conditions: 2015 Existing Viaduct, 2015 Viaduct Closed (No Build Alternative), 2015 Project, and 2030 Project. The primary performance measure used for this analysis is LOS, which is a commonly used measure of operational effectiveness for transportation facilities. LOS is used to assess a variety of transportation facilities ranging from arterials to freeway segments. For the evaluation of signalized intersections, LOS is specifically based on the *average vehicle delay* calculated for a given intersection. LOS is represented by a letter grade ranging from "A" (short delays and free-flow traffic conditions) to "F" (very congested or break-down conditions).

The intersection analysis results are summarized for the south, central, and north sub-areas. The specific locations selected for analysis were based on several factors related to the proximity of the intersection to the SR 99 corridor or its access points, forecasted traffic volumes associated with the locations under the range of modeled conditions, and current congestion levels. Except for Mercer Street at Sixth Avenue N., only signalized intersections (existing or proposed) were analyzed. All signalized intersections directly affected by, or created as a result of, implementation of the Bored Tunnel Alternative are included in the analysis.

Intersections that are projected to operate at LOS E or F indicate those locations that are most likely to experience substantial congestion during the peak hour. Intersections that operate at LOS A through D would experience little to moderate congestion levels during peak times and generally are not of concern. While traffic congestion is a common occurrence in the urban environment, identifying LOS E and F intersections does indicate those areas that warrant consideration of how congestion may affect major travel movements and specific travel modes such as transit or freight. Also of concern is whether congestion may lead to air quality concerns, which is assessed in Appendix M, Air Discipline Report.

Key Findings

- While most intersections in the south sub-area are expected to operate at LOS D or better conditions with the 2015 Existing Viaduct, six locations are expected to operate at LOS E or F during one or both of the peak hours. The Bored Tunnel Alternative in general would maintain or modestly improve intersection traffic operations in the area for the 2015 timeframe. Most intersections with the 2015 Project are expected to operate at LOS D or better during the AM peak hour, with two

intersections forecasted to continue to operate at LOS E similar to the 2015 Existing Viaduct. Two intersections are forecasted to operate at LOS E or F during the PM peak. By 2030, growth in traffic is expected to result in three LOS E/F intersections in both the AM and PM peak hours.

- For the 2015 Project, traffic operations at each intersection under the New Dearborn and Charles Intersections option are expected to be slightly better than under the New Dearborn Intersection option. This includes the intersections of Alaskan Way S. with S. Dearborn Street and S. Charles Street, as well as the intersections of First Avenue S. at S. Dearborn Street and S. Charles Street. This is due to greater distribution of turning traffic volumes with the improved east-west surface street connections in place. However, delay encountered by traffic using Alaskan Way S. to access and egress the new SR 99 ramps to and from the south for the New Dearborn and Charles Intersections option would be greater than or equal to that of the New Dearborn Intersection option because traffic would need to pass through an additional signalized intersection. For the 2030 Project, these intersections are projected to operate at LOS D or better at under both options.
- All intersections evaluated in the central sub-area with the 2015 Existing Viaduct are expected to operate at LOS D or better during the AM peak, and only First Avenue at Columbia Street would experience LOS F conditions during the PM peak. Results are similar for the 2015 Project, which would reduce congestion on many downtown streets (including the aforementioned First Avenue intersection at Columbia Street, which improves considerably with the 2015 Project with the removal of the Columbia Street on-ramp to SR 99). By 2030, traffic growth is expected to result in one LOS E intersection during the AM peak, and to worsen conditions at the Broad Street and Western Avenue intersection to LOS F due to increased traffic turning from Broad Street onto Western Avenue.
- In the north sub-area, LOS E and F conditions are expected at two intersections with the 2015 Existing Viaduct during the AM peak and at three locations during the PM peak. The Bored Tunnel Alternative would create a number of new intersections, all of which are expected to operate well. Elsewhere, three LOS E intersections are expected during the 2015 Project AM peak, while seven locations are expected to operate at LOS E or F conditions during the PM peak. Many of these locations are along Mercer Street, which carries a substantial share of the east-west traffic in the area. By 2030, traffic growth is expected to result in 4 intersections operating at LOS E or F conditions during the AM peak, and 11 during the PM peak.

- With the Curved Sixth Avenue option, the intersection LOS would degrade into congested conditions (LOS E or F) at one location in the AM and PM peak hours in the 2030 Project when compared to conditions with the Straight Sixth Avenue option. The LOS for Fifth Avenue N. at Mercer Street would change from LOS D to LOS E because the volume shifts in response to the left-turn restriction at Sixth Avenue N. and Mercer Street exceed the ability of the traffic signal to serve the volume better.
- Though not specifically analyzed for intersection operations, the 2015 Viaduct Closed (No Build Alternative) is likely to increase the number of intersections operating at LOS E and F considerably, and would likely increase delay at many of these locations well beyond the LOS F threshold, leading to substantial congestion. This is especially likely for intersections in the north and south sub-areas and along north-south arterials through the central waterfront and downtown as traffic shifts from the SR 99 corridor to alternate surface street routes.

Detailed intersection analysis results are shown in Exhibits 5-29, 5-30, and 5-31 for the south, central, and north sub-areas, respectively. Exhibit 5-32 reports results for intersections that would be affected differently by the Curved Sixth Avenue option. Exhibit 5-33 reports results for the intersections that would be affected differently under the New Dearborn and Charles Intersections option.

5.3.1 South Sub-Area

Two configurations are being considered for new cross streets that would be built to intersect with Alaskan Way S. near the south portal. The New Dearborn Intersection option would add one new intersection and cross street on Alaskan Way S. at S. Dearborn Street. The southbound on-ramp and northbound off-ramp from SR 99 would form the south leg of this new signalized intersection. The New Dearborn and Charles Intersections option would add two new intersections and cross streets along Alaskan Way S. at S. Charles Street and S. Dearborn Street. These new intersections would both be signalized. The southbound on-ramp and northbound off-ramp from SR 99 would form the south leg of the Alaskan Way S./ S. Charles Street intersection.

The two south portal options are shown on Exhibit 5-34. Intersection analysis results for the south sub-area, which includes streets located south of S. King Street and west of Fourth Avenue, are shown in Exhibit 5-29. Operational results for intersections affected by the New Dearborn Intersection option are shown in Exhibit 5-33.

Exhibit 5-29. Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), South (With New Dearborn Intersection Option)

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Alaskan Way S.	S. Royal Brougham Way	B	18	N/A	N/A	N/A	N/A	N/A	N/A	C	30	N/A	N/A	N/A	N/A	N/A	N/A
Alaskan Way S.	S. Dearborn Street	N/A	N/A	N/A	N/A	D	37	D	44	N/A	N/A	N/A	N/A	C	22	C	23
Alaskan Way S.	S. King Street	N/A	N/A	A	6	B	19	B	19	N/A	N/A	B	15	B	17	C	22
Alaskan Way S.	S. Jackson Street	A	2	A	5	A	7	A	5	A	3	A	5	A	5	A	5
Alaskan Way S.	S. Main Street	A	3	B	19	B	10	A	9	A	4	B	11	A	6	A	8
E. Frontage Road	S. Atlantic Street	N/A	N/A	B	16	D	47	E	56	N/A	N/A	B	10	C	21	C	28
E. Frontage Road	S. Royal Brougham Way/ SR 99 ramps	N/A	N/A	C	31	C	29	C	34	N/A	N/A	B	17	D	44	D	47
Alaskan Way S.	Ferry Holding	A	4	F	103	N/A	N/A	N/A	N/A	A	6	E	56	N/A	N/A	N/A	N/A
Alaskan Way	Yesler Way	B	19	C	30	D	39	C	34	C	22	C	31	B	14	B	19
E. Marginal Way	h-shaped overcrossing	N/A	N/A	N/A	N/A	C	28	N/A	N/A	N/A	N/A	N/A	N/A	B	17	C	26
E. Marginal Way/ Terminal 46	S. Atlantic Street	N/A	N/A	F	102	E	66	F	80	N/A	N/A	E	63	D	39	D	47
Colorado Avenue	S. Atlantic Street	N/A	N/A	E	68	E	58	E	59	N/A	N/A	C	28	D	47	E	56
First Avenue S.	S. Atlantic Street	D	46	D	47	C	22	C	33	D	43	E	58	E	59	F	97
First Avenue S.	S. Royal Brougham Way	D	48	D	35	C	22	C	25	C	31	D	52	C	34	D	36
First Avenue S.	S. Dearborn Street	N/A	N/A	N/A	N/A	B	15	B	19	N/A	N/A	N/A	N/A	C	27	C	26
First Avenue S.	S. Jackson Street	B	15	B	12	B	12	B	17	C	24	B	12	B	18	C	26
First Avenue S.	S. Main Street	A	4	A	6	A	7	B	11	A	10	A	9	B	11	B	11
First Avenue	Yesler Way	B	18	B	20	D	42	D	40	C	27	E	56	F	100	F	110

Exhibit 5-29. Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), South (With New Dearborn Intersection Option) - continued

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Second Avenue S.	S. Jackson Street	B	20	C	33	C	33	D	45	B	19	D	53	E	75	F	103
Second Avenue S.	S. Main Street	B	13	B	18	C	26	C	31	C	24	C	23	C	28	C	33
Second Avenue S.	Yesler Way	B	10	B	16	B	14	B	14	B	12	B	16	B	15	B	16
Fourth Avenue S.	S. Main Street	A	9	A	7	A	6	A	8	B	10	A	8	A	6	A	6
Fourth Avenue S.	S. Jackson Street	C	22	A	28	C	29	D	41	C	21	C	26	C	28	D	51
Fourth Avenue S.	S. Royal Brougham Way	D	43	B	17	C	29	D	38	E	68	E	56	D	51	D	54

N/A = not applicable

Exhibit 5-30. Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), Central

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Alaskan Way	Columbia Street	A	7	A	7	B	18	B	15	A	5	B	15	A	9	A	10
Alaskan Way	Marion Street	B	12	C	25	B	12	A	10	B	15	C	26	B	12	B	17
Alaskan Way	Madison Street	A	10	A	10	A	5	A	6	B	15	B	15	B	17	B	14
Elliott Avenue	Bell Street	A	5	A	5	A	2	A	2	E	62	A	7	A	3	A	3
Elliott Avenue	Wall Street	B	17	B	16	B	13	B	13	C	30	C	32	B	11	B	11
Elliott Avenue	Broad Street	D	36	C	28	C	24	C	25	C	30	D	41	C	34	D	38
Western Avenue	Marion Street	B	17	C	21	C	21	C	21	B	16	B	14	A	10	B	12
Western Avenue	Madison Street	B	17	B	17	B	18	B	18	B	20	C	27	C	25	B	20
Western Avenue	Spring Street	B	11	A	8	B	16	B	17	B	12	B	12	A	10	B	11
Western Avenue	Battery Street/SR 99 off-ramp	B	16	B	16	A	1	A	1	A	10	A	10	A	3	A	3
Western Avenue	Wall Street	B	18	B	17	B	19	D	40	C	27	C	31	C	27	C	28
Western Avenue	Broad Street	B	16	B	14	B	19	B	17	C	22	B	13	C	21	F	96
First Avenue	Columbia Street	C	32	B	14	A	10	A	8	F	148	F	146	B	11	B	15
First Avenue	Marion Street	B	11	B	13	B	18	B	18	B	14	B	11	B	16	B	16
First Avenue	Madison Street	A	9	A	8	A	8	A	8	A	9	B	13	A	10	A	9
First Avenue	Spring Street	A	7	A	7	D	45	D	41	B	13	B	12	B	19	C	30
First Avenue	Seneca Street	B	19	C	24	B	18	B	19	B	17	C	23	B	14	B	14
Second Avenue	Cherry Street	A	5	A	6	B	11	B	11	A	9	B	10	A	10	B	13
Second Avenue	Columbia Street	B	15	B	13	A	6	A	6	C	24	C	21	A	9	A	9
Second Avenue	Marion Street	B	15	D	43	D	51	E	68	B	20	D	36	D	43	D	48

Exhibit 5-30. Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), Central (continued)

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Second Avenue	Madison Street	A	8	B	19	B	15	C	32	B	12	B	16	B	17	C	25
Second Avenue	Spring Street	A	9	B	12	C	24	D	39	B	10	B	13	B	11	B	14
Second Avenue	Seneca Street	B	16	C	24	B	16	B	18	E	79	C	28	B	11	B	11
Second Avenue	University Street	A	9	A	10	B	11	B	12	A	8	B	17	B	16	C	21
Second Avenue	Union Street	B	11	B	11	B	14	B	15	B	12	B	17	B	15	B	17
Second Avenue	Pike Street	A	10	A	10	A	8	A	7	B	12	B	12	B	10	B	10
Second Avenue	Pine Street	A	9	A	10	B	12	B	11	B	13	B	16	B	17	B	18
Second Avenue	Bell Street	A	7	A	5	A	5	A	6	B	13	B	14	B	11	A	10
Second Avenue	Battery Street	B	19	A	5	A	5	A	6	A	9	A	5	A	8	A	8
Second Avenue	Wall Street	B	15	B	15	B	16	B	17	B	16	B	15	B	16	B	17
Fourth Avenue	Cherry Street	A	4	A	9	B	10	B	16	B	14	A	9	A	8	B	11
Fourth Avenue	Columbia Street	C	24	D	46	E	66	E	79	B	11	D	46	C	23	D	42
Fourth Avenue	Marion Street	B	16	C	25	B	16	C	20	C	23	B	12	D	44	D	46
Fourth Avenue	Madison Street	C	28	D	37	D	54	E	66	B	17	C	28	D	40	E	64
Fourth Avenue	Spring Street	A	9	B	19	B	15	D	39	B	17	B	18	C	26	D	36
Fourth Avenue	Seneca Street	A	8	B	12	B	12	B	15	C	21	D	46	D	48	E	62
Fourth Avenue	University Street	A	7	A	10	A	7	A	8	D	39	C	25	C	28	D	50
Fourth Avenue	Union Street	A	8	B	12	B	12	B	12	B	13	B	13	B	14	B	15
Fourth Avenue	Pike Street	B	18	B	19	B	15	B	18	B	19	D	42	C	26	C	33
Fourth Avenue	Pine Street	C	21	C	21	B	20	C	22	B	13	C	22	C	20	C	27
Fourth Avenue	Blanchard Street	A	7	A	8	A	8	A	8	A	7	A	8	A	8	A	8
Fourth Avenue	Bell Street	A	7	A	8	A	8	A	7	A	9	A	10	A	9	A	10
Fourth Avenue	Battery Street	B	10	A	10	B	11	B	11	B	18	B	18	B	20	C	21
Fourth Avenue	Wall Street	A	6	A	6	A	6	A	6	A	9	A	8	A	6	A	7

Exhibit 5-31. Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), North (With Straight Sixth Avenue Option)

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Western Avenue W.	Elliott Avenue W.	A	9	B	16	B	13	B	15	C	32	C	21	B	18	C	21
W. Mercer Place	Elliott Avenue W.	B	17	E	60	E	66	E	74	C	23	F	83	F	83	F	86
First Avenue	Denny Way	C	33	C	26	E	57	F	91	C	33	D	37	D	50	E	73
Second Avenue	Denny Way	A	9	A	7	A	7	A	9	A	8	A	7	B	15	B	15
Broad Street	Denny Way	C	27	C	25	B	16	B	18	C	26	C	24	C	25	C	28
Broad Street Turn	Mercer Street			A	8							B	14				
Fifth Avenue	Denny Way	B	17	B	20	B	16	B	15	B	15	B	18	D	37	D	42
Fifth Avenue N.	Broad Street	D	37	C	27	D	41	D	43	C	33	C	28	C	30	D	36
Fifth Avenue N.	Harrison Street	C	26	B	12	B	11	B	11	C	31	B	18	A	7	A	9
Fifth Avenue N.	Mercer Street	C	21	C	31	D	36	D	43	D	36	B	17	E	66	E	72
Fifth Avenue N.	Roy Street	C	35	B	17	C	24	D	53	B	18	C	21	C	30	D	50
Taylor Avenue N.	Mercer Street					C	22	C	25					B	14	C	23
Sixth Avenue	Battery Street	A	10	A	9	B	12	B	13	B	18	B	18	E	73	F	87
Sixth Avenue	Denny Way	B	12	A	8	B	15	B	19	B	17	C	21	B	13	B	15
Sixth Avenue N.	John Street					A	8	B	11					A	9	A	9
Sixth Avenue N.	Thomas Street					A	7	A	9					B	13	B	12
Sixth Avenue N.	Harrison Street					A	10	B	11					B	12	B	13
Sixth Avenue N.	Republican/SR 99 on-ramp					A	4	A	4					A	1	A	1
Sixth Avenue N.	Mercer Street					B	14	B	15					B	15	C	30
Aurora Avenue SB	Denny Way	B	14	B	18					B	20	D	48				
Aurora Avenue NB	Denny Way	C	25	C	28					D	55	F	98				
Aurora Avenue	Denny Way					C	31	C	34					D	41	E	60
Aurora Avenue	John Street					A	7	A	9					A	7	A	8
Aurora Avenue	Thomas Street					B	17	B	12					C	22	C	24
Aurora Avenue	Harrison Street					C	22	C	22					B	16	B	17

Exhibit 5-31. Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), North (With Straight Sixth Avenue Option) (continued)

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Dexter Avenue	Denny Way	B	20	C	27	D	50	F	91	C	24	E	61	D	36	E	60
Dexter Avenue N.	John Street					A	7	A	8					A	7	A	8
Dexter Avenue N.	Thomas Street					B	13	A	9					B	17	B	17
Dexter Avenue N.	Harrison Street	C	25	B	18	A	9	**B**	19	A	10	B	13	A	9	B	11
Dexter Avenue N.	Republican/SR 99 off-ramp					B	17	B	16					B	12	B	15
Dexter Avenue N.	Mercer Street	D	40	D	42	D	40	D	42	E	63	D	48	E	69	F	94
Dexter Avenue N.	Roy Street	A	7	A	7	B	20	C	25	A	8	A	9	B	13	B	14
Dexter Avenue N.	Aloha Street	B	17	C	28	D	41	D	43	B	11	B	15	B	16	C	22
Ninth Avenue N.	Mercer Street	C	22	D	38	C	28	D	41	C	27	D	43	D	43	E	66
Westlake Avenue N.	Mercer Street	A	8	D	43	D	43	D	43	E	67	F	115	F	135	F	163
Fairview Avenue N.	Valley Street	C	29	E	63	E	63	F	91	D	35	D	53	E	58	E	80
Fairview Avenue N.	I-5 off-ramp	E	67							C	23						
Fairview Avenue N./I-5 ramp	Mercer Street	E	68	D	47	E	63	E	66	F	211	F	140	F	135	F	168

Exhibit 5-32. Intersection Level of Service and Average Vehicle Delay (Seconds), Intersections Affected by the Curved Sixth Avenue Option

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Fifth Avenue N.	Mercer Street	C	21	C	31	D	48	E	75	D	36	B	17	E	65	E	58
Sixth Avenue N.[1]	Mercer Street	N/A	N/A	N/A	N/A	A[1]	<1[1]	A[1]	<1[1]	N/A	N/A	N/A	N/A	A[1]	<1[1]	A[1]	<1[1]
Northbound approach[1]		N/A	N/A	N/A	N/A	A[1]	10[1]	A[1]	10[1]	N/A	N/A	N/A	N/A	A[1]	10[1]	B[1]	11[1]
Dexter Avenue N.	Mercer Street	C	35	D	42	D	48	D	55	E	62	D	48	E	79	F	93

LOS = level of service
N/A = not applicable
[1] An LOS rating has been associated with the overall intersection delay based on LOS ratings for unsignalized intersection delay ranges. This intersection is unsignalized; therefore, in addition to the overall intersection delay, the approach with the most delay has also been provided.

Exhibit 5-33. Intersection Level of Service and Average Vehicle Delay (Seconds), Intersections Affected by the New Dearborn and Charles Intersections Option

Street	Cross Street	2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project		2005 Existing		2015 Existing Viaduct		2015 Project		2030 Project	
		AM Peak Hour								PM Peak Hour							
Alaskan Way S.	S. King Street	N/A	N/A	A	6	C	32	B	17	N/A	N/A	B	15	B	18	B	18
Alaskan Way S.	S. Dearborn Street	N/A	N/A	N/A	N/A	C	31	C	27	N/A	N/A	N/A	N/A	B	16	B	17
Alaskan Way S.	S. Charles Street	N/A	N/A	N/A	N/A	C	34	D	44	N/A	N/A	N/A	N/A	B	11	B	14
First Avenue S.	S. Dearborn Street	N/A	N/A	N/A	N/A	A	7	A	8	N/A	N/A	N/A	N/A	A	9	B	15
First Avenue S.	S. Charles Street	N/A	N/A	N/A	N/A	A	9	A	8	N/A	N/A	N/A	N/A	A	8	B	13

N/A = not applicable

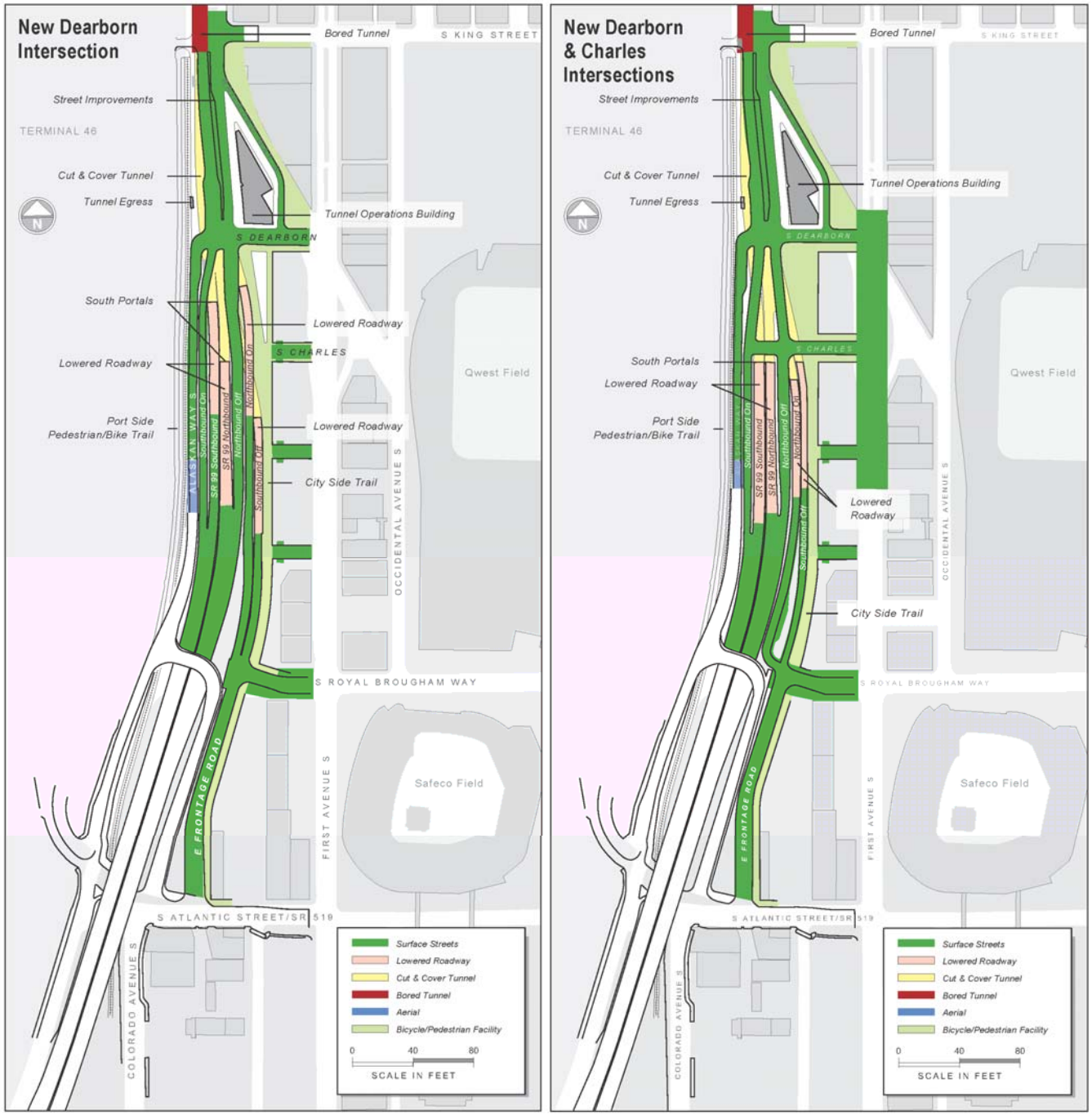


Exhibit 5-34
South Portal Options

2015 Existing Viaduct

The S. Holgate Street to S. King Street Viaduct Replacement Project improvements to SR 99 will be in place by 2015 and are considered part of the 2015 Existing Viaduct. That project includes revisions to the street system west of First Avenue S. near S. Atlantic Street and S. Royal Brougham Way. Additionally, new ramp connections to SR 99 will be provided to Alaskan Way S. south of S. King Street. These ramps will provide an entrance to southbound SR 99 and an exit from northbound SR 99, complementing the existing Columbia and Seneca ramps and providing new access into the central waterfront, Pioneer Square, and stadium areas. While these new ramps are expected to draw additional traffic onto Alaskan Way S., intersections on Alaskan Way S. are generally expected to operate to LOS D or better conditions in the south sub-area, with a few exceptions. One exception is the new intersection at Alaskan Way S./Alaskan Way S. ramps/ferry holding. This intersection is expected to operate at LOS F and LOS E during the AM and PM peak hours respectively, though this is largely a result of the operational approach to hold ferry traffic for a period of time and release it in platoons and is not reflective of congestion or over-capacity conditions. Traffic on Alaskan Way S. would not experience particularly long delays at this location.

The h-shaped overcrossing will be used when the tail track crossing S. Atlantic Street is blocked by trains. When the tail track is clear, traffic will travel along S. Atlantic Street between the intersections of E. Marginal Way S./Terminal 46 and Colorado Avenue S. It was estimated that the tail track is blocked approximately 50 percent of the day; therefore, the h-shaped overcrossing will also be used as a bypass about half of the day. The intersection of E. Marginal Way S./Terminal 46 at S. Atlantic Street is projected to operate at LOS F and LOS E during the AM and PM peak hours. The intersection of Colorado Avenue S. at S. Atlantic Street is projected to operate at LOS E during the AM peak hour. Operations at these two intersections reflects the need for a relatively long cycle length to accommodate all movements associated with the h-shaped overcrossing and disruption caused by changing between timing plans when the overcrossing cycles in or out of use. In addition, the signal system for the intersection of E. Marginal Way S./ Terminal 46 at S. Atlantic Street must also provide for movements at the adjacent Colorado Avenue S./S. Atlantic Street intersection, further adding to potential delays in the general area.

The high-volume intersection of First Avenue S. at S. Atlantic Street is expected to operate at LOS E conditions for the PM peak hour. During the PM peak hour, congestion levels are affected by heavy northbound through movements and southbound left-turns, which require considerable portions of the available signal cycle lengths to accommodate.

The heavily traveled intersection of S. Royal Brougham Way at Fourth Avenue S. is expected to continue to operate at LOS E during the PM peak hour, as it does today.

In Pioneer Square, the intersection of First Avenue S. at Yesler Way is expected to operate at LOS F during the PM peak hour. Delays at this location are primarily due to increased traffic volumes on First Avenue S. compared to pre-2015 Existing Viaduct (no S. Holgate Street to S. King Street Viaduct Replacement Project) conditions coupled with the availability of only one travel lane in each direction during the afternoon.

2015 Viaduct Closed (No Build Alternative)

SR 99 mainline traffic in the south end would transition from the previously reconstructed S. Holgate Street to S. King Street segment of SR 99 to and from the Alaskan Way surface arterial via a set of single-lane ramps connecting to an unimproved Alaskan Way at S. King Street. This configuration introduces a substantial reduction in capacity on the corridor relative to existing conditions and the 2015 Existing Viaduct. As a result, severe backups are expected to form at the transition points, spreading elsewhere into the street network.

Though not specifically assessed for intersection operations, inferences based on modeled changes in travel patterns may be drawn. Locations in the south end most likely to experience considerable congestion are the transition ramps from SR 99 to Alaskan Way S./East Frontage Road/S. King Street, as well as the intersections along First Avenue S. at S. Atlantic Street and at S. Royal Brougham Way, along Alaskan Way north of S. King Street, and most intersections on First Avenue between S. King Street and Madison Street. These locations are expected to operate with substantial levels of congestion due to the large increases in traffic volumes diverted from the SR 99 corridor.

2015 Project

With the 2015 Project, traffic patterns in the south end would change relative to the 2015 Existing Viaduct due to the relocation of the SR 99 stadium area ramps, the closure of the midtown ramps, and the introduction of newly created intersections within the study network. The First Avenue S. ramps at Railroad Way S. would be removed and replaced with ramps that connect to a new East Frontage Road at S. Royal Brougham Way (and continuing on to S. Atlantic Street as well). This ramp relocation would redistribute traffic to S. Royal Brougham Way and S. Atlantic Street west of First Avenue S., rather than to First Avenue S. between S. Atlantic Street and Railroad Way S. The closure of the midtown ramps with the 2015 Project is expected to direct more traffic to the SR 99 ramps in the stadium area. As a result, arterial volumes in the south end are expected to be higher with the 2015 Project, primarily along Alaskan Way S. The results of

the analysis indicate that intersection operations are not expected to be affected, with the exception of the effects described below.

Operations at the intersection of First Avenue S. at S. Atlantic Street, with the 2015 Project, are anticipated to improve to LOS C during the AM peak hour but remain at LOS E during the PM peak hour, largely due to opposing high-volume traffic movements during the PM peak.

Traffic patterns along S. Atlantic Street are expected to change compared to the 2015 Existing Viaduct as traffic reroutes from First Avenue S. to S. Atlantic Street to the East Frontage Road to access the new northbound on-ramp and also to Alaskan Way, via the h-shaped overcrossing. With the 2015 Existing Viaduct, the h-shaped overcrossing allows only southbound movements from Alaskan Way S. With the 2015 Project, both northbound and southbound movements would be allowed.

The intersection of S. Atlantic Street at E. Marginal Way S. is expected to operate at LOS E during the AM peak hour, an improvement over operations with the 2015 Existing Viaduct (LOS F). The intersection of S. Atlantic Street and Colorado Avenue S. is expected to continue to operate at LOS E during the AM peak hour, similar to the 2015 Existing Viaduct. The intersection of Second Avenue S. and S. Jackson Street is expected to operate at LOS E during the PM peak hour, compared to LOS D for the 2015 Existing Viaduct. This is due to an increase in traffic on Second Avenue S. First Avenue S. at Yesler Way is expected to operate at LOS F during the PM peak hour due to increased traffic volumes on First Avenue S. as compared to the 2015 Existing Viaduct and the capacity limitations associated with one travel lane in each direction with a parking lane in both directions. Prohibition of parking on First Avenue S. during the PM peak period near this intersection would improve traffic operations but would adversely affect parking and access to businesses in the Pioneer Square area.

Comparison of the New Dearborn Intersection Option and New Dearborn and Charles Intersections Option

The New Dearborn Intersection option would connect the new SR 99 ramps to and from the south at a new intersection of Alaskan Way S./S. Dearborn Street. The New Dearborn and Charles Intersections option would include new intersections along Alaskan Way S. at S. Dearborn Street and S. Charles Street, with the new SR 99 ramps to and from the south connecting at S. Charles Street. Under both options, traffic signals and pedestrian crossings would be provided at the new intersection(s).

Under both options, operations are expected to be LOS D or better at the intersections of Alaskan Way S. at S. Dearborn Street and at S. Charles Street, as

well as the intersection of First Avenue S. at S. Dearborn and S. Charles Streets, which is an acceptable LOS for an urban area intersection.

Average intersection delay and LOS are projected to be slightly better for each of the two new intersections under the New Dearborn and Charles Intersections option. However, the improvements in delay are minimal (8 seconds or less) at the intersection of Alaskan Way S. and S. Dearborn Street during both the 2015 AM and PM peak hours and the intersection of First Avenue S. at S. Dearborn Street during the 2015 AM peak hour. During the PM peak hour, intersection delay at the First Avenue S./S. Dearborn Street intersection is forecasted to be 18 seconds less under the New Dearborn and Charles Intersections option compared to the New Dearborn Intersection option. This is expected due to some redistribution of turning traffic volumes resulting from the increase in east-west surface street connections.

However, while individual intersection LOS and delay may be somewhat improved under the New Dearborn and Charles Intersections option, the delay that traffic would incur while traveling on First Avenue S. and along Alaskan Way S. accessing SR 99 would be equal to or greater than that incurred under the New Dearborn Intersection option because of the additional signalized intersection that would be encountered. For example, while delay increases by 18 seconds at the First Avenue S./S. Dearborn Street intersection under the New Dearborn Intersection option compared to the New Dearborn and Charles Intersections option, the combined delay at the intersections of First Avenue S./ S. Dearborn Street and First Avenue S./S. Charles Street is not substantially different (17 seconds) under the New Dearborn and Charles Intersections option.

2030 Project

As shown in Exhibit 5-29, intersection operations for the 2030 Project closely mirror those for the 2015 Project. Of the 21 signalized intersections investigated for the south end, traffic growth between 2015 and 2030 is forecasted to degrade LOS at 15 locations by one grade, though 10 of these locations are LOS D or better, indicating good overall performance and moderate or light congestion.

Specific locations where LOS would degrade during the AM peak hour include E. Marginal Way S. (Terminal 46 driveway)/S. Atlantic Street and the East Frontage Road/S. Atlantic Street. The primary factors influencing future changes in LOS at these locations between 2015 and 2030 are mainly related to general background growth in traffic volumes due to changes in local and/or regional land use intensity.

During the PM peak hour, an estimated 8 of the 21 total intersections evaluated are expected to show an increase in congestion levels based on the LOS results. These intersections include Alaskan Way S. at S. King Street, E. Marginal Way S.

at the h-shaped overcrossing, First Avenue S. at S. Royal Brougham Way, First Avenue S. at S. Jackson Street, Colorado Avenue S. at S. Atlantic Street, First Avenue S. at S. Atlantic Street, Second Avenue S. at S. Jackson Street, and Fourth Avenue S. at S. Jackson Street. Of these locations, only the latter four locations would experience higher levels of congestion at LOS E or LOS F.

Similar to the 2015 Project, traffic operations are expected to be slightly better under the New Dearborn and Charles Intersections option, at the intersections of Alaskan Way S. at S. Dearborn Street and at S. Charles Street as well as the intersection of First Avenue S. at S. Dearborn and S. Charles Streets. However, these intersections are projected to operate at LOS D or better under both options. Also similar to 2015, while individual intersection LOS may be somewhat better under the New Dearborn and Charles Intersections option, the delay that traffic on Alaskan Way S. accessing SR 99 would incur would be equal to or greater than that incurred under the New Dearborn Intersection option because of the additional signalized intersection that would be encountered.

Comparison of the New Dearborn Intersection Option and New Dearborn and Charles Intersections Option

Similar to the 2015 Project, operations are expected to be LOS D or better at the intersections of Alaskan Way S. at S. Dearborn Street and at S. Charles Street, as well as at the intersection of First Avenue S. at S. Dearborn and S. Charles Streets under both options. Delay and LOS are expected to be slightly better under the New Dearborn and Charles Intersections option, at the intersections of Alaskan Way S. at S. Dearborn Street and at S. Charles Street, as well as the intersection of First Avenue S. at S. Dearborn and S. Charles Streets.

Also similar to 2015, while individual intersection LOS may be somewhat better under the New Dearborn and Charles Intersections option, the delay that traffic would incur on Alaskan Way S. accessing SR 99 and along First Avenue S. would be equal to or greater than that incurred under the New Dearborn Intersection option because of the additional signalized intersection that would be encountered. For example, the intersection of Alaskan Way S. at S. Dearborn Street is forecasted to operate at LOS D with 44 seconds of delay under the New Dearborn Intersection option compared to LOS C with 27 seconds of delay under the New Dearborn and Charles Intersections option. However, the intersection of Alaskan Way S. at S. Charles Street operates at LOS D with a delay of 44 seconds, so overall delay along Alaskan Way S. in this area is greater under the New Dearborn and Charles Intersections option.

5.3.2 Central Sub-Area

Detailed intersection analysis results for the central sub-area are shown in Exhibit 5-30.

2015 Existing Viaduct

With the 2015 Existing Viaduct, one intersection during the PM peak hour is forecasted to operate at LOS E or F conditions, while all intersections studied are expected to operate at LOS D or better during the AM peak hour. However, during the AM peak hour the intersection of First Avenue at Seneca Street is anticipated to experience queuing onto the SR 99 off-ramp due to heavy traffic volumes destined to downtown and conflicts with pedestrian circulation and local traffic movements at the ramp terminal.

With the 2015 Existing Viaduct, the intersection of First Avenue at Columbia Street is expected to operate at LOS F during the PM peak hour. The intersection of First Avenue at Columbia Street serves as the access point to southbound SR 99 from downtown, and therefore serves relatively high concentrations of traffic. Queues from the Columbia Street southbound on-ramp frequently spill back to First Avenue, causing additional delays at this intersection.

With the 2015 Existing Viaduct, a number of intersections are anticipated to operate at acceptable levels of service but with queues expected to spill back and affect SR 99 mainline traffic. Traffic on the northbound SR 99 off-ramp to Seneca Street is anticipated to spill back from the intersection of Seneca Street at First Avenue onto SR 99, causing delays along SR 99. Also, the intersection of Western Avenue at Battery Street is expected to experience queues that spill back onto both the southbound SR 99 Battery Street Tunnel off-ramp and northbound Western Avenue off-ramp, resulting in some queues and delay on SR 99.

2015 Viaduct Closed (No Build Alternative)

Traffic delays and congestion levels for intersections within the central sub-area for the 2015 Viaduct Closed (No Build Alternative) are expected to be higher for the majority of locations than for the 2015 Existing Viaduct. Key groupings of intersections that would likely experience the most pronounced increases in congestion would include the signalized intersections along Alaskan Way (surface arterial), intersections on First Avenue, and those along the one-way system of Second and Fourth Avenues.

While the geometric constraints upstream and downstream of the central waterfront area would effectively meter traffic volumes into the downtown core, the redistribution of SR 99 traffic to surface arterials would result in utilization of available capacity on these downtown streets. As such, high levels of congestion would be expected for key north-south arterials, as well as for east-west connectors to and from I-5 between Union Street and James Street.

2015 Project

With the 2015 Project, the removal and/or relocation of some SR 99 on- and off-ramps is expected to result in changes in travel patterns to and from SR 99.

Ramps currently provided at Columbia Street, Seneca Street, Western Avenue, and Elliott Avenue would be replaced by ramps to Alaskan Way in the stadium area, as well as by improved connections in the South Lake Union area. Traffic that uses the Columbia and Seneca Street ramps today would instead enter and exit on Alaskan Way at S. Charles Street (or S. Dearborn Street depending on the south option that is chosen) and continue into the CBD. Elliott/Western trips could similarly use Alaskan Way to travel to Broad Street, or instead continue through the new bored tunnel and enter and exit in the South Lake Union area.

Traffic operations would improve on most streets within the CBD, particularly at Columbia Street and First Avenue, which is congested today due to SR 99 ramp traffic. Traffic operations at the intersection of Fourth Avenue at Columbia Street are expected to decrease from LOS D for the 2015 Existing Viaduct to LOS E in the AM peak hour for the 2015 Project due to the increase in traffic volumes along Fourth Avenue.

2030 Project

With the 2030 Project, the majority of intersections in the central sub-area are anticipated to operate much as they do with the 2015 Project, with a few exceptions. During the AM peak hour the intersection of Second Avenue at Marion Street is anticipated to operate under constrained conditions (at or below LOS E). The increased delay is likely due to projected traffic growth between 2015 and 2030 and greater use of Second Avenue as a southbound route through the city. The intersection of Fourth Avenue at Madison Street is anticipated to operate at LOS E, again likely due to projected traffic growth between 2015 and 2030 and greater use of Fourth Avenue as a northbound route through the city.

The intersection of Western Avenue at Broad Street is anticipated to experience heavy congestion during the PM peak hour with the 2030 Project. Again, the expected increase in delay and congestion at this intersection between 2015 and 2030 is likely due to projected traffic growth. All approaches for this location, with the exception of the northbound Western Avenue approach, are expected to operate under constrained conditions (at or below LOS E). The intersections of Fourth Avenue at Madison Street and Fourth Avenue at Seneca Street are expected to operate at LOS E during the PM peak hour with the 2030 Project. Similar to the AM peak hour, this is likely due to projected traffic growth between 2015 and 2030 and greater use of Fourth Avenue as a northbound route through the city.

5.3.3 North Sub-Area

Two configurations for Sixth Avenue N. and the southbound on-ramp are being considered. The Straight Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. from Harrison to Mercer Streets in a typical

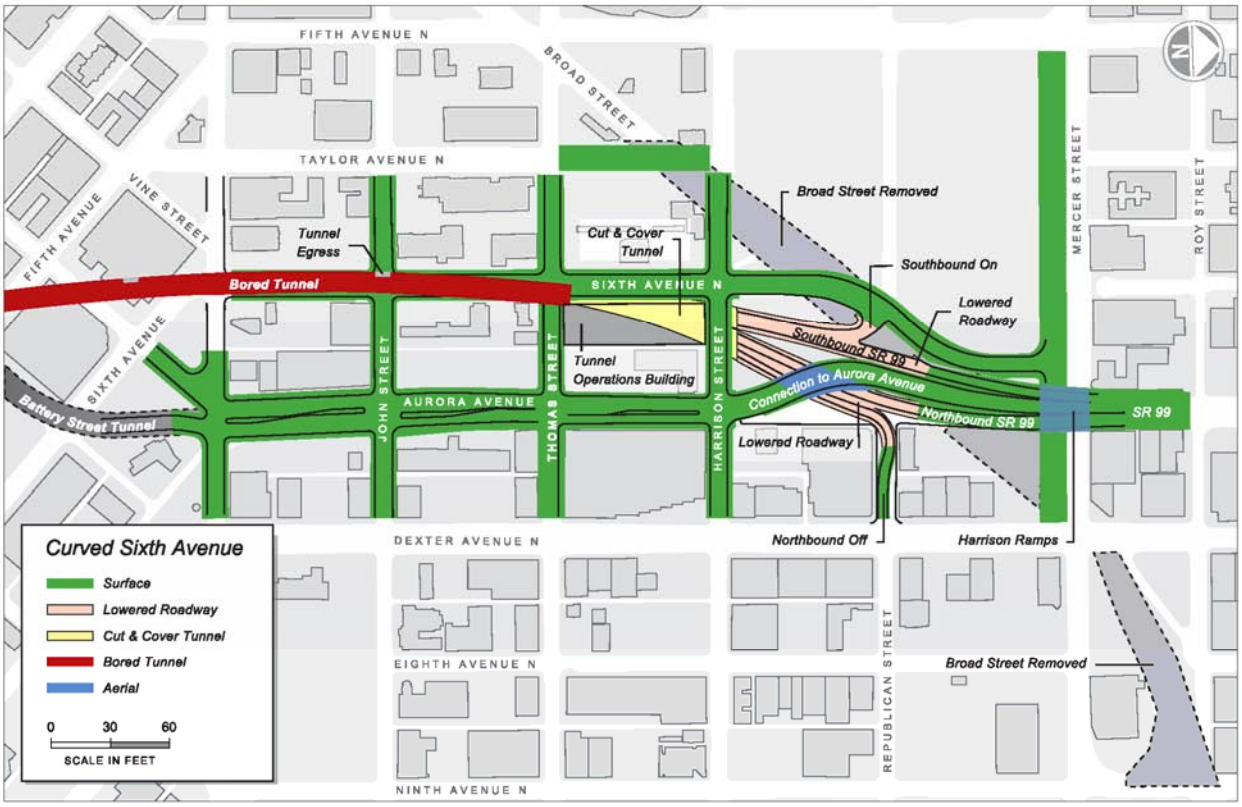
grid formation. The new roadway would have two lanes in each direction with signalized intersections at Republican and Mercer Streets. The Curved Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. in a curved formation between Harrison and Mercer Streets. The new roadway would have two lanes in each direction south of the new SR 99 on-ramp at Republican Street, with two southbound lanes and a single northbound lane continuing north to Mercer Street. A signalized intersection would be provided at Republican Street, while access to Mercer Street is expected to be limited to right turns only, though the City of Seattle is currently assessing the feasibility and safety implications of signalizing this intersection under the Curved Sixth Avenue option to allow for additional movements. However, for the purposes of this analysis, it is assumed that it would be unsignalized. If the Mercer Street intersection is not signalized under the Curved Sixth Avenue option, pedestrian crossings of Mercer Street would not be allowed at this location.

The two north portal area options are shown on Exhibit 5-35. Intersection analysis results for the north sub-area, which consists of arterials and intersections south and west of Lake Union and near Seattle Center, are shown in Exhibit 5-31. Operational results for intersections affected by the Curved Sixth Avenue option are shown in Exhibit 5-33.

2015 Existing Viaduct

With the 2015 Existing Viaduct in the north sub-area, it is assumed that the Mercer East Project would convert the segment of Mercer Street from Fairview Avenue N. to Dexter Avenue N. into a two-way facility by widening this segment from four lanes (currently one-way eastbound) to three lanes in each direction. As part of these sub-area improvements, Valley Street would be reduced to a two-lane roadway (one lane each direction). The conversion to a two-way roadway would also necessitate a new signalized intersection on Mercer Street to provide access to Broad Street.

Heavy traffic flow to and from I-5 would continue to affect a number of intersections along the Mercer Street corridor. The intersection of Fairview Avenue N. and Mercer Street is projected to operate at LOS D during the AM peak hour and LOS F during the PM peak hour, though forecasted delays are considerably reduced from existing conditions due to the Mercer corridor improvements. The Mercer Street/Westlake Avenue N. intersection is projected to operate at LOS F during the PM peak hour, when outbound traffic on Westlake Avenue N. peaks, while the Mercer Street intersection at Dexter Avenue N. would operate at LOS D during both the AM and PM peak hours.



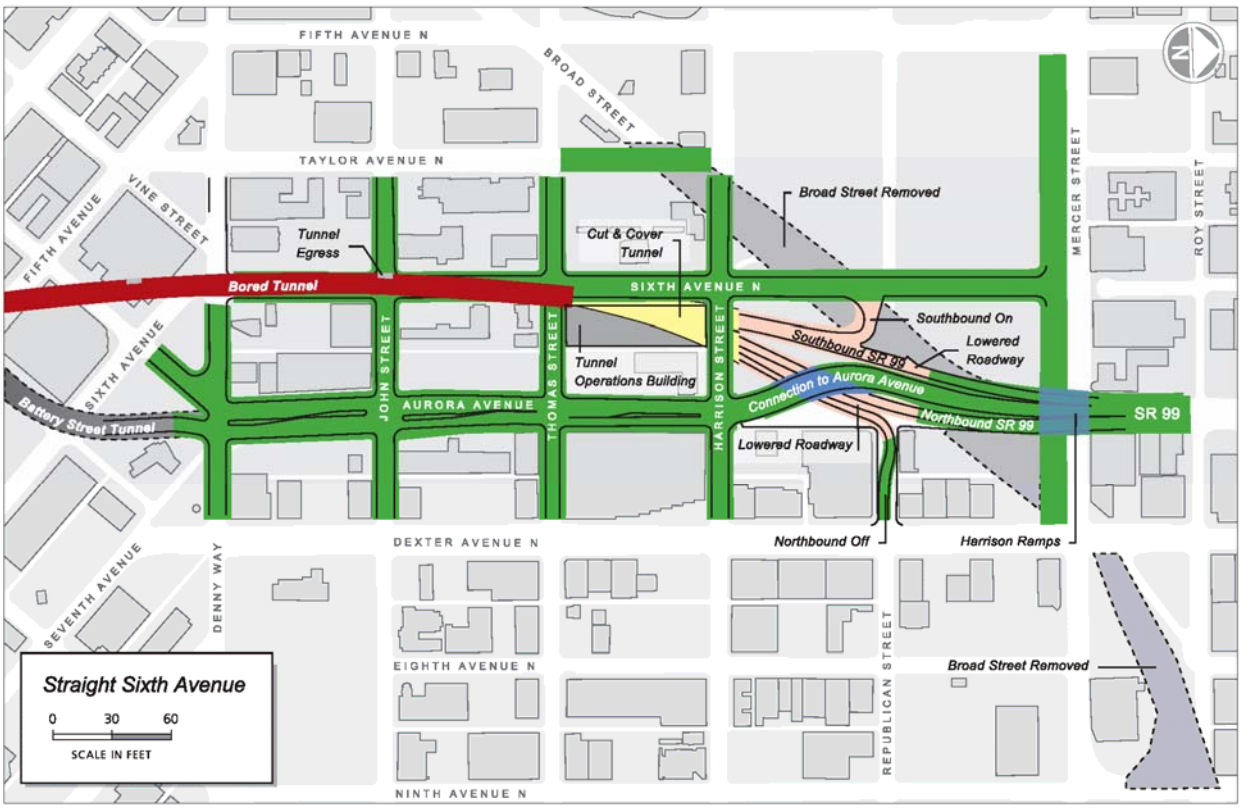


Exhibit 5-35
North Portal Options

The intersection of Fairview Avenue N. and Valley Street is projected to operate at LOS E conditions during the AM peak hour when it accommodates heavy inbound movements from Eastlake Avenue and is also affected by nearby congestion at the I-5/Mercer Street ramps.

The intersections of Denny Way at southbound and northbound Aurora Avenue are projected to operate at LOS D or better during the PM peak hour and LOS C or better during the AM peak hour. This relatively good LOS reflects the long green time given to the high volume east-west movement. However, the north and south approaches at these intersections operate at a worse LOS than the overall intersection LOS. The southbound approach at the intersection of Denny Way and southbound Aurora Avenue is forecasted to operate at LOS E during the AM peak hour and LOS F during the PM peak hour. This is a result of the southbound left-turn lane traffic spilling back into the southbound through lanes, causing this intersection to essentially operate with one southbound through lane, instead of two lanes, for much of the AM and PM peak hours. The northbound approach at the intersection of Denny Way and northbound Aurora Avenue is forecasted to operate at LOS D during the AM peak hour and LOS F during the PM peak hour.

To the east, the intersection of W. Mercer Place at Elliott Avenue is projected to operate at LOS E during the AM peak hour and LOS F during the PM peak hour. The number of lanes along Elliott Avenue W. is reduced between the 2005 existing conditions and the 2015 Existing Viaduct to provide BAT lanes during peak hours. The reduction in the number of through lanes, coupled with heavy north-south volumes on Elliott Avenue and increased southbound traffic turning left from Elliott Avenue to W. Mercer Place, results in degraded LOS at this intersection.

2015 Viaduct Closed (No Build Alternative)

North end congestion levels for the 2015 Viaduct Closed (No Build Alternative) are generally expected to be higher than those for the 2015 Existing Viaduct in the majority of locations. While the Battery Street Tunnel would remain open in the 2015 Viaduct Closed (No Build Alternative), the SR 99 corridor would terminate at the Battery Street/Western Avenue ramps. Traffic volume estimates for the 2015 Viaduct Closed (No Build Alternative) show that the majority of traffic southbound on SR 99 would use the Broad Street and Denny Way off-ramps rather than the Battery Street Tunnel off-ramp. Similarly, in the northbound direction, most trips destined to the north would likely use the Denny Way on-ramp rather than the upstream on-ramp at the south end of the Battery Street Tunnel. As a result, key intersections on Broad Street and Wall Street (southbound SR 99 traffic) and on Battery Street (northbound SR 99 traffic) would be affected noticeably. Heavy queuing and long backups may be particularly severe at the SR 99 ramp termini intersections at Denny Way and on side-street exits.

2015 Project

With the 2015 Project in the north area, several network changes are expected for the SR 99 interchange area and surface streets south of Mercer Street. East-west arterials such as John, Thomas, and Harrison Streets would all intersect with a new north-south arterial (Aurora Avenue) with east-west through movements allowed. The northbound SR 99 off-ramp south of Mercer Street and the southbound on-ramp would both be located at Republican Street. Additional surface street changes include the closure of Broad Street, extending Sixth Avenue N. to Mercer Street, connecting Harrison Street between Sixth Avenue N. and Taylor Avenue N., and converting Sixth Avenue N. from one-way to two-way between Denny Way and Wall Street. These changes improve access between SR 99 and the local street grid, attracting additional trips to the South Lake Union area. As a result, some increase in local street congestion is anticipated.

For the 2015 Project, three intersections during the AM peak hour and seven intersections during the PM peak hour are expected to operate with delays at LOS E or worse.

During the AM peak hour, the intersection of Valley Street at Fairview Avenue N. is projected to operate similarly to the 2015 Existing Viaduct and to experience queues that could potentially spill back into the adjacent intersections of Valley Street at Boren Avenue N. and Mercer Street at Fairview Avenue N. On Denny Way, the intersection of Denny Way at First Avenue is forecasted to operate under LOS E conditions during the AM peak hour, a result of heavy east-west movements coupled with traffic exiting the downtown and Belltown areas northbound via First Avenue. In addition, queuing and delays along the north-south streets intersecting with Mercer Street are anticipated, and therefore the intersection of Fairview Avenue N. at Mercer Street is expected to operate at LOS E or worse.

During the PM peak hour, several intersections along Mercer Street would operate at LOS E or F conditions, largely as a result of heavy traffic flows associated with I-5. The intersection of Mercer Street at Fairview Avenue N., which serves as the ramp terminal for the I-5 ramps to Mercer Street, is expected to experience long delays and queuing along all approaches, as it also does under both existing conditions and the 2015 Existing Viaduct. Similar to the AM peak hour, the intersection of Valley Street at Fairview Avenue N. is projected to operate similar to the 2015 Existing Viaduct and operate under congested conditions. The intersections of Mercer Street at Westlake Avenue N. and at Dexter Avenue N. are also expected to experience moderate to long delays for all approaches. Long queues are projected on the north-south Westlake Avenue N. approaches in particular, similar to the 2015 Existing Viaduct.

Comparison of the Curved Sixth Avenue Option and Straight Sixth Avenue Option

The Curved Sixth Avenue option would include a modified Sixth Avenue N. alignment near Republican Street and the on-ramp to southbound SR 99. This option would align Sixth Avenue N. farther to the east between Republican Street and Mercer Street, as shown in Exhibit 5-35. For this analysis, it is assumed that the resulting intersection at Mercer Street would be unsignalized and restricted to right turns for the northbound outbound approach and right turns for the eastbound inbound movement. No westbound left turns from Mercer Street or northbound left turns from Sixth Avenue N. would be allowed at the new intersection of Mercer Street and Sixth Avenue N.

The City of Seattle is currently assessing the feasibility and safety implications of signalizing this intersection in the Curved Sixth Avenue option to allow for all movements. However, with the current assumption of no signal, a rerouting of trips accessing the southbound on-ramp to SR 99 at Republican Street and other points along Sixth Avenue N. from westbound Mercer Street would be needed. Proposed access routes to the southbound Republican Street on-ramp would be via Harrison Street and Thomas Street from southbound Dexter Avenue N., or alternatively, access southbound SR 99 via Mercer Street, Taylor Avenue N., and Roy Street.

Traffic operations for the Curved Sixth Avenue option, in terms of delays and LOS, would not differ substantially from the Straight Sixth Avenue option. The Curved Sixth Avenue option would increase the delay at the Mercer Street/Dexter Avenue N. intersection in the 2015 Project because of an increase in the westbound left-turn movement. The westbound left-turn volume would increase by 75 vehicles per hour in the AM peak hour and by 105 vehicles per hour in the PM peak hour, because the traffic that would have turned left at Sixth Avenue N. can no longer complete that turn. This traffic was destined for either the southbound SR 99 on-ramp at Republican Street or the street grid south of the Republican Street on-ramp.

Some of the westbound left-turn volume at Sixth Avenue N. is expected to reroute to the Roy Street connection to southbound SR 99. The intersection of Roy Street and SR 99 is stop-controlled on Roy Street. Due to the high speeds and volumes on SR 99, traffic turning right from eastbound Roy Street to southbound SR 99 is expected to experience long delays. The Roy Street approach already is projected to operate at LOS F and at 15 percent over capacity in the PM peak hour and at LOS E with 47 seconds of delay in the AM peak hour, which would offer a less desirable connection to SR 99 than the Republican Street on-ramp.

Some of the westbound left-turn volume at Sixth Avenue N. is also expected to reroute to Harrison Street via Ninth Avenue N. and Westlake Avenue N. in both the AM and PM peak hours.

With the additional volume at Mercer Street/Dexter Avenue N., the delay increases from the 2015 Project with the Straight Sixth Avenue option in both peak hours (40 to 48 seconds per vehicle in the AM peak hour and 69 to 79 seconds per vehicle in the PM peak hour). In the AM peak hour, some signal timing optimizations may slightly improve delays; however, in the PM peak hour the intersection does not have enough capacity to allow this movement more time without affecting other over-capacity movements.

When compared with the Straight Sixth Avenue option, the Mercer Street at Fifth Avenue N. intersection would operate similarly in the AM peak hour (LOS D) and PM peak hour (LOS E).

At the Mercer Street and Sixth Avenue N. intersection, when compared with the Straight Sixth Avenue option, overall intersection delays would be less with the Curved Sixth Avenue option because the signal is removed so that Mercer Street traffic travels freely through the intersection. Although the northbound approach (Sixth Avenue N.) would be stopped by a stop sign, it would be restricted to right-turn only and operate at acceptable LOS A (AM and PM peak hours).

2030 Project

With the 2030 Project most intersections are anticipated to operate much as they would for the 2015 Project for the north area, with slight increases in delays resulting from projected traffic growth. During the AM peak, the intersection of Dexter Avenue at Denny Way is expected to operate at LOS F in the 2030 Project. The increased delay at this intersection is primarily due to the projected increase in traffic along the Dexter Avenue and Denny Way corridor by the 2030 horizon.

During the PM peak hour for the 2030 Project, four additional intersections are expected to operate at LOS E or F, beyond those anticipated for the 2015 Project. These include the intersections of Denny Way at Aurora Avenue, Dexter Avenue at Denny Way, Ninth Avenue N. at Mercer Street and Denny Way at First Avenue. The intersection of Denny Way at Aurora Avenue/Battery Street/Wall Street is anticipated to operate at LOS F during the PM peak hour, which can be attributed to traffic growth both on Denny Way and Aurora Avenue. In addition, the adjacent intersection of Dexter Avenue at Denny Way is anticipated to operate with increased delay (LOS F in the PM peak hour) by the 2030 horizon. Expected queuing activity between these two closely spaced intersections would likely cause spillback to adjacent intersections along Denny Way, resulting in additional delays on Denny Way. The intersection of Ninth Avenue N. at Mercer Street is anticipated to fall from LOS D in 2015 to LOS E in 2030 due to increases in traffic for all approaches. The majority of additional queues and delays at this location is expected for the southbound Ninth Avenue approach and westbound Mercer Street. The intersection of Denny Way at First Avenue is forecasted to operate

under LOS E and F conditions during the AM and PM peak hours respectively, a result of heavy east-west movements coupled with traffic exiting the downtown and Belltown areas northbound via First Avenue.

Comparison of Curved Sixth Avenue Option to Straight Sixth Avenue Option

The Curved Sixth Avenue option would increase the delay at the Mercer Street/ Dexter Avenue N. intersection compared to the Straight Sixth Avenue option in the 2030 Project because of an increase in the westbound left-turn movement. The westbound left-turn volume would increase by 100 vehicles per hour in the AM peak hour and by 85 vehicles per hour in the PM peak hour, because the traffic that would turn left at Sixth Avenue N. under the Straight Sixth Avenue option could not complete that turn under the Curved Sixth Avenue option. This traffic was destined for either the southbound SR 99 on-ramp at Republican Street or the street grid south of the Republican Street on-ramp.

Under the Curved Sixth Avenue option, some of the westbound left-turn volume at Sixth Avenue N. is expected to reroute to the Roy Street connection to southbound SR 99; however, before any traffic shifts there, the Roy Street approach already is projected to operate at LOS F and at 48 percent over capacity in the PM peak hour and at LOS F with 98 seconds of delay in the AM peak hour, which would offer a less desirable connection to SR 99 than the Republican Street on-ramp.

Some of the westbound left-turn volume at Sixth Avenue N. is also expected to reroute to Harrison Street via Ninth Avenue N. and Westlake Avenue N. in both the AM and PM peak hours under the Curved Sixth Avenue option.

With the additional volume at Mercer Street/Dexter Avenue N., the delay increases from the 2030 Project with the Straight Sixth Avenue option in the AM peak hour (42 to 55 seconds per vehicle in the AM peak hour). In the PM peak hour, the volume shifts result in a nominal decrease in delay (94 to 93 seconds per vehicle) because the total volume entering the intersection is slightly less (in the AM, more traffic would enter the intersection than under the Straight Sixth Avenue option).

When the Curved Sixth Avenue option is compared with the Straight Sixth Avenue option, the Mercer Street at Fifth Avenue N. intersection would operate worse in the AM and PM peak hours (operates at LOS E instead of LOS D) because volumes shift to the northbound through movement on Fifth Avenue N., which conflicts with the heavy westbound left from Mercer Street.

The Mercer Street and Sixth Avenue N. intersection would experience less overall intersection delay under the Curved Sixth Avenue option when compared with the Straight Sixth Avenue option because the signal is removed so that Mercer Street traffic travels freely through the intersection. Although the northbound

approach (Sixth Avenue N.) is stopped by a stop sign, it is restricted to right-turn only and operates at acceptable LOS A (AM peak hour) and LOS B (PM peak hour) conditions.

5.4 AM and PM Peak Hour Travel Times

Key Findings

Projected travel times for the routes investigated are not expected to vary noticeably between the 2015 Existing Viaduct and the 2015 Project. The majority of travel times during the AM and PM peak hours are expected to be within 1 to 2 minutes of each other. Some larger travel time variations may occur for specific routes, as shown in the analysis summary, but such increases or reductions would likely remain within a range of 3 to 4 minutes for each peak hour period.

The largest travel time variations between the 2015 Existing Viaduct and the 2015 Project are expected to be occur on the route between Woodland Park and S. Spokane Street. For the peak direction of travel in the AM peak hour (southbound), a decrease of up to 2 minutes was noted. For the PM peak hour, peak direction (northbound) travel times could decrease by up to 4 minutes. Non-peak direction travel time reductions between the 2015 Existing Viaduct and the 2015 Project were shown to be even more pronounced.

As expected, travel times would generally increase between the 2015 and 2030 Project due to background growth in traffic demand.

The greatest increases in travel times between 2015 and 2030 were for the West Seattle to CBD route (PM outbound), Ballard to S. Spokane Street via Mercer Street and the bored tunnel (PM southbound), Ballard to S. Spokane Street via AWV (PM northbound), and Northgate to Boeing Access Road route (PM southbound), with increases of up to 5, 5, 5, and 6 minutes, respectively.

The 2015 Viaduct Closed (No Build Alternative) would result in much greater travel times compared to the other modeled conditions. As an example, travel times for the Woodland Park to S. Spokane Street route in the 2015 Viaduct Closed (No Build Alternative) could be up to three times longer than travel times under the other modeled.

AM and PM peak hour travel times for routes using the SR 99 corridor are presented as a gauge for how efficient an alternative may be for providing mobility during periods of high use. The travel time routes analyzed were shown in Exhibit 2-8 in Chapter 2, Methodology. Travel times are described below for the key regional and downtown routes that were deemed appropriate for representing the primary travel patterns experienced on or adjacent to the corridor:

- South to and from downtown, represented by West Seattle to CBD (Fourth Avenue and Seneca Street) via SR 99.
- North to and from downtown via SR 99, represented by Woodland Park (SR 99 and N. 50th Street) to CBD (Fourth Avenue and Seneca Street).
- Through trips on SR 99, represented by Woodland Park to S. Spokane Street.
- Through trips on the Elliott/Western corridor, represented by Ballard Bridge to S. Spokane Street:
    - Via Alaskan Way (or AWV if applicable).
    - Via Mercer Street, bored tunnel.
- Northgate to Boeing Access Road via I-5.
- Mercer Street from I-5 to Elliott Avenue.
- Second Avenue from Wall Street to S. Jackson Street.
- Fourth Avenue from S. Jackson Street to Battery Street.

Exhibit 5-36 summarizes corridor travel times by route and direction. This exhibit assumes the Straight Sixth Avenue option in the north end, which reflects a signal at the intersection of Mercer Street and Sixth Avenue N. However, differences between the two north end options (Curved Sixth Avenue and Straight Sixth Avenue) are discussed further for the two travel time routes that are affected by these design options: Ballard to S. Spokane Street via Mercer Street and the bored tunnel, and Mercer Street from I-5 to Elliott Avenue.

Exhibit 5-36. Corridor Travel Times

	2015 Existing Viaduct	Viaduct Closed (No Build Alternative)	2015 Project[1]	2030 Project[1]	2015 Existing Viaduct	Viaduct Closed (No Build Alternative)	2015 Project[1]	2030 Project*
	AM Peak Hour				PM Peak Hour			
West Seattle to CBD (Fourth Avenue and Seneca Street)								
Inbound	20	N/A	23/24	25/25	-	-	-	-
Outbound	-	-	-	-	25	N/A	21/21	27/27
Woodland Park to CBD (Fourth Avenue and Seneca Street)								
Inbound	19	N/A	18	22	-	-	-	-
Outbound	-	-	-	-	15	N/A	15	18
Woodland Park to S. Spokane Street								
Southbound	16	N/A	14	15	15	43	12	15
Northbound	16	N/A	12	12	18	47	14	16
Ballard to S. Spokane Street (via Alaskan Way, AWV)								
Southbound	15	N/A	15/15	15/15	17	N/A	17/17	18/18
Northbound	19	N/A	20/20	20/20	21	N/A	22/22	27/27
Ballard to S. Spokane Street (via Mercer Street, Bored Tunnel)								
Southbound	N/A	N/A	14	14	N/A	N/A	16	21
Northbound	N/A	N/A	19	21	N/A	N/A	21	23
Northgate to Boeing Access Road								
Southbound	28	N/A	28	30	32	N/A	32	38
Northbound	28	N/A	28	32	30	N/A	30	34
Mercer Street (I-5 to Elliott)								
Westbound	9	N/A	10	11	11	N/A	11	14
Eastbound	7	N/A	8	8	12	N/A	10	14
Second Avenue (Wall Street to S. Jackson Street)								
Southbound	8	N/A	9	12	9	N/A	10	12
Fourth Avenue (S. Jackson Street to Battery Street)								
Northbound	8	N/A	9	9	9	N/A	9	11

Note: Estimated travel times shown in minutes.
AWV = Alaskan Way Viaduct
CBD = Central Business District
N/A = not applicable
[1] Where two travel time values are given for the 2015 and 2030 Project, the first reflects the New Dearborn Intersection option and the second reflects the New Dearborn and Charles Intersections option.

5.4.1 West Seattle to CBD

This route represents trips between West Seattle (specifically the intersection of California Avenue and S.W. Alaska Street) and the CBD (specifically at Fourth Avenue and Seneca Street) and is presented for the peak traffic flow direction only (i.e., inbound in the AM and outbound in the PM peak period).

For the inbound direction during the AM peak hour, travel times for the 2015 Project would be approximately 3 minutes longer than those for the 2015 Existing Viaduct with the New Dearborn Intersection option and 4 minutes longer with the New Dearborn and Charles Intersections option. These increases in travel time are largely because the selected CBD destination is relatively close to the existing midtown ramps reflected with the 2015 Existing Viaduct. For travel times to points in the south CBD and Pioneer Square area from West Seattle, the 2015 Project travel times would likely be similar to the 2015Existing Viaduct. For the reverse, outbound direction in the PM peak hour, travel times for the 2015 Project (again for both options) would be shorter than for the 2015Existing Viaduct. This decrease is likely due to the removal of the mainline weaving conflict between the Columbia Street on-ramp and the First Avenue S. off-ramp to the stadium area for the 2015 Project, as well as traffic for the 2015 Project not needing to pass through the highly congested First Avenue/Columbia Street intersection as it does for the 2015Existing Viaduct.

Travel time increases between the 2015 and 2030 Project would be roughly 2 minutes in the AM peak hour inbound direction and up to 6 minutes in the PM peak hour outbound direction due to general growth in ramp and mainline demand from 2015 to 2030.

5.4.2 Woodland Park to CBD

This route covers trips between N. 50th Street/SR 99 and downtown Seattle and is again presented for the peak direction trip only (i.e., southbound in the AM peak and northbound in the PM peak).

For this route, similar travel times are expected for the 2015 Existing Viaduct and the 2015 Project. In the southbound direction for the AM peak hour, travel times are approximately 19 and 18 minutes for the 2015 Existing Viaduct and the 2015 Project, respectively. In the northbound direction during the PM peak hour, travel times for the 2015 Existing Viaduct are expected to be similar to those for the 2015 Project. For the 2030 Project, peak direction travel times would increase by approximately 3 to 4 minutes compared to the 2015 Project.

5.4.3 Woodland Park to S. Spokane Street

Due to reduced friction along the SR 99 corridor in terms of fewer weaving areas and ramp merging sections, 2015 Project travel times for this route are expected to be lower than 2015 Existing Viaduct travel times for both the AM and PM peak hour periods. AM peak hour travel times for the southbound direction would decrease by approximately 2 minutes while northbound trips would show up to a 4-minute reduction in travel time. For PM peak hour conditions, travel times for the primary northbound direction would decrease by roughly 4 minutes and southbound travel times would decrease by up to 3 minutes. These reductions for both time periods are mainly due to improved traffic flow resulting from consolidation and relocation of corridor ramps and improved roadway geometry. In addition, the bored tunnel would be more direct (shorter distance) than the existing viaduct. For this travel time route, a PM peak hour travel time was also estimated for the 2015 Viaduct Closed (No Build Alternative), showing dramatically higher travel times (up to a three-fold increase) than for either the 2015 Existing Viaduct or the 2015 Project. In the 2015 Viaduct Closed (No Build Alternative), the assumed route through downtown was via a range of arterials, including Wall Street, Second Avenue, Madison Street, and Alaskan Way.

From 2015 Project to the 2030 Project, travel times would generally increase based on background growth in traffic demand.

5.4.4 Ballard Bridge to S. Spokane Street (via AWV and/or Alaskan Way)

This route reflects the travel times for trips between Ballard and Interbay.

While removal of the Elliott/Western ramps with the 2015 Project would be expected to result in longer-duration trips for this route compared to the 2015 Existing Viaduct, travel times are shown to be fairly consistent between these modeled conditions. Due to the high concentrations of ramp traffic and weaving conflicts on SR 99 for the 2015 Existing Viaduct (AM and PM), pronounced backups on SR 99 in both directions (notably at off-ramp locations) are anticipated, thereby resulting in high travel times for the mainline Alaskan Way Viaduct segment. Also, traffic volumes on Alaskan Way for the 2015 Project (AM and PM) are projected to be relatively moderate, with modest levels of congestion in both the northbound or southbound directions. The modest levels of congestion on Alaskan Way with the 2015 Project and frequent backups on SR 99 during peak periods for the 2015 Existing Viaduct serve to counteract the differences in routing and would result in comparable travel times overall between the two modeled conditions (within 1 minute).

As shown in Exhibit 5-36, travel times for the 2015 Project and the 2030 Project were estimated for the two south end options (New Dearborn Intersection option and New Dearborn and Charles Intersections option) for both time periods and

directions. Differences in travel times between these two options are expected to be negligible. By the 2030 horizon, travel times for either option would remain similar to the 2015 Project for the AM peak hour but increase by up to 5 minutes for the PM peak hour (northbound direction).

5.4.5 Ballard Bridge to S. Spokane Street (via Mercer Street and Bored Tunnel)

This route uses Elliott Avenue to W. Mercer Place and takes Mercer Street to access the bored tunnel via Sixth Avenue for the southbound route. The routing for the northbound trip would be via the bored tunnel, the Republican Street off-ramp, Dexter Avenue N., Mercer Street, Fifth Avenue N., Roy Street, Queen Anne Avenue N., W. Mercer Street, W. Mercer Place, to Elliott Avenue W./15th Avenue W. Since this path would not exist for the 2015 Existing Viaduct, only travel times for the 2015 Project and the 2030 Project are discussed. As shown in Exhibit 5-36, travel times for this route through the bored tunnel are similar to the Alaskan Way route described above for the 2015 Project. For both the AM and PM peak hours, travel times in the peak and non-peak directions are the same or within 1 minute for the two Ballard to S. Spokane Street routes.

Travel times on the Mercer Street/bored tunnel route would generally increase between 2015 and 2030 based on higher traffic levels and associated mainline friction. Travel time increases in the PM peak hour would be more pronounced overall, particularly in the peak northbound direction toward Ballard.

The Curved Sixth Avenue and Straight Sixth Avenue options would show modest differences in travel times for this route. A preliminary analysis of selected intersections within a sub-section of the Ballard to S. Spokane Street route was performed to gauge the impacts of the two Sixth Avenue intersection configurations at Mercer Street. The findings of this analysis show that between Elliott Avenue and SR 99, the Curved Sixth Avenue option, which assumes a stop-controlled intersection at Sixth Avenue N. and Mercer Street (with turn restrictions), would likely experience a reduction of up to 1 or 2 minutes in travel time for the peak and non-peak directions and time periods. For the Straight Sixth Avenue option, the additional signal on Mercer Street would slightly reduce critical east-west capacity. Travel times for remaining portions of the travel time route (outside of the Elliott Avenue to SR 99 sub-section) would be similar between the two Sixth Avenue options.

5.4.6 Northgate to Boeing Access Road (via I-5)

Travel times between Northgate and Boeing Access Road are generally the highest of any route examined, primarily due to the physical distance covered along the route. The results of the operational analysis show that implementation of the project elements by the 2015 horizon would not affect travel times

noticeably compared to the 2015 Existing Viaduct. In fact, travel time differences between the 2015 Existing Viaduct and the 2015 Project are expected to be less than 1 minute, on average. However, by the 2030 horizon year, travel times for the 2030 Project would likely increase due to background traffic growth, with the most pronounced increases occurring during the PM peak hour. Northbound trips during the PM peak hour may experience up to 4 minutes of additional travel time for the 2030 Project (compared to the 2015 Project), while southbound travel times may increase by up to 6 minutes.

5.4.7 Mercer Street (I-5 to Elliott Avenue)

East-west travel times for the Mercer Street corridor are generally similar for both the 2015 Existing Viaduct and the 2015 Project. As part of the initial changes for Mercer Street with the 2015 Existing Viaduct, the segment between Fairview Avenue N. and Eighth Avenue N. would be converted from its current one-way configuration to a two-way arterial. With the additional segment of Mercer Street converted to two-way operations between Eighth Avenue N. and Fifth Avenue N. with the 2015 Project, changes in travel times are expected as a result of shifts in travel patterns (e.g., more traffic drawn to Mercer Street). Also, removal of the Elliott/Western ramps in the 2015 Project would likely shift some traffic demand to the South Lake Union and Uptown areas to and from SR 99 compared to 2015Existing Viaduct.

For the AM peak hour, travel times are expected to increase by approximately 1 minute from the 2015 Existing Viaduct to 2015 Project for both the eastbound and westbound directions. However, the reverse is expected for eastbound traffic during the PM peak hour, when travel times may decrease slightly (primarily due to signal timing assumptions that maximize eastbound capacity). For the 2030 Project, travel times would generally be higher than for the 2015 Project during the PM peak hour and similar for the AM peak hour.

Similar to the Ballard to S. Spokane Street travel time route, the Curved Sixth Avenue and Straight Sixth Avenue options would show minor differences in travel times for this east-west route. A preliminary analysis of the entire travel time route between Elliott Avenue and the I-5 ramps (at Fairview Avenue) was performed to assess the effects of the two Sixth Avenue intersection configurations at Mercer Street. Analysis results show that the Curved Sixth Avenue option would likely result in a reduction of 1 to 3 minutes in travel time for the various directions and time periods compared to the Straight Sixth Avenue option.

5.4.8 Second Avenue (Wall Street to S. Jackson Street)

Average travel times within the CBD along a critical segment of Second Avenue between Wall Street and Jackson Street were compared for the 2015 Existing Viaduct, the 2015 Project, and the 2030 Project. Travel times on Second Avenue (southbound) are expected to be approximately 1 minute longer for the 2015 Project compared to the 2015 Existing Viaduct (for both AM and PM peak hours). These expected increases are attributed to the higher southbound volumes on Second Avenue for the 2015 Project, primarily due to removal of the midtown ramps. For the 2030 Project, travel times are expected to increase over those for the 2015 Project, by approximately 3 minutes in the AM peak hour and 2 minutes in the PM peak hour.

5.4.9 Fourth Avenue (S. Jackson Street to Battery Street)

Similar to the Second Avenue comparison, average travel times were estimated for the reverse northbound direction along Fourth Avenue between Jackson Street and Battery Street. Travel times on Fourth Avenue are expected to increase by approximately 1 minute from the 2015 Existing Viaduct to the 2015 Project for the AM peak hour. For the PM peak hour, average travel times are not expected to change between the 2015 Existing Viaduct and the 2015 Project. Travel times are also not expected to change between the 2015 Project and the 2030 Project for the AM peak hour. However, significantly higher PM peak hour volumes are expected on Fourth Avenue compared to AM peak hour volumes for the 2015 Project. Therefore, future PM peak hour increases in volume for the 2030 Project would result in travel time increases of up to 2 minutes compared to the 2015 Project.

5.5 Roadway Connectivity and Access

This section gauges the provision and quality of connections between the SR 99 corridor and other streets and highways in the study area.

Key Findings

- Connections to SR 519, the stadium area, central waterfront, Pioneer Square, and southern portions of downtown are improved with the 2015 Existing Viaduct and the Bored Tunnel Alternative by providing new access to southbound SR 99 and from northbound SR 99 through the S. Holgate Street to S. King Street Viaduct Replacement Project (Alaskan Way S. ramps). Additional arterial improvements under the Bored Tunnel Alternative would improve the functionality of these new ramps.
- The Bored Tunnel Alternative would relocate access to SR 99 south of downtown. The Seneca Street and Columbia Street ramps would not be replaced in their current location; this access would instead be provided

by the Alaskan Way S. ramps. Traffic could use these ramps to distribute to several arterial routes downtown via Alaskan Way and the downtown street grid, rather than accessing downtown directly at the current ramp locations at First Avenue at Seneca and Columbia Streets.

- The northbound off-ramp to Western Avenue and southbound on-ramp from Elliott Avenue would be removed under the Bored Tunnel Alternative. SR 99 trips to and from northwest Seattle communities (Ballard, Magnolia, Belltown) would have several routing choices. One option would be to exit and enter SR 99 on the Alaskan Way S. ramps and continue on Alaskan Way or other downtown arterials to reach the Elliott/Western corridor in Belltown. Another option would be to continue through the bored tunnel to the South Lake Union exits at Republican Street or Roy Street and then use various combinations of Mercer Street, Harrison Street, Broad Street, or Denny Way to reach the Elliott/Western corridor.
- The lightly used Battery Street Tunnel ramps immediately adjacent to the Battery Street Tunnel would be closed under the Bored Tunnel Alternative. New consolidated ramps at Aurora Avenue/Denny Way would provide for this access under the Bored Tunnel Alternative.
- Connections in the South Lake Union, Uptown, and Queen Anne areas would be improved for the Bored Tunnel Alternative, which includes connecting several east-west arterial streets that are severed today. Connections to SR 99 would be provided by new ramps at Republican Street or via arterial connections north of Mercer Street (similar to existing conditions north of Mercer Street).

Exhibit 5-37 details the connections to and from SR 99 for the existing facility, 2015 Existing Viaduct, and the Bored Tunnel Alternative.

Exhibit 5-37. Connections Provided To and From SR 99

	Existing Facility	2015 Existing Viaduct	Bored Tunnel Alternative
Stadium Area (south of S. King Street)			
SB SR 99 to Stadium Area	First Avenue off-ramp	First Avenue off-ramp	S. Royal Brougham Way off-ramp
Stadium Area to NB SR 99	First Avenue on-ramp	First Avenue on-ramp	S. Royal Brougham Way on-ramp
Stadium Area to SB SR 99	Indirect arterial routes to E. Marginal Way or S. Spokane Street	Alaskan Way S. on-ramp (at S. King Street)	Alaskan Way S. on-ramp
NB SR 99 to Stadium Area	Indirect arterial routes from E. Marginal Way or S. Spokane Street	Alaskan Way S. off-ramp (at S. King Street)	Alaskan Way S. off-ramp

Exhibit 5-37. Connections Provided To and From SR 99 (continued)

	Existing Facility	2015 Existing Viaduct	Bored Tunnel Alternative
Downtown Seattle (S. King Street – Stewart Street)			
SB SR 99 to Downtown	Denny Way off-ramp or Battery Street Tunnel off-ramp	Denny Way off-ramp or Battery Street Tunnel off-ramp	Harrison Street off-ramp
Downtown to NB SR 99	Denny Way on-ramp or Battery Street Tunnel on-ramp	Denny on-ramp or Battery Street Tunnel on-ramp	Harrison Street on-ramp
Downtown to SB SR 99	Columbia Street on-ramp	Columbia Street on-ramp	Alaskan Way S. on-ramp
NB SR 99 to Downtown	Seneca Street off-ramp	Seneca Street off-ramp	Alaskan Way S. off-ramp
Elliott and Western Corridor (Stewart Street – Denny Way)			
SB SR 99 to Belltown	Denny Way off-ramp or Battery Street Tunnel off-ramp	Denny Way off-ramp or Battery Street Tunnel off-ramp	Harrison Street off-ramp
Belltown to NB SR 99	Denny Way on-ramp or Battery Street Tunnel on-ramp	Denny Way on-ramp or Battery Street Tunnel on-ramp	Harrison Street on-ramp
Belltown to SB SR 99	Elliott Avenue on-ramp	Elliott Avenue on-ramp	Arterial routes to Republican Street on-ramp or Alaskan Way S. on-ramp
NB SR 99 to Belltown	Western Avenue off-ramp	Western Avenue off-ramp	Arterial routes from Republican Street off-ramp or Alaskan Way S. off-ramp
South Lake Union Area (north of Denny Way)			
SB SR 99 to Uptown	Denny Way off-ramp Broad Street off-ramp Arterial connections	Denny Way off-ramp Broad Street off-ramp Arterial connections	Harrison Street off-ramp. Arterial connections (north of Mercer Street)
SB SR 99 to South Lake Union	Denny Way off-ramp Broad Street off-ramp	Denny Way off-ramp Broad Street off-ramp	Harrison Street. Arterial connection to Mercer
Uptown to SB SR 99	Arterial connections	Arterial connections	Arterial connections (north of Mercer) Republican Street on-ramp
South Lake Union to SB SR 99	Arterial connections via Broad Street or Denny Way across SR 99.	Arterial connections via Broad Street or Denny Way across SR 99.	Arterial connections (north of Mercer) Republican Street on-ramp
NB SR 99 to Uptown	Mercer Street/Dexter Avenue off-ramp or arterial connections continuing via Broad Street or Denny Way across SR 99	Mercer Street/Dexter Avenue off-ramp or arterial connections, continuing via Broad Street or Denny Way across SR 99	Republican Street off-ramp and choice of several arterial connections
NB SR 99 to South Lake Union	Mercer Street/Dexter Avenue off-ramp Arterial connections	Mercer/Dexter off-ramp Arterial connections	Republican Street off-ramp Arterial connections (north of Mercer Street)

Exhibit 5-37. Connections Provided To and From SR 99 (continued)

	Existing Facility	2015 Existing Viaduct	Bored Tunnel Alternative
Uptown to NB SR 99	Cross SR 99 on Denny Way or Mercer Street, enter on arterial connections	Cross SR 99 on Denny Way or Mercer Street, enter on arterial connections	Cross SR 99 on choice of several route, entering at Harrison Street/Aurora Avenue on-ramp or arterial connections (north of Mercer Street)
South Lake Union to NB SR 99	Denny Way on-ramp Arterial connections	Denny Way on-ramp Arterial connections	Harrison Street/Aurora Avenue on-ramp

NB = northbound
SB = southbound

5.5.1 2015 Existing Viaduct

The S. Holgate Street to S. King Street Viaduct Replacement Project will be completed prior to 2015 and is included in the 2015 Existing Viaduct. The primary transportation network difference between the 2005 existing facility and the facility with the 2015 Existing Viaduct is that new ramps to southbound SR 99 and from northbound SR 99 would be provided to Alaskan Way S. near S. Dearborn Street. Furthermore, the connection between E. Marginal Way S. and First Avenue S. on S. Atlantic Street would be improved with a new grade-separated facility (i.e., the h-shaped overcrossing) that would operate while the rail crossing is blocked by train movements, which improves access to the First Avenue S. ramps for traffic traveling on E. Marginal Way S. In addition, by 2015, the Mercer East Project would have converted Mercer Street to two-way traffic flow between I-5 and Dexter Avenue N. and would have disconnected Broad Street from Ninth Avenue N. and connected it to Mercer Street at Eighth Avenue N., which would improve access to the arterial connections to Aurora Avenue.

5.5.2 Viaduct Closed (No Build Alternative)

In Scenario 1 of the Viaduct Closed (No Build Alternative) with a sudden unplanned closure, the viaduct and ramps at First Avenue S., Columbia Street, Seneca Street, Elliott Avenue, and Western Avenue would be closed. In Scenario 2 with catastrophic failure and collapse of the viaduct, the same viaduct and ramp structures would be closed, but in addition, the surface streets under the viaduct would also be unusable. In addition to the roadway directly under the viaduct, this would include the following streets where they cross under the viaduct:

- Railroad Way S.
- S. King Street
- S. Jackson Street
- S. Main Street
- S. Washington Street

- Yesler Way
- Columbia Street
- Marion Street
- Madison Street
- Spring Street
- Seneca Street
- University Street
- Elliott Avenue
- Blanchard Street
- Bell Street
- Western Avenue

The overall effect is that the Viaduct Closed (No Build Alternative) would severely inhibit roadway connectivity and access in the downtown area, with Scenario 2 further affecting local circulation as well.

5.5.3 Bored Tunnel Alternative

To and From Stadium Area/SR 519

With the Bored Tunnel Alternative, access to the stadium area would be provided by a new interchange connecting to Alaskan Way S., S. Royal Brougham Way, and the East Frontage Road. Access from southbound SR 99 and to northbound SR 99 would be maintained, though relocated from First Avenue S. to ramps that connect to the East Frontage Road in the vicinity of S. Royal Brougham Way. Access to and from the south would be provided via new ramps connecting to Alaskan Way S. near S. King Street. S. Royal Brougham Way would end east of SR 99 at its intersection with the SR 99 southbound off-ramp and SR 99 northbound on-ramp.

To and From Downtown Seattle

With the Bored Tunnel Alternative, the ramps to downtown would not be provided at their current locations. Instead, access would be provided from northbound SR 99 to Alaskan Way S., and from Alaskan Way S. to southbound SR 99 south of S. King Street. The removal of the downtown ramps would alter traffic patterns, and the Alaskan Way surface street would be expected to carry additional traffic to and from downtown and the stadium area.

An advantage of this configuration is that the downtown Seattle street grid is better able to accommodate traffic flows than the single point locations where the Columbia and Seneca Street ramps begin and end. Additionally, traffic would be able to distribute from Alaskan Way to the downtown street grid using any of

several cross streets, including S. Jackson Street, S. Main Street, Yesler Way, and Columbia, Marion, Madison, and Spring Streets, rather than being concentrated in single locations.

Because the stadium area ramps would be less centrally located to downtown than the existing ramps, trips destined for the central and northern portions of downtown would have to travel a few additional blocks on arterial streets rather than on SR 99. Conversely, trips destined to and from the southern areas of downtown would find that the stadium area ramps provide more direct access. In addition, access to SR 99 for trips to and from the Seattle Ferry Terminal at Colman Dock would be more direct with the stadium area ramps under the Bored Tunnel Alternative than it is with the Seneca and Columbia Street ramps today.

To and From Belltown/Interbay

The northbound off-ramp to Western Avenue and southbound on-ramp from Elliott Avenue would both be removed under the Bored Tunnel Alternative. Trips that currently use these ramps may instead exit and enter SR 99 on the Alaskan Way ramps and continue on Alaskan Way or other downtown arterials to reach the Elliott/Western corridor in Belltown. Another option is to use Mercer Street or Denny Way and Broad Street to access SR 99 at Republican Street and continue through the bored tunnel.

In addition, the lightly used and geometrically substandard Battery Street Tunnel ramps immediately adjacent to the Battery Street Tunnel would be closed with the decommissioning of the Battery Street Tunnel. The Harrison Street ramps from Aurora Avenue provide good access to and from SR 99 for these trips; however, use of these ramps for these trips would also involve travel on east-west streets through Belltown.

To and From Mercer (South Lake Union Area)

For the Bored Tunnel Alternative, access in the South Lake Union and Uptown areas would be improved in terms of operational safety and connectivity compared to the existing configuration. SR 99 would be lowered below grade from the Battery Street Tunnel to approximately Mercer Street. Arterial connections directly to SR 99 in this segment would no longer be provided, and access would instead be consolidated to ramps at Harrison Street and Republican Street and arterial connections north of Mercer Street. The new ramps would be a considerable operational improvement over the right-angle turns on and off the facility serving these movements today.

South of Mercer Street, access on and off SR 99 would be provided at Harrison Street and Republican Street. Since the bored tunnel would extend nearly to Harrison Street, SR 99 would no longer be a barrier to connecting John, Thomas, and Harrison Streets, thereby connecting the local street grid between Denny Way

and Harrison Street. Broad Street would be closed between Fifth Avenue N. and Ninth Avenue N., allowing the street grid to be reestablished in this area. Mercer Street would continue to cross under SR 99 as it does today, but it would be widened and converted to a two-way street with three lanes in each direction and a center turn lane.

Two options are being considered for extending Sixth Avenue N., each providing access to the new southbound on-ramp at Republican Street. Under the Curved Sixth Avenue option, only eastbound traffic from Mercer Street would be able to access the extended roadway, as westbound left turns would likely be prohibited due to geometric constraints associated with intersection spacing.

North of Mercer Street, arterial connections to SR 99 would not change from the existing facility.

5.6 Transit Services

This section identifies the expected operational effects on transit services using both qualitative and quantitative information. These effects include expected changes in ridership, transit routing, reliability, coverage area, and potential variations in travel time along major transit corridors that could be affected by the project. Travel model results were used to determine potential travel time effects on bus routes currently operating along SR 99 to downtown Seattle.

The major transit network change resulting from the Bored Tunnel Alternative would be the loss of the midtown ramps at Columbia and Seneca Streets. This change would require transit routes that currently use the Columbia and Seneca Street ramps to exit SR 99 to instead use the newly constructed south end ramps at Dearborn Street.

Under the Bored Tunnel Alternative, the new transit pathway would connect SR 99 from the south to the Third Avenue transit spine at Washington or Main Streets, and traverse along Third Avenue from the south end in order to minimize delay for coaches turning onto Third Avenue to and from midtown side streets with high pedestrian volumes. This new transit pathway would eliminate the ongoing operational challenges at the Seneca and Columbia Street ramps. Transit coaches bottom-out on Seneca Street in the inbound direction, resulting in more maintenance issues for transit vehicles. For the outbound direction via Columbia Street, transit coaches frequently block southbound transit flow on Third Avenue due to the combination of traffic congestion on Columbia Street and the limited capacity for buses at the Columbia Street/Second Avenue stop.

Transit coaches using the proposed Main/Washington Street transit pathway would need to pass through more signalized intersections to travel between

Seneca Street or Columbia Street and the south end compared to routes that currently use the existing midtown ramps. In the inbound direction, coaches would need to pass through an estimated 17 additional signalized intersections to reach the Third Avenue/Seneca Street intersection. In the outbound direction, coaches would need to pass through an estimated nine signalized intersections from the Third Avenue/Columbia Street intersection to the proposed SR 99 ramp intersection. This Main/Washington transit pathway will also avoid ferry-related traffic congestion in Pioneer Square and along Alaskan Way between Yesler Way and Marion Street as well.

Key Findings

- Under the Bored Tunnel Alternative, transit access for bus routes operating between South King County/West Seattle and downtown Seattle would no longer be available at the Columbia and Seneca Street ramps. However, transit service would be provided more directly to locations in south downtown, including Pioneer Square. Transit routes would likely access downtown to and from the stadium area ramps at Alaskan Way S. The northbound off-ramp would have a general-purpose lane and a transit-only lane to accommodate buses coming from West Seattle and South King County.
- The screenlines used in this environmental analysis (refer to Exhibit 4-11 in Chapter 4) capture nearly all transit service traveling to and from downtown Seattle. Using these broad screenlines, ridership response to changes on the limited facilities directly affected by the Bored Tunnel Alternative would likely be diluted by the total volume of transit ridership into and out of downtown Seattle.
- Nevertheless, the broad screenlines show a slight reduction (about 2 percent) in transit volumes to and from the south with the 2015 Project as compared to the 2015 Existing Viaduct. This reduction in ridership appears to result from the added transit travel time resulting from the loss of the midtown ramps.
- The 2015 Viaduct Closed (No Build Alternative) is expected to result in a larger reduction in transit ridership (i.e., 4 to 5 percent) from the 2015 Existing Viaduct due to the severe congestion that would affect transit service throughout the downtown area, particularly to and from the south.
- Projected transit ridership for the 2015 Project and the 2015 Viaduct Closed (No Build Alternative) to and from the north (i.e., across the north screenline) would approximate the ridership volumes for the 2015 Existing Viaduct.

- Efforts to maintain or improve operating conditions for buses could result in higher levels of transit ridership than currently projected for the 2015 Viaduct Closed (No Build Alternative).
- With the 2015 Project, peak hour transit travel times between West Seattle and downtown in the AM inbound and outbound and PM inbound directions range between 2 and 4 minutes longer than those for the 2015 Existing Viaduct, which is a 13 to 20 percent increase. In the PM outbound direction, however, estimated travel times are expected to improve by approximately 16 percent.
- Under the Bored Tunnel Alternative, existing on- and off-ramps located at Denny Way would be closed and replaced with downtown access ramps to and from SR 99 three blocks farther north near Harrison Street. Although the north portal configuration would require transit to pass through three additional signalized intersections between the on-/off-ramps and Denny Way, it also would result in more centralized transit access in South Lake Union.
- Transit lanes in both directions would be provided from south of Harrison Street through the Denny Way intersection.[1]
- Changes in transit travel times for the trip between Woodland Park and downtown Seattle using the transit pathways north of downtown Seattle range between an 11 percent decrease in travel time in the inbound direction during the PM peak to a 9 percent increase in travel time in the outbound direction during the AM peak. The inbound AM peak has a travel time decrease of 1 minute (5 percent), while the outbound PM peak has a 1 minute increase (7 percent).

5.6.1 Transit Network Changes and Transit Priority Treatments

South Portal

The 2015 Existing Viaduct assumes the completion of the S. Holgate Street to S. King Street Viaduct Replacement Project. The 2015 Existing Viaduct does not necessitate a change in routing or service coverage because the existing viaduct and midtown ramps north of King Street would still exist. Transit access to and from the SODO and Pioneer Square areas would continue to be provided on First and Fourth Avenues S. and the SODO Busway while transit access to downtown

[1] Per a recent agreement between the City of Seattle and the King County Department of Transportation regarding the extension of the northbound BAT lane between Denny Way and Harrison Street, an alternative configuration is being considered. This configuration would extend the northbound transit lane to a point south of Harrison Street; however, this option would affect the width of the sidewalk on the west side of the roadway.

from West Seattle, Burien, and other points south would be principally provided via SR 99 using the Columbia and Seneca Street midtown ramps.

Under the Bored Tunnel Alternative, the Columbia and Seneca Street ramps would be removed, and all transit currently operating on SR 99 would need to exit and enter SR 99 in the stadium area. This change in service coverage would increase the number of buses traveling through south downtown Seattle by approximately 520 buses per day. This change would also increase transit travel time to destinations in central downtown. Some of these travel time effects will be mitigated by the provision of a northbound transit-only lane on SR 99 from S. Holgate Street to the off-ramp intersection. However, the revised bus routings also would allow express buses from West Seattle, Burien, and White Center to access south downtown Seattle, a market that has traditionally had transit access only via local streets.

North Portal

With the 2015 Existing Viaduct, bus routes would continue to use the Denny Way ramps resulting in no change to existing transit operations. With the 2015 Project, transit vehicles would use new SR 99 center lane on-/off-ramps at Harrison Street. This configuration would require southbound transit vehicles on SR 99 to weave across two lanes of traffic just south of Aloha Street to access the exit ramp in the center lane. In the northbound direction, transit vehicles entering SR 99 from Harrison Street would weave across traffic continuing northbound on SR 99 in order to service stops along Aurora Avenue. While weaving would occur in this segment of the corridor, it also would occur with the 2015 Existing Viaduct. Transit lanes on SR 99 between Harrison Street and Denny Way and along Battery and Wall Streets would provide continuous transit lanes from Third Avenue to SR 99 in both directions, thereby improving the speed and reliability of bus service to and from SR 99.

5.6.2 Modeled Transit Ridership

Exhibit 5-38 summarizes projected daily transit ridership at three screenlines. The regional travel demand model also identifies AM peak transit ridership, which is summarized in Exhibit 5-39.

Exhibit 5-38. Model-Estimated Daily Transit Ridership (Person-Trips) at Selected Screenlines

	Existing (2005)	2015 Existing Viaduct	2015 Viaduct Closed (No Build Alternative)	2015 Project	2030 Project
South (south of S. King Street)	56,640	99,180	95,600	97,000	163,700
Central (north of Seneca Street)	90,060	126,890	120,500	124,780	179,160
North (north of Thomas Street)	89,610	118,710	119,120	118,830	169,940

Exhibit 5-39. Model-Estimated AM Peak Period Transit Ridership (Person-Trips) at Selected Screenlines

	Existing (2005)	2015 Existing Viaduct	2015 Viaduct Closed (No Build Alternative)	2015 Project	2030 Project
South (south of S. King Street)	18,240	31,320	30,650	30,780	54,520
Central (north of Seneca Street)	26,880	36,690	35,450	36,380	53,810
North (south of Thomas Street)	29,150	36,410	36,570	36,510	52,780

Transit Ridership Growth between 2005 and 2015 – Existing Viaduct and Project

Between 2005 and 2015, projected increases in daily transit demand for the 2015 Project range from 32 percent at the north screenline to 71 percent in the south. The increases for the AM peak period are slightly less, ranging from 25 percent at the north screenline to 69 percent at the south screenline. These increases in daily and peak period transit demand reflect population and employment growth as well as transit improvements expected to be implemented between 2005 and 2015, including Link LRT to Sea-Tac Airport and north to the University of Washington, and King County Metro's RapidRide BRT service to downtown Seattle from West Seattle, Ballard, and Shoreline.

Daily ridership growth between 2005 and 2015 with the 2015 Project would generally be similar to or slightly lower than ridership growth in the 2015 Existing Viaduct, depending on the screenline. For the north screenline, daily transit ridership with the 2015 Project would be similar to ridership in the 2015 Existing Viaduct. For the central and south screenlines, daily transit ridership for the 2015 Project would be slightly less (between 2 and 4 percent) than with the 2015 Existing Viaduct. As with the daily ridership forecasts, AM peak period transit ridership for the 2015 Project would have a slight decline in transit demand at the south and central screenlines (approaching 1 to 2 percent) as compared to the 2015 Existing Viaduct.

The slight decrease in transit demand between the 2015 Existing Viaduct and the 2015 Project at the central and south screenlines would likely be due to anticipated changes in transit access in south downtown. With the 2015 Project, bus routes from West Seattle and South King County would exit to downtown farther south than the current access locations at Columbia and Seneca Streets. While this routing change would expand bus service coverage south of the CBD, it would also increase travel times for riders destined for the north end of downtown. Different bus routing assumptions or arterial transit priority enhancements to improve bus travel times could potentially provide sufficient benefit to offset the relatively small projected decrease in transit ridership relative to the 2015 Existing Viaduct.

The relatively small variations in 2015 transit ridership at screenlines for the 2015 Existing Viaduct, the 2015 Project, and the 2015 Viaduct Closed (No Build Alternative) would also be reflected in mode shares for Seattle's Center City. These shares, further discussed below under Transit Mode Share, would be about 34 percent for home-based work trips and about 9 percent for non-work trips.

2015 Viaduct Closed (No Build Alternative)

For the north screenline, 2015 daily transit ridership for the 2015 Viaduct Closed (No Build Alternative) is projected to be similar to volumes for the 2015 Existing Viaduct and the 2015 Project. At the south screenline, the volumes for the 2015 Viaduct Closed (No Build Alternative) would be approximately 3 percent lower than the volumes for the 2015 Existing Viaduct but would approximate the volumes for the 2015 Project.

Transit ridership at the central screenline in the 2015 Viaduct Closed (No Build Alternative) in the downtown area is expected to be approximately 4 percent lower than that for the 2015 Existing Viaduct and 3 percent lower than that for the 2015 Project. This is a result of congested conditions on surface streets, which would affect the ability of bus routes to operate efficiently or reliably. The model results indicated an increase in demand for Link LRT service, which likely reflects the exclusive operations that it provides versus the mixed traffic conditions for bus service.

With the 2015 Viaduct Closed (No Build Alternative), measures would likely be implemented in an effort to maintain or improve operating conditions for transit vehicles. To the degree that such measures are successful, they could result in higher levels of transit ridership than currently projected for the 2015 Viaduct Closed (No Build Alternative). However, such measures (e.g., conversion of general-purpose traffic lanes to transit-only lanes) could also result in even more increased congestion for general-purpose traffic.

2030 Project

By 2030, total daily transit ridership in the study area is forecasted to increase substantially—between 41 percent and 44 percent over the 2015 Existing Viaduct and the 2015 Project levels for the north and central screenlines, and between 65 percent and 69 percent for the south screenline. By 2030, transit riders would be able to use existing and new bus routes as well as new rail services (Link LRT and Sounder commuter rail, with each expanded according to the ST2 Plan) provided by Sound Transit. Expanded transit services would affect transit demand at each screenline.

By 2030, AM peak period transit ridership in the study area is also forecasted to increase over 2015 levels—by nearly 50 percent for the north and central screenlines. For the south screenline, the increase in AM peak period transit

ridership between 2015 and 2030 would be from 74 to 77 percent or from about 31,000 person-trips to almost 55,000.

Transit Mode Share

The transit shares for 2005, 2015, and 2030 are identified in Exhibit 5-40. The projected transit ridership for 2015 and 2030 indicates that the transit share of total demand would gradually increase with the 2015 Existing Viaduct, and the 2015 Project, and the 2030 Project. The extent of ridership growth by 2030 would be such that transit shares of total travel are expected to increase substantially. Expanded bus and rail service, particularly Link LRT service in place by 2030, would contribute to this growth in transit mode shares, along with assumed higher automobile operating costs and higher parking costs.

Exhibit 5-40. Model-Estimated Daily Transit Mode Shares: To, From, and Within Seattle's Center City

	Existing (2005)	2015 Existing Viaduct	2015 Viaduct Closed (No Build Alternative)	2015 Project	2030 Project
Home-based work	31.0%	34.2%	34.0%	34.2%	40.5%
Non-work	8.1%	8.9%	8.7%	8.8%	10.1%

The transit share of home-based work trips (i.e., commuting to work) is estimated to grow between 2005 and 2030 from 31 percent of total trips to almost 41 percent. It would grow to about 34 percent for the 2015 Existing Viaduct, the 2015 Viaduct Closed (No Build Alternative), and the 2015 Project. Between 2005 and 2030, the transit share of non-work trips is estimated to grow from 8 percent to 10 percent of total travel. It would grow to about 9 percent for the 2015 Existing Viaduct, the 2015 Viaduct Closed (No Build Alternative), and the 2015 Project.

5.6.3 Transit Connectivity and Coverage

2015 Existing Viaduct

Access from SR 99 to the central part of downtown Seattle would continue to be provided at the Columbia Street on-ramp and Seneca Street off-ramp, in addition to access provided at the stadium area ramps.

For buses accessing downtown Seattle from the north end, existing access locations would be maintained. No additional access locations would be provided for buses, and additional transit-only lanes would not be provided on Aurora Avenue.

Bored Tunnel Alternative

Under the Bored Tunnel Alternative, existing access ramps at Seneca and Colombia Streets would no longer be available. Transit vehicles traveling on

SR 99 from West Seattle and South King County would instead use the new ramps located at the stadium area, and then travel on arterials in Pioneer Square to Third and Fourth Avenues to access the downtown Seattle grid. A shoulder transit lane on northbound SR 99 from approximately S. Holgate Street to the end of the stadium area off-ramp would allow transit vehicles to bypass potential queues emanating from the ramp terminus intersection. With the new stadium area ramps, transit vehicles traveling on SR 99 to the south end of downtown Seattle would have improved access to locations in the SODO area as well as in Pioneer Square and south downtown. Buses would turn on S. Main Street or other east-west streets, and then on Third Avenue or Fourth Avenue to access the downtown street grid.

In comparison to conditions with the 2015 Existing Viaduct, access from the stadium area ramps would increase travel time for riders traveling to midtown or uptown locations, while providing faster trips for those traveling to destinations south of the downtown Seattle core. This additional transit service in the south downtown Seattle area would be complemented by improved street facilities, including one and potentially two new east-west streets between Alaskan Way S. and First Avenue S. at S. Dearborn Street and a second option at S. Charles Street.

For transit vehicles serving downtown Seattle from the north, the Denny Way ramps would be replaced with ramps to Harrison Street and Aurora Avenue, providing a similar connection to Denny Way. Buses operating along Aurora Avenue would likely use this left-side exit to access downtown Seattle. Transit lanes would be provided on Aurora Avenue, Battery Street, and Wall Street. There would be transit lanes in both directions between south of Harrison Street and Denny Way.

The Bored Tunnel Alternative would also provide added traffic and pedestrian access across Aurora Avenue in the South Lake Union area. New east-west streets would connect Thomas, John, and Harrison Streets. The extension of Sixth Avenue N. to Mercer Street would improve access to southbound SR 99 from Mercer Street. These access improvements provide opportunities for potential new transit connections in South Lake Union as well as improved pedestrian access to transit.

5.6.4 Peak Hour Travel Times for Transit Corridors

The following sections identify estimated travel times for several transit corridors serving downtown Seattle. For the Ballard to CBD (Denny Way) corridor, travel times are available for the bus lanes on Elliott Avenue. For the Aurora Avenue and West Seattle/CBD corridors, the travel demand information for 2015 does not identify transit-specific travel times. However, the information for general traffic

does allow comparisons between the modeled conditions for major transit corridors.

Travel time variations between the 2015 Existing Viaduct and the 2015 Project are summarized in Exhibit 5-41. The variations are presented for three major transit corridors that could be affected by project-related changes. Affected transit travel for a fourth corridor, S. King Street to downtown Seattle, is reflected in the West Seattle/downtown Seattle travel times.

Exhibit 5-41. 2015 Travel Times Along Major Transit Travel Corridors

	2015 Existing Viaduct	2015 Project[1]	Change	2015 Existing Viaduct	2015 Project[1]	Change
	AM Peak Hour			PM Peak Hour		
Ballard to Denny Way[2]						
Inbound	8	8	0	8	8	0
Outbound	8	8	0	7	8	+1
Aurora Avenue (Woodland Park to CBD)						
Inbound	19	18	-1	18	16	-2
Outbound	11	12	+1	14	15	+1
West Seattle to CBD						
Inbound	20	23/24	+3/+4	15	17/17	+2/+2
Outbound	12	16/16	+4/+4	25	21/21	-4/-4

Note: Travel times are in minutes; CBD location for the Aurora Avenue and West Seattle corridors is Fourth Avenue and Seneca Street.
CBD = Central Business District
[1] Where two travel time values are given, the first reflects the New Dearborn Intersection option, and the second reflects the New Dearborn and Charles Intersections option.
[2] Represented by transit travel on Elliott Avenue between the Ballard Bridge and Denny Way.

Peak Hour Travel Times – Ballard/Denny Way

The estimated travel times for bus travel along Elliott Avenue between the south end of the Ballard Bridge and Denny Way for the 2015 Existing Viaduct and the 2015 Project are shown in Exhibit 5-41. For most trips, travel time with the 2015 Project would be generally the same as for the 2015 Existing Viaduct. The PM peak hour outbound direction (the period of heaviest transit demand), however, has an estimated increase in travel time of 1 minute. The increase for outbound travel is primarily due to the added time it is expected to take for northbound traffic to travel through the Elliott Avenue/W. Mercer Place intersection due to the projected increase in southbound left turns.

Peak Hour Travel Times – Aurora Avenue Corridor (Woodland Park/Downtown Seattle)

The estimated travel times in 2015 along the Aurora Avenue corridor are shown in Exhibit 5-41 for the 2015 Existing Viaduct and the 2015 Project. For portions of Aurora Avenue with a transit lane, transit travel times were identified. For the other segments, general-purpose travel times are presented. With the 2015 Project, the right-side Denny Way ramps on Aurora Avenue would be replaced with left-side ramps to and from Harrison Street. Additionally, right-side transit lanes would be provided along Aurora Avenue northbound between Sixth Avenue N. and Harrison Street and southbound between Harrison Street and Wall Street, providing transit priority through the critical Denny Way intersection.

With peak hour travel time differences of approximately 2 minutes or less, conditions along the Aurora Avenue corridor in the 2015 Project would be generally comparable to the 2015 Existing Viaduct. The AM peak period would benefit from a 1 minute decrease in travel time (approximately 5 percent) in the peak direction. In the outbound direction, which directly affects fewer riders, the 2015 Project is expected to result in a travel time increase of about 1 minute, or 9 percent, over the 2015 Existing Viaduct. In the PM peak period, transit travelers would experience a 1 minute (6 percent) increase in travel time in the peak direction, while the inbound direction would benefit from an estimated 2-minute (11 percent) decrease in travel time.

Peak Hour Travel Times – West Seattle/Downtown Seattle Corridor

The estimated travel times in 2015 along the West Seattle/downtown Seattle corridor for the 2015 Existing Viaduct and the 2015 Project (with travel times for the New Dearborn Intersection option and the New Dearborn and Charles Intersections option) are shown in Exhibit 5-41. With the 2015 Project, direct access to and from downtown Seattle via Columbia and Seneca Streets would no longer be available. However, in the PM peak period, travel times would be less for the 2015 Project as compared to the 2015 Existing Viaduct because traffic would no longer be using congested westbound Columbia Street to access SR 99. Also, having buses use the new stadium area ramps would increase transit service and coverage in the area south of downtown Seattle. Travel times would likely be the same for both the 2015 Existing Viaduct and the 2015 Project if buses exit via S. King Street. However, with the 2015 Project, some time savings over general-purpose travel is expected to occur for transit vehicles, with the northbound bus-only shoulder lane between S. Holgate Street and the S. Royal Brougham Way off-ramp. For this segment, transit travel times are reflected, whereas general-purpose travel times are reflected for the rest of the West Seattle/downtown Seattle corridor.

The loss of the midtown ramps in the 2015 Project requires transit to travel through nine additional signalized intersections in the southbound direction and

17 additional signals in the northbound direction between the south portal on- and off-ramps and central downtown. Some increase in travel time is anticipated for bus routes operating between West Seattle and downtown Seattle, although, as noted above, this would be at least partially offset by lower travel times for southbound travel in the PM peak hour. The highest variation in travel times between the 2015 Existing Viaduct and the 2015 Project is an increase of 4 minutes, or approximately 33 percent, for outbound trips in the AM peak hour and 3 to 4 minutes, or 15 to 20 percent, for inbound trips during the AM peak hour. The highest travel time increase of 33 percent occurs in the AM off-peak (outbound) direction, which involves substantially fewer riders than AM inbound travel.

Travel time benefits are expected for transit vehicles due to the provision of the shoulder transit lane for northbound SR 99 between approximately S. Holgate Street and the off-ramp terminus. Also, with the new routes, transit travel times from West Seattle to the south downtown area would be less than in the 2015 Existing Viaduct since riders would not have to double-back from the Seneca off-ramp. In the AM peak hour, travel speeds in the shoulder transit lane are estimated at 32 mph as compared to 19 mph for travel in the general-purpose lane. In the PM peak hour travel speeds in the shoulder transit lane are estimated at 31 mph compared to 28 mph for travel in the general-purpose lane. The larger speed differential in the AM peak is expected since this is the peak direction.

For the PM peak hour, travel time differences between the 2015 Existing Viaduct and the 2015 Project are generally estimated to be 3 minutes or less. For inbound trips, travel time for the 2015 Project would be 2 minutes longer than that for the 2015 Existing Viaduct, while for the more heavily traveled outbound trips, travel time for the 2015 Project would be 3 minutes shorter than that for the 2015 Existing Viaduct. The longer inbound travel time for the 2015 Project is likely due to traffic having to pass through more signalized intersections than in the 2015 Existing Viaduct.

For the PM peak hour outbound direction, when transit demand is the greatest, transit travel time is expected to decrease by almost 16 percent compared to the 2015 Existing Viaduct. For inbound trips, travel time for the 2015 Project would be 2 minutes, or 13 percent, longer than for the 2015 Existing Viaduct. As with the AM inbound travel time, the longer inbound travel time for the 2015 Project is likely due to having to pass through more signalized intersections than in the 2015 Existing Viaduct.

Peak Hour Travel Times – South King County (Burien)/Downtown Seattle Corridor

For the 2015 Project, direct access for bus trips between South King County (Burien) and downtown Seattle via Columbia Street and Seneca Street would no longer be available. Since the Burien to CBD routes would have the same

alignments as West Seattle to CBD service, the travel times for the 2015 Existing Viaduct and the 2015 Project would be comparable. The faster time for the 2015 Existing Viaduct is likely because this is the off-peak direction for the AM period, and SR 99 southbound is expected to flow at relatively high speeds.

For the 2015 Project, traffic would have to pass through more signalized intersections to reach the southbound on-ramp in the stadium area. Even though this is the off-peak direction during the PM peak hour, the additional signalized intersections result in increased delay for the 2015 Project. However, because this is the off-peak direction, it affects relatively fewer riders than the AM inbound direction trips. Also, buses operating between Burien and downtown Seattle would benefit from the shoulder transit lane on SR 99 between S. Holgate and S. King Streets in terms of shorter travel time.

For the 2015 Project, transit service from South King County would have to pass through more signalized intersections between the south portal on- and off-ramps in the stadium area and central downtown. This would result in increased transit delay in both directions during the AM peak period, and in the inbound direction during the PM peak period for the 2015 Project. Inbound delays would be longer if not for the shoulder transit lane on SR 99 between S. Holgate and S. King Streets, which provides a speed advantage to buses operating between Burien and downtown Seattle. In the AM peak hour, travel speeds in the shoulder transit lane are estimated at 32 mph compared to 19 mph for travel in the general-purpose lane. In the PM peak hour, travel speeds in the shoulder transit lane are estimated at 31 mph compared to 28 mph for travel in the general-purpose lane. The PM peak outbound direction is shown to have a travel time decrease of 3 minutes, or almost 14 percent.

5.6.5 Intersection Level of Service Changes Affecting Transit

While travel time changes provide information about the flow of traffic through an area, intersection LOS data provide more detailed information about how operations at specific intersections could affect transit service. At several locations, the LOS would be generally the same in the 2015 Existing Viaduct and the 2015 Project; in some cases, conditions would be improved with the 2015 Project. In a few cases, conditions would be at LOS F or fall below LOS D with the 2015 Project. The following sections summarize results for selected locations.

At the south end of downtown Seattle, degraded LOS is projected for AM peak hour trips at First Avenue S. and Yesler Way with the 2015 Project (LOS D) compared to the 2015 Existing Viaduct (LOS B). In the PM peak hour, the intersection would operate at LOS F with the 2015 Project as compared to LOS E for the 2015 Existing Viaduct. The intersection of Fourth Avenue S. and S. Royal Brougham Way would operate at LOS C in the AM peak hour for the 2015 Project

compared to LOS B for the 2015 Existing Viaduct. For PM peak hour trips, the intersection would operate at LOS D for the 2015 Project and LOS E for the 2015 Existing Viaduct.

In the central area of downtown Seattle, First Avenue and Madison Street would operate at LOS A in the AM peak hour with the 2015 Existing Viaduct and the 2015 Project. In the PM peak hour this location would operate at LOS B with the 2015 Existing Viaduct and LOS A with the 2015 Project. The intersection of Second Avenue and Marion Street would operate at LOS D with the 2015 Existing Viaduct and the 2015 Project during AM and PM peak hours.

At the north end of downtown Seattle, the intersection of Fifth Avenue N. and Mercer Street would operate at LOS C in the AM peak hour with the 2015 Existing Viaduct and at LOS D with the 2015 Project. In the PM peak hour, this intersection would operate at LOS B with the 2015 Existing Viaduct and at LOS E with the 2015 Project. The intersection of Dexter Avenue N. and Mercer Street would operate at LOS D in the AM peak hour in both the 2015 Existing Viaduct and the 2015 Project. In the PM peak hour, this intersection would operate at LOS D with the 2015 Existing Viaduct and at LOS E with the 2015 Project.

The above LOS information indicates that some intersections used by buses would experience poorer operating conditions in 2015 with the 2015 Project as compared to the 2015 Existing Viaduct. These poorer conditions could affect transit service travel times. The significance of any individual intersection impact depends on the performance of other intersections along the pathway, as traffic at some intersections experiences increased delay and traffic at other intersections flows more freely.

5.6.6 Transit Priority Measures for the 2015 Project

With the Bored Tunnel Alternative, a peak-only shoulder transit lane would be provided on northbound SR 99 from approximately S. Holgate Street to the end of the stadium area off-ramp to allow transit vehicles to bypass potential queues emanating from the ramp terminus intersection. Additionally, in the north end, right-side arterial transit lanes would be provided on the new north-south road between Denny Way and Harrison Street to facilitate transit flow through this area. The primary benefit of this transit lane is anticipated to be providing priority for transit through the Denny Way intersection.

5.7 Truck Traffic and Freight

Key Findings

- Freight connections between SR 99 and streets in the SODO area, including the stadium area ramps and E. Marginal Way, would be improved under the Bored Tunnel Alternative.
- Freight connections to the Interbay and BINMIC areas would no longer be provided on SR 99 at the north end of the central waterfront (Elliott/Western ramps area). Freight traffic from Elliott and Western Avenues would connect to Alaskan Way via Broad Street. These trucks would incur potentially longer delays at Broad Street due to increased traffic, as well as regular train crossings. Connection to SR 99 in the south end of the central waterfront would occur roughly at S. King Street. Alternatively, this freight traffic could also use Mercer Street to access the bored tunnel via the Republican Street ramps.
- Ramp connections in the South Lake Union area would be altered compared to today. Direct connections to Mercer Street (northbound) for freight traffic headed to South Lake Union and to Broad Street (southbound) for freight traffic headed to the Uptown and Belltown areas would be eliminated but would be replaced by new connections to Republican Street and Harrison Street. These new ramps would operate like off-ramps with curves connecting to cross streets, and they would be designed to accommodate truck movements.
- For freight operators that choose to access southbound SR 99 in the South Lake Union area, the Curved Sixth Avenue option would be less advantageous to freight mobility because westbound traffic on Mercer Street would not be able to turn left onto Sixth Avenue N. to directly access the southbound SR 99 on-ramp at Republican Street. Instead, trucks would have to take less direct routes to reach the southbound on-ramp.
- Both the Straight Sixth Avenue and the Curved Sixth Avenue options would result in grades that trucks would have to negotiate on Sixth Avenue N. between Harrison and Mercer Streets. These grades may induce slower speeds for some vehicles traveling on this section of Sixth Avenue N. The Curved Sixth Avenue option would have steeper grades between Mercer Street and Harrison Street because the elevation at the Mercer Street intersection would be slightly lower than it would be for the Straight Sixth Avenue option.
- Hazardous and flammable cargo and over-height loads would be prohibited in the bored tunnel all day; they would have to be transported through downtown on either Alaskan Way or I-5. This change would

affect freight from the Ballard/Interbay areas. Currently, hazardous and flammable materials are prohibited only during the peak periods on the Alaskan Way Viaduct and all day in the Battery Street Tunnel.

5.7.1 Freight Connections

In the south end, full connections for freight would be provided between SR 99 and the local arterial system around the stadium area. Northbound off-ramps and southbound on-ramps would be provided for freight trips that wish to access downtown streets (or would be excluded from using the bored tunnel) at S. Royal Brougham Way. Northbound freight vehicles with over-height or hazardous or flammable restrictions would be required to exit SR 99 at the stadium area to maintain travel through downtown. Alaskan Way would remain a likely route for these vehicles.

Along the central waterfront, the Bored Tunnel Alternative would maintain access to Alaskan Way from SR 99 for those freight trips serving the Interbay, Magnolia, Ballard, and Fremont areas. While the existing connections on SR 99 at Elliott and Western Avenues would no longer exist for the Bored Tunnel Alternative, freight would have access via other routes to areas in northwest Seattle, including connections from Alaskan Way to Broad Street and then to Elliott and Western Avenues. Travel times for freight would be slightly higher, as vehicles would encounter signalized intersections along Alaskan Way. Additional travel time could be incurred at the railroad crossing at Broad Street, Wall Street, and Vine Street during the peak hours due to higher traffic volumes, as well as regular train crossings. Alternatively, this connection could also be made via the bored tunnel and Mercer Street. In the north section, full connections would be provided between SR 99 and the local arterial system. Southbound freight vehicles with over-height or hazardous or flammable restrictions would be required to exit SR 99 at Harrison Street to maintain travel through downtown.

The northbound off-ramp to Mercer Street would be replaced by a northbound off-ramp at Republican Street. Trucks would use this ramp to access Mercer Street (via Dexter Avenue N.). Two Sixth Avenue options for accessing southbound SR 99 from Mercer Street have been proposed, and each would affect freight operations. For both options, entering connections would be improved compared to the existing side-street connections. Both options also feature grades that would need to be negotiated between Mercer and Harrison Streets.

Under the Straight Sixth Avenue option, eastbound or westbound freight traffic would gain access to southbound SR 99 via Sixth Avenue N. After turning onto Sixth Avenue N., freight traffic would then turn left at the T-intersection at Republican Street. Traffic would then proceed to the southbound on-ramp and

then to SR 99, accessing the tunnel at Harrison Street. A signalized intersection at Mercer Street and southbound Sixth Avenue N. would help facilitate access to the on-ramp for westbound freight traffic. Trucks that access southbound Sixth Avenue N. from Mercer Street would encounter grades of about 7.5 percent. Those trucks continuing on after the Republican Street intersection (to Harrison Street) would encounter a grade of just less than 6 percent. Overall, the grades with the Straight Sixth Avenue option would be less steep than those with the Curved Sixth Avenue option because the latter option would begin at a lower elevation at Mercer Street.

Under the Curved Sixth Avenue option, both eastbound and westbound freight traffic from Mercer Street would be able to access southbound SR 99, although both directions present their own sets of challenges. Eastbound traffic (west of Aurora Avenue) would turn right onto Sixth Avenue N., and then left at the T-intersection at Republican Street. This is a similar route as under the Straight Sixth Avenue option, except that trucks would be required to travel farther on the downgrade on Mercer Street, and subsequently farther on an upgrade on Sixth Avenue N., to reach the Republican Street on-ramp to southbound SR 99. No left turns to Sixth Avenue N. from Mercer Street for westbound traffic would be allowed. For freight operators that choose to access southbound SR 99 in the South Lake Union area, westbound traffic would be required to travel via a very circuitous path to reach the southbound on-ramp. Westbound freight trips on Mercer Street would instead need to turn left on Dexter Avenue N., turn right on Harrison Street, cross SR 99 and turn right on Sixth Avenue N. to reach the Republican Street on-ramp. Due to the number of turns and tight curves at the on-ramp, the described route would require difficult right turns for trucks, which may result in some truck drivers choosing to bypass this maneuver and opting for another route through the corridor. Another option would include traveling westbound on Mercer Street, then right on Taylor Avenue N., then right on Roy Street with a connection to southbound Aurora Avenue. Trucks that access southbound Sixth Avenue N. from Mercer Street would encounter grades of about 7.5 percent. Those trucks continuing on after the Republican Street intersection (to Harrison Street) would encounter grades of 7 percent.

Overall, freight vehicles using the Mercer Street underpass would encounter grades on either side of SR 99, which may slow them down for a short distance. Grades for the Mercer Street underpass at Aurora Avenue would remain as they are today, 7.5 percent on the west side and 11.5 percent on the east side. Trucks could choose to take alternative routes in this area due to this condition.

5.7.2 Ability of Design to Facilitate Freight Operations

New connections in the South Lake Union area would be designed to adequately accommodate turning trucks at key intersections. In addition, with the closure of

Broad Street east of Taylor Avenue N., trucks would use two-way Mercer Street to get from SR 99 and I-5 to Fifth Avenue N. under the Bored Tunnel Alternative. The likely truck route connecting I-5 to the waterfront would include Mercer Street (at I-5) to Fifth Avenue N., Fifth Avenue N. to Broad Street, and Broad Street to Alaskan Way.

This configuration is a less attractive option for trucks than would be found under the full Program, where trucks would have the ability to use two-way Mercer Street to access Elliott Avenue W. As the project moves forward, project street designs will continue to evolve. While it is early in the design process, the project will continue to evaluate configurations that would provide adequate design features (e.g., adequate turning radii and lane widths) to facilitate turning movements for trucks (i.e., vehicles 75 feet in length).

Hazardous and flammable cargo and over-height loads would be prohibited in the bored tunnel all day; they would have to be transported through downtown Seattle on either Alaskan Way or I-5. This change would affect freight from the Ballard/Interbay areas because hazardous and flammable materials are currently prohibited on the Alaskan Way Viaduct only during peak periods.

5.7.3 Freight Train Operations

Minimal effects on rail operations are foreseen. The S. Holgate Street to S. King Street Viaduct Replacement Project will separate street and train traffic. A primary objective of this project is to minimize effects on freight and passenger rail operations. If closures of the rail line are necessary, they would be temporary.

5.8 Parking

Key Findings

The Bored Tunnel Alternative would eliminate approximately 110 on-street parking spaces in the south portal area. The majority of these spaces are along Railroad Way S. between Alaskan Way S. and Occidental Avenue S.

The Bored Tunnel Alternative would remove approximately 210 on-street spaces in the north portal area. The affected spaces are predominantly along John, Thomas, and Harrison Streets, where the existing parallel parking would be converted to travel lanes.

The Bored Tunnel Alternative would remove about 250 off-street parking spaces in the south portal area. No off-street spaces would be removed in the north portal area.

There would be no long-term effects to existing parking under the viaduct from the Bored Tunnel Alternative.

There is no difference in parking effects between the two options in the south portal area or the north portal area options.

Exhibit 5-42 summarizes the potential parking effects for the Bored Tunnel Alternative. The Bored Tunnel Alternative would reduce the number of parking spaces compared to existing conditions. The Bored Tunnel Alternative would not permanently affect any parking spaces under the viaduct. Effects to parking spaces under the viaduct during construction are covered in Chapter 6, Construction Effects and Mitigation. Potential future removal of spaces related to the surface street reconfiguration component of the Program is discussed in Chapter 7, Cumulative Effects.

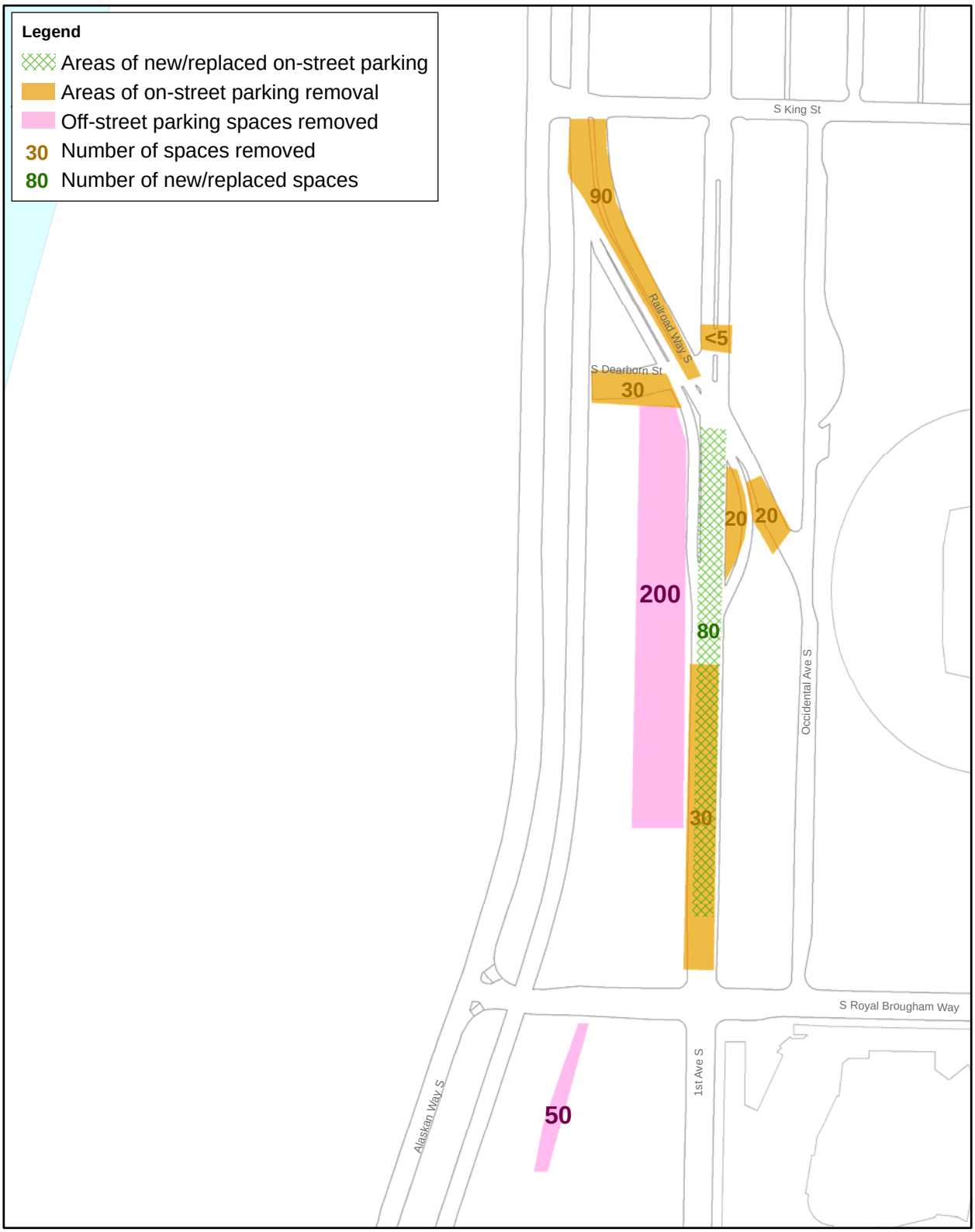
Exhibit 5-42. Parking Effects of the Bored Tunnel Alternative

	South Portal	North Portal	Total Spaces
Existing Conditions[1]			
On-street spaces	190	370	560
Off-street spaces	250	0	250
Total spaces existing	**440**	**370**	**810**
Number of Spaces Removed[2]			
On-street spaces	-110	-210	-320
Off-street spaces	-250	0	-250
Under the viaduct	**0**	**0**	**0**
Net change	**-360**	**-210**	**-570**

[1] Spaces within the project boundaries.
[2] Negative numbers indicate parking removals.

5.8.1 South Portal

Exhibit 5-43 shows the location of the affected parking spaces in the south portal area. The south portal area encompasses the area from approximately S. Royal Brougham Way to S. King Street. There are currently about 190 on-street spaces in this area that are outside of the boundaries of the S. Holgate Street to S. King Street Viaduct Replacement Project. Of these 190 spaces, 140 are short-term and 50 are long-term spaces. The Bored Tunnel Alternative would replace approximately 80 on-street spaces, with an overall loss of about 110 spaces. On-street parking is available within several blocks of the spaces that would be removed. Most of the on-street spaces that would be permanently removed are along Railroad Way S. and currently allow 2-hour metered parking. Drivers who would have otherwise used these spaces may have to travel several blocks farther to find available on-street spaces on surrounding streets, or they could use a pay lot.



0 600 Feet

Source: City of Seattle, 2009.

Exhibit 5-43
South Portal Affected Parking Spaces

The parking removals are consistent with Seattle's Comprehensive Plan (2005a). Goal TG18 indicates that in making decisions about on-street parking, transportation is the primary purpose of the arterial street system. Additionally, it is the City's general policy, as described in policy T-42, to replace short-term parking only when the project results in a concentrated and substantial amount of on-street parking loss. SDOT will ultimately determine how on-street parking spaces are managed and will likely encourage short-term parking instead of long-term parking. There is no difference in parking effects between the two south portal area options.

Approximately 250 off-street parking spaces would be permanently affected by the Bored Tunnel Alternative. Of these spaces, about 200 are on the WOSCA property and are currently unavailable due to construction of the S. Holgate Street to S. King Street Viaduct Replacement Project. However, the S. Holgate Street to S. King Street Viaduct Replacement Project assumed that these 200 spaces could be replaced. With the Bored Tunnel Alternative, there may be space on the WOSCA site to replace some of the off-street parking; however, the conservative assumption is that these spaces would not be replaced. As a result, the 200 spaces on the WOSCA site are included as an effect of the Bored Tunnel Alternative. Future use of the space will be up to WSDOT or potential future property owners.

In the south portal area, the majority of the parking losses are off-street losses (i.e., public pay lots), which are abundant and underutilized in the stadium area when events are not taking place. The off-street parking utilization rate for the stadium area is about 31.1 percent on an average non-event weekday (PSRC 2006a). Because parking lots are generally underutilized in the stadium area, parking spaces are not anticipated to be difficult to find during average days.

During events at the stadiums, finding available parking may be more challenging or may cost more than under current conditions. However, a number of major parking facilities are located near the stadiums, including the Safeco Field Garage, Qwest Event Center Garage, Union Station Garage, North Lot (Qwest Field), Impark Parking, and Home Plate Parking. These six parking facilities provide about 6,900 parking spaces for use during events. Many smaller parking lots and garages are also within walking distance of the stadiums. Event-goers will continue to be encouraged to use bus and rail service and to carpool to the stadiums. The Safeco Field Transportation Management Plan (Baseball Club of Seattle, LLP, and the Seattle Mariners 2009) and the Qwest Field Transportation Management Program (Washington State Public Stadium Authority, First & Goal, Inc., and the Seattle Seahawks 2009) both include parking reduction and transit-related goals and mitigation measures that aim to reduce the number of event attendees who require parking near the stadiums.

5.8.2 North Portal

The north portal area extends from just south of Denny Way at the Battery Street Tunnel north portal along SR 99 to Roy Street and includes some surrounding streets. There are approximately 140 on-street short-term parking spaces and approximately 230 on-street long-term spaces within the north portal area, for a total of 370 on-street spaces. The on-street long-term spaces mainly consist of metered spaces with a 10-hour limit. For the Bored Tunnel Alternative, approximately 160 spaces would be replaced, resulting in a loss of 210 on-street spaces, compared with existing conditions. Most of these spaces would be removed to accommodate bicycle, transit, or general-purpose vehicle lanes. Several blocks may be converted from angle-in parking spaces to parallel parking, which would result in fewer spaces than the current number. Off-street public parking is not expected to be affected. Exhibit 5-44 shows the location of the affected parking spaces in the north portal area.

In addition to the public parking, there would be some private and employee parking spaces affected. Private parking within the fenced lot to south of the existing building between Sixth Avenue N. and Harrison Street, on the east side of Sixth Avenue N., would be removed for the new tunnel operations building. The new roadway also would require the removal of some employee parking spaces in a lot on the north side of Harrison Street, west of Aurora Avenue. The office building associated with both of these parking areas would be removed as part of the project.

As discussed for the south portal area, the removal of parking spaces in the north portal area would be consistent with Seattle's Comprehensive Plan (2005a). In making decisions about on-street parking, transportation is the primary purpose of the arterial street system. Additionally, it is the City's general policy to replace short-term parking only when the project results in a concentrated and substantial amount of on-street parking loss. SDOT will ultimately determine how on-street parking spaces are managed, so no assumptions are made about whether the new and replaced on-street spaces would be long- or short-term spaces.

There is no difference in parking effects between the two Sixth Avenue options.

5.9 Pedestrians

Key Findings

Bored Tunnel Alternative improvements in the south portal area include removal of the First Avenue S. ramps at Railroad Way S. and new cross street connections with associated sidewalk facilities between S. Royal Brougham Way and S. King Street east of the SR 99 ramp system. These improvements would improve pedestrian mobility and access in this area.

0 600 Feet

N

Source: City of Seattle, 2009.

Exhibit 5-44
North Portal Affected Parking Spaces

The City Side Trail, a dedicated pedestrian and bicycle path on the east side of the SR 99 ramp system, would greatly increase the overall pedestrian experience in the south portal area, as well as the connectivity to the existing combined pedestrian/ bicycle trail to Myrtle Edwards Park and the E. Marginal Way bicycle lanes.

The New Dearborn and Charles Intersection option would provide an additional east-west crossing of Alaskan Way S. and E. Marginal Way S. as compared to the New Dearborn Intersection option.

The City of Seattle will also have completed the construction of a new pedestrian/ bicycle overpass connecting Uptown to the waterfront at Thomas Street.

5.9.1 Pedestrian Facilities Provided

2015 Existing Viaduct

Pedestrian facilities with the 2015 Existing Viaduct are very similar to those discussed for existing conditions, with the exception of the pedestrian facilities added by the S. Holgate Street to S. King Street Viaduct Replacement Project. The S. Holgate Street to S. King Street Viaduct Replacement Project will construct combined pedestrian and bicycle facilities adjacent to Terminal 46 and on the west side of E. Marginal Way S., as well as improve sidewalk and crosswalk facilities on S. Atlantic Street. More detail on the pedestrian facilities included in the S. Holgate Street to S. King Street Viaduct Replacement Project can be found in the *SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project Environmental Assessment and Draft Section 4(f) Evaluation* (FHWA and WSDOT 2008). The Mercer East Project (I-5 to Dexter) would provide new or improved wider sidewalks as well as new signal-controlled pedestrian crossings on Mercer and Valley Streets, between Fairview and Ninth Avenues N. The City of Seattle will also have completed the construction of a new pedestrian/bicycle overpass connecting Uptown to the waterfront at Thomas Street. No other substantial pedestrian facilities or connections are anticipated to be constructed by the City of Seattle within the project area within this timeframe.

2015 Viaduct Closed (No Build Alternative)

As noted for the 2015 Existing Viaduct, no additional pedestrian facilities are anticipated to be constructed by the City of Seattle within the project area. However, a key difference between the existing conditions, the 2015 Existing Viaduct, and the 2015 Viaduct Closed (No Build Alternative) is the expected increase in vehicle traffic on surface streets through downtown Seattle. In certain instances, the increase in automobile traffic may result in an increase in intersection-related conflicts between pedestrians and automobiles at intersections. This could be particularly true for pedestrian crossings that occur in conflict with right-turning automobile movements. In addition to potential pedestrian and automobile conflicts, pedestrians may also

experience an increase in crossing wait times due to the expected increase in vehicle volumes on surface streets in downtown Seattle.

Bored Tunnel Alternative

Exhibits 5-45 and 5-46 show the pedestrian and bicycle facilities in the south and north portal areas.

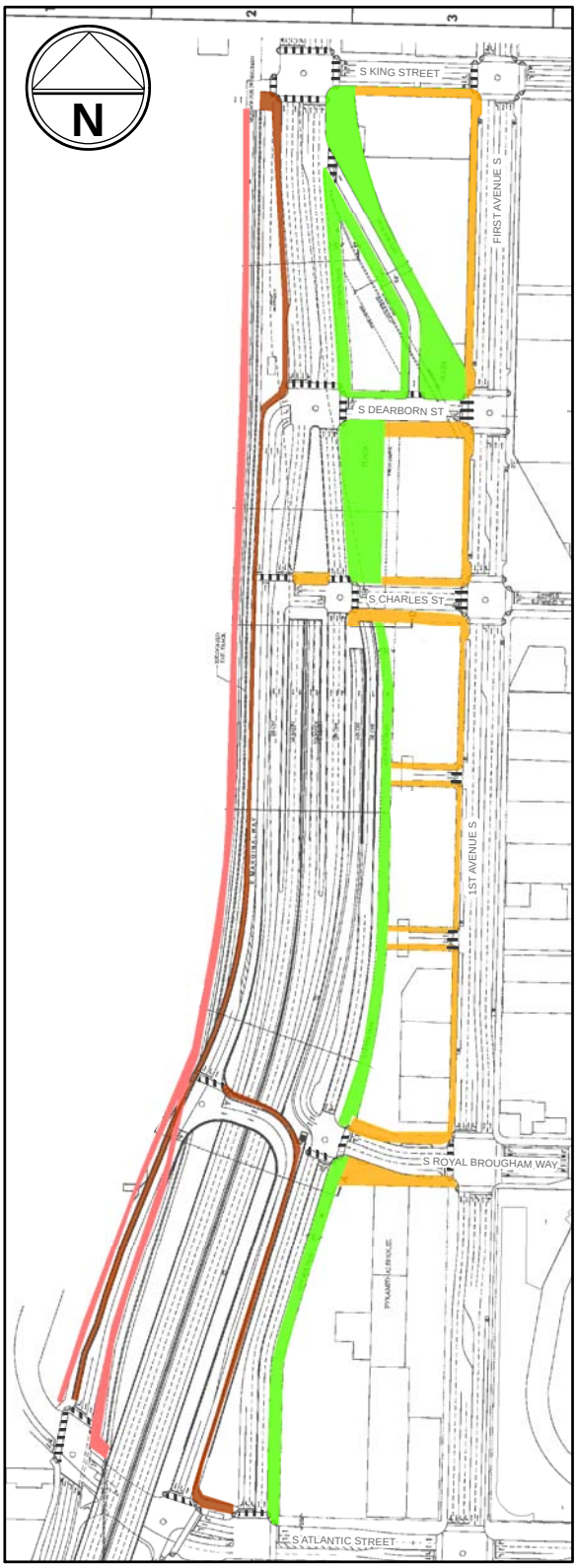
South Portal Area

A new combined pedestrian/bicycle trail (City Side Trail) would provide the primary north-south pedestrian facility in the south portal area. This proposed trail is an extension of the trail constructed as part of the S. Holgate Street to S. King Street Viaduct Replacement Project that runs adjacent to the East Frontage Road south of S. Royal Brougham Way. With either south portal area option of the Bored Tunnel Alternative, the combined pedestrian/facility would continue northward on the east side of the SR 99 ramps/Alaskan Way S. to S. King Street. The trail would vary in width between S. Royal Brougham Way and S. King Street but the exact width has not yet been determined.

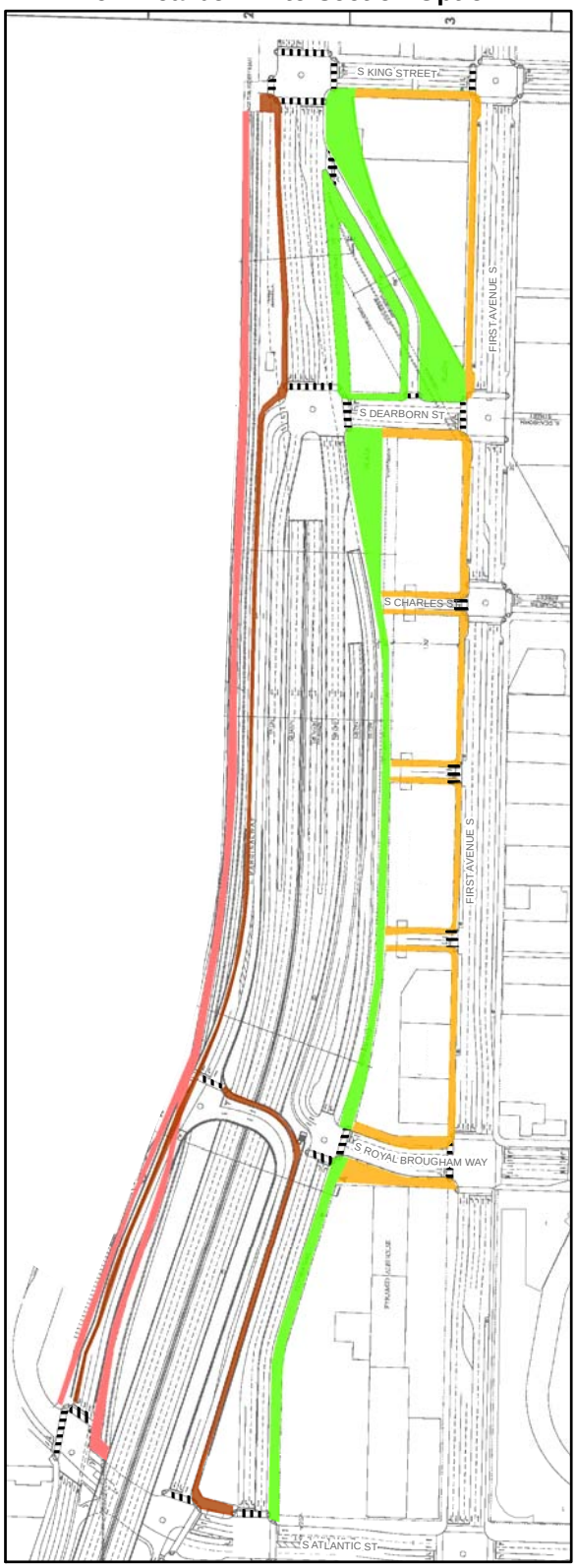
Under the New Dearborn and Charles Intersections option, the City Side Trail would approach S. Charles Street adjacent to the SR 99 ramps and Alaskan Way S. with crosswalk facilities at either First Avenue S. or the northbound SR 99 off-ramp. The City Side Trail would transition to a wide plaza area between S. Charles and S. Dearborn Streets, and then split to either side of the south tunnel operations building, before rejoining at S. King Street. Sidewalk facilities would be present on S. Charles and S. Dearborn Streets between First Avenue S. and E. Marginal Way S., which would connect with sidewalks on E. Marginal Way S. but not directly to the Port Side Pedestrian/Bike Trail, due to the BNSF tail track. Pedestrian crossings of SR 99 and Alaskan Way S. would include S. Dearborn Street, the north side of S. Charles Street, S. Royal Brougham Way/h-shaped overcrossing, and S. Atlantic Street.

Under the New Dearborn Intersection option, S. Charles Street does not extend west to the northbound SR 99 off-ramps because of the location of the portals for the SR 99 northbound on-ramps and the southbound off-ramps that extend farther north than they do under the New Dearborn and Charles Intersections option. Therefore, the City Side Trail would continue northward unimpeded past S. Charles Street, transitioning to a wide plaza as it approaches S. Dearborn Street. North of S. Dearborn Street, the City Side Trail would be as described under the previously discussed option, and would split to either side of the south tunnel operations building, before rejoining at S. King Street. Due to the SR 99 northbound on-ramp and southbound off-ramp locations, the sidewalk system on S. Charles Street would not connect to E. Marginal Way S. Pedestrian crossings of the SR 99 ramp system would be at S. Dearborn Street, S. Royal Brougham Way/h-shaped overcrossing, and S. Atlantic Street. As was noted for the New Dearborn and Charles Intersections option, these sidewalk facilities would not directly connect to the Port Side Pedestrian/Bike Trail due to the BNSF tail track.

New Dearborn and Charles Intersections Option



New Dearborn Intersection Option



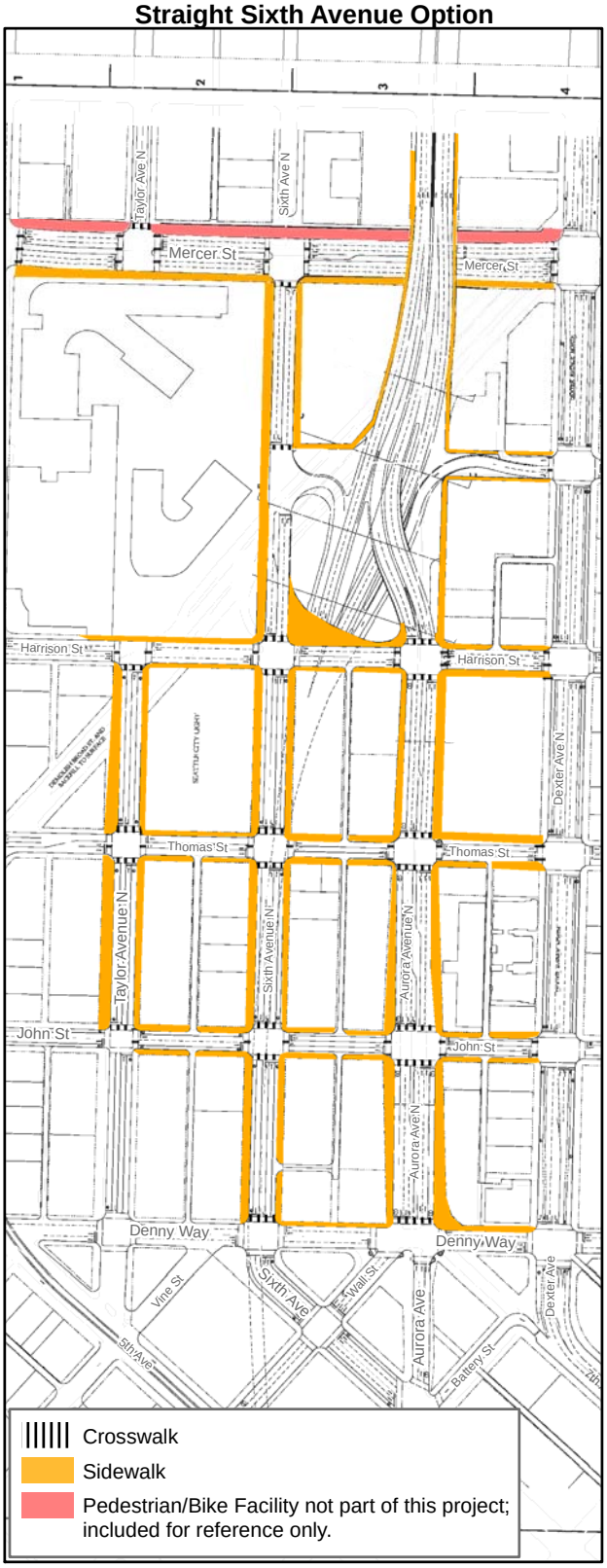
City Side Trail
Port Side Pedestrian/Bike Trail*
Sidewalk
Sidewalk (Other)*
|||||| Crosswalk

** Not part of this project. Included for reference only.*

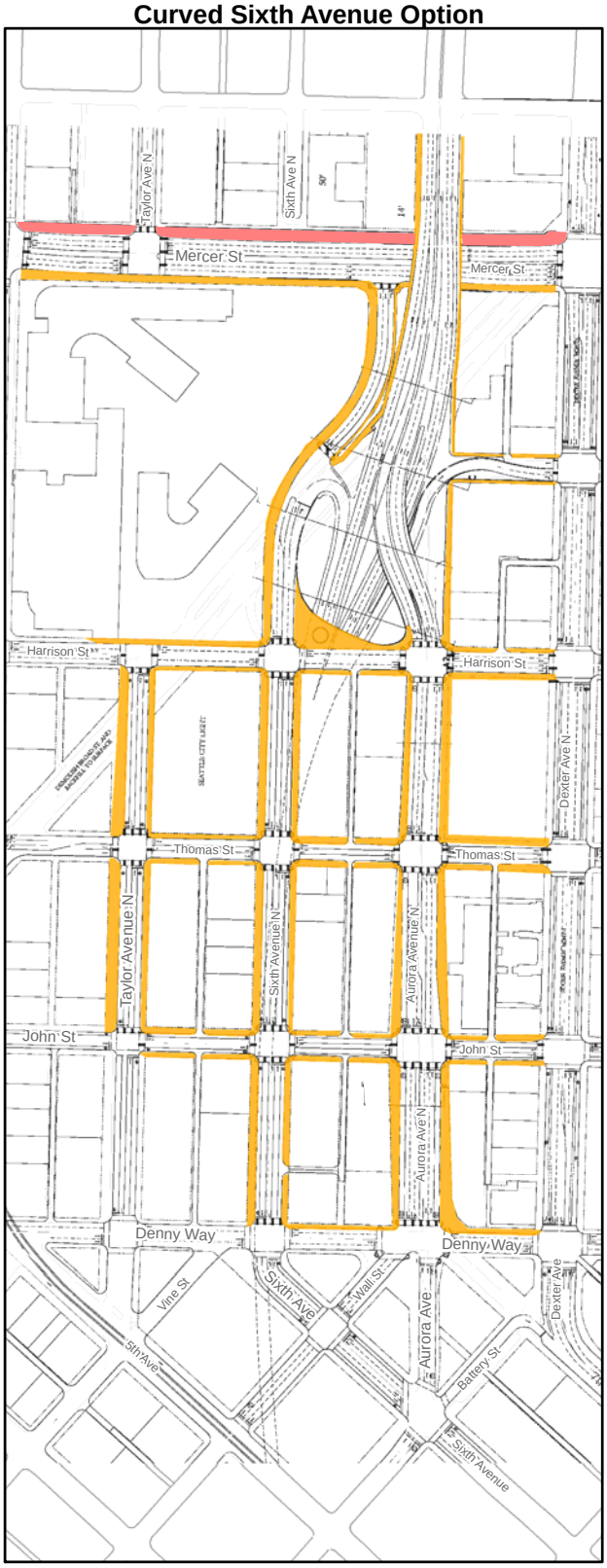
0 200 400 600 Feet

Exhibit 5-45
South Portal Pedestrian and Bicycle Facilities

Straight Sixth Avenue Option



Curved Sixth Avenue Option



N

0 200 400 600 Feet

Exhibit 5-46
North Portal Pedestrian and Bicycle Facilities

Waterfront Area

The Marion Street pedestrian bridge would be reconstructed after the removal of the viaduct to help maintain elevation for ferry passenger movements between the upper level of the ferry and First Avenue S.

The existing Lenora Street crossing of the SR 99 facility is grade-separated (Lenora Street dead-ends under the elevated SR 99 roadway) with a connection to a public stairway and elevator that allows pedestrians to access the east side of Alaskan Way. Under the Bored Tunnel Alternative, Lenora Street would connect with a new four-lane Elliott/Western Connector roadway. The Elliott/Western Connector would include a sidewalk on both sides of the roadway and would connect to Lenora via an at-grade intersection. The at-grade intersection of Lenora Street and the Elliott/Western Connector would include pedestrian crosswalks on the south and east intersection approaches.

North Portal Area

North of the Battery Street Tunnel, the Bored Tunnel Alternative would construct new crossings over SR 99 at John, Thomas, and Harrison Streets. Mercer Street would be widened and modified for two-way operations, and reconstruction of SR 99 would allow for improved sidewalk facilities. In addition, Broad Street would be closed and backfilled to allow the street grid west of SR 99 to be connected from approximately Fifth Avenue N. to Ninth Avenue N. A new Sixth Avenue N. would be provided between Harrison and Mercer Streets.

The new crossings at John, Thomas, and Harrison Streets would include approximately 10-foot-wide sidewalks on both sides. On the north side of Mercer Street there would be 25 feet for bicycle and pedestrian pathways. A sidewalk would also be located along the south side of Mercer Street.

The Straight Sixth Avenue option would provide the ability for pedestrians traveling on Sixth Avenue N. to connect to the combined pedestrian and bicycle trail on the north side of the redesigned Mercer Street.

The Curved Sixth Avenue option would not allow for pedestrian crossings of Mercer Street at the intersection of Sixth Avenue N. and Mercer Street. Under the Curved Sixth Avenue option, pedestrians would be required to cross Mercer Street at either Taylor Avenue N. or Dexter Avenue N., depending on the pedestrian's desired starting point and destination.

5.9.2 SR 99 Corridor Effects on Pedestrian Mobility and Access

In the south portal area, the Bored Tunnel Alternative's addition of sidewalks as part of the new cross street connections and the City Side Trail would improve pedestrian mobility and access between the stadium and waterfront areas, as well

as connectivity to regional facilities to the north. Of the two connection options, the New Dearborn and Charles Intersections option provides additional pedestrian facilities and an additional pedestrian crossing of the SR 99/Alaskan Way S./E. Marginal Way S. via sidewalks on S. Charles Street.

North of the Battery Street Tunnel, Bored Tunnel Alternative improvements that would provide connections across SR 99 at John, Thomas, Harrison, and Mercer Streets would dramatically increase pedestrian safety and mobility across SR 99 in the Seattle Center and South Lake Union areas and greatly improve the pedestrian experience. The Republican Street off-ramp would disrupt pedestrian flow along SR 99, similar to the disruption caused by the northbound off-ramp to Mercer Street today.

Of the two options under consideration in the north portal area, the Straight Sixth Avenue option would provide better mobility and access for pedestrians because it would provide crosswalks on all sides of a signalized intersection, and it would provide an additional access point to the combined bicycle and pedestrian facility on the north side of Mercer Street. The Curved Sixth Avenue option would not provide pedestrian access across Mercer Street at Sixth Avenue N. and may require out of direction travel for pedestrians who are unaware of the crossing restriction.

5.10 Bicycles

Key Findings

- In the south portal area, the City Side Trail, a dedicated pedestrian and bicycle path immediately east of the SR 99 ramp system would provide an off-street bicycle facility for all levels of cyclists, as well as an extension of the existing combined pedestrian/bicycle trail in the central waterfront area.
- The Mercer Street undercrossing would include a combined bicycle and pedestrian pathway on the north side of the roadway. This off-street facility would provide cyclists with considerably improved east-west mobility and rider experience in the Seattle Center/South Lake Union area. In addition, connection of the street grid at John, Thomas, and Harrison Streets would considerably enhance overall connectivity and accessibility for cyclists.
- The Straight Sixth Avenue option for the extension of Sixth Avenue N. would provide cyclists with an additional access point to the combined bicycle and pedestrian facility on the north side of the redesigned Mercer Street. The Curved Sixth Avenue option would not provide this additional access.

5.10.1 2015 Existing Viaduct

Bicycle facilities with the 2015 Existing Viaduct are expected to be largely the same as discussed for existing conditions, with the exception of the construction of the Lake to Bay Trail elements of bicycle lanes on Valley and Roy Streets between Fairview and Dexter Avenues N. and on Ninth Avenue N. between Valley and Mercer Streets that would be completed as part of the Mercer East Project. The City of Seattle will also have completed the construction of a new bicycle/ pedestrian overpass connecting Uptown to the waterfront at Thomas Street. No other substantial additional bicycle facilities are anticipated to be constructed by the City of Seattle within the project area other than those that are being completed as part of the S. Holgate Street to S. King Street Viaduct Replacement Project.

5.10.2 2015 Viaduct Closed (No Build Alternative)

As noted for the 2015 Existing Viaduct, no substantial additional bicycle facilities are anticipated to be constructed by the City of Seattle within the project area. However, a key difference between the existing conditions, the 2015 Existing Viaduct, and the 2015 Viaduct Closed (No Build Alternative) is the expected increase in vehicle traffic on surface streets through downtown Seattle. With the viaduct closed, traffic using Alaskan Way to enter downtown streets could conflict with the bicycle trail on the east side of Alaskan Way because turning vehicles increase the potential for conflicts. Bicyclists riding in the street or within marked bicycle lanes may face increased potential for conflicts with vehicles given the higher volume of traffic, particularly along Dexter Avenue N., Alaskan Way, and E. Marginal Way S.

5.10.3 Bored Tunnel Alternative

South Portal Area

A new combined pedestrian/bicycle trail (City Side Trail) would provide an additional north-south bicycle facility in the south portal area, which would be complementary to the Port Side Pedestrian/Bike Trail adjacent to the Port of Seattle properties to the west. The City Side Trail is an extension of the trail constructed as part of the S. Holgate Street to S. King Street Viaduct Replacement Project that runs adjacent to the East Frontage Road south of S. Royal Brougham Way. The combined pedestrian/bicycle facility would continue northward on the east side of the SR 99 ramp system to S. King Street. The trail would vary in width between S. Royal Brougham Way and S. King Street, but the exact width has not yet been determined.

North Portal Area

Bicycle facilities in the northern portion of the project area include bicycle and pedestrian pathways on the north side of Mercer Street. In addition to these

facilities, the new John, Harrison, and Thomas Street crossings of Aurora Avenue would provide additional connectivity and mobility for cyclists in the Seattle Center/South Lake Union area. The John Street crossing of Aurora Avenue may also include bicycle lanes in both directions.

The Straight Sixth Avenue option would provide the ability for cyclists riding on Sixth Avenue N. to connect to the combined bicycle and pedestrian trail on the north side of the redesigned Mercer Street. The Curved Sixth Avenue option would allow only right-in and right-out movements to and from Sixth Avenue N. to eastbound Mercer Street. No access to the westbound Mercer Street or the north side of Mercer Street and the combined pedestrian-bicycle facility is assumed to be provided at Sixth Avenue N. with the Curved Sixth Avenue option.

5.10.4 Bicyclist Mobility and Access

In the southern portion of the project area, the dedicated, off-street combined pedestrian/bicycle trail provides additional bicycle facilities and connections in the stadium and waterfront areas. These facilities would be complementary to the Port Side Pedestrian/Bike Trail that will be constructed as part of the S. Holgate Street to S. King Street Viaduct Replacement Project, which is on the western boundary of the project area adjacent to the Port of Seattle facilities.

The shared-use facility on Mercer Street would increase bicycle connections across SR 99 and improve rider safety and overall experience in the Seattle Center/South Lake Union area. These enhancements to bicycle mobility would be further improved if bicycle lanes are included as part of the John Street crossing of SR 99. It should be noted that Dexter Avenue N. is projected to see an increase in automobile traffic, and the northbound off-ramp to Republican Street would likely experience higher usage than the existing off-ramp to Mercer Street largely due to improved access to westbound Mercer Street and other cross streets. The combination of these two changes may affect cyclists' comfort level and use of the Dexter Avenue bicycle lanes and increase the potential for conflict between cyclists and vehicle traffic.

Of the two Sixth Avenue N. extension options under consideration, the Straight Sixth Avenue option would provide an additional access point from the south to the combined bicycle and pedestrian facility on the north side of Mercer Street.

5.11 Ferries

Colman Dock, located on Pier 50 and 52 on Seattle's downtown waterfront, is the Seattle terminus for the Washington State Ferries. The passenger-only service from Vashon Island, operated by King County, also uses Colman Dock, while the service from West Seattle uses Pier 55 in the central waterfront. Access to Colman

Dock is provided from Alaskan Way at Yesler Way, and exits are provided to Alaskan Way at Yesler Way and Marion Street.

Travel model results and traffic analysis tools were used to determine potential effects on vehicles exiting or entering Colman Dock. Signal operations for the ferries were assumed to remain similar to current conditions for the future (i.e., vehicles exiting the ferries would preempt north-south traffic on Alaskan Way for 180 seconds).

Key Findings

With the 2015 Viaduct Closed (No Build Alternative), volumes on Alaskan Way would nearly double in the vicinity of the Seattle Ferry Terminal. This would result in very poor operating conditions for vehicles entering and exiting Colman Dock, especially in the peak periods.

In peak periods for the 2015 and 2030 Project, overall LOS at the Alaskan Way and Marion Street and Alaskan Way and Yesler Way intersections would be similar to the 2015 Existing Viaduct.

As with existing ferry operations, service disruptions due to issues with vessels or terminals, or demand spikes associated with peak summer holiday traffic, would likely still cause some disruption to traffic operations along Alaskan Way in the vicinity of Marion Street and Yesler Way. Vehicles trying to enter Colman Dock may exceed the storage capacity of the left-turn pocket in the current design and affect northbound through traffic on Alaskan Way.

5.11.1 2015 Existing Viaduct

Although the delay and LOS varies some by movement, overall the intersections at Alaskan Way and Marion Street and Alaskan Way and Yesler Way perform well (LOS C or better) in both peak periods.

5.11.2 2015 Viaduct Closed (No Build Alternative)

With the viaduct closed, traffic volumes on Alaskan Way would nearly double in the vicinity of the Seattle Ferry Terminal. This would result in very poor operating conditions for vehicles entering and exiting Colman Dock, especially in the peak periods.

5.11.3 2015 and 2030 Project

The intersections at Alaskan Way and Marion Street and Alaskan Way and Yesler Way would continue to perform well (LOS D or better) in both peak periods even with the anticipated increase in background traffic over that time period. As with existing ferry operations, however, service disruptions due to issues with vessels or terminals or demand spikes associated with peak summer holiday traffic

would likely still cause some disruption to traffic operations along Alaskan Way near Marion Street and Yesler Way. In these instances, vehicles trying to enter Colman Dock may exceed the storage capacity of the left-turn pocket in the current design and affect northbound through traffic on Alaskan Way.

5.12 Safety

Corridor design aspects and collision history are reviewed in this section to compare effects and benefits related to safety.

Key Findings

Restoration of the street grid between Denny Way and Mercer Street in the Bored Tunnel Alternative would provide substantially improved pedestrian and bicycle routes across SR 99, which is expected to decrease the number of pedestrian-vehicle collisions in this area (previously identified as a pedestrian accident location).

North of the Battery Street Tunnel, the Bored Tunnel Alternative would consolidate access points, eliminate conflicting weaving movements that exist currently, and provide acceleration and deceleration lanes and could potentially decrease collision rates on SR 99 between Denny Way and Mercer Street.

The Bored Tunnel Alternative would decommission the Battery Street Tunnel and the associated northbound on-ramp and southbound off-ramp (the Battery Street Tunnel ramps), as well as the Elliott/Western ramps, eliminating areas with higher than average collision rates at the ramps and within the Battery Street Tunnel.

The Bored Tunnel Alternative would replace the current midtown ramps at Seneca and Columbia Streets with new ramps in the stadium area connecting to Alaskan Way—this change would eliminate the current diverging, merging, and weaving movements associated with the Seneca and Columbia Street ramps that lead to queuing and collisions on the mainline.

The Bored Tunnel Alternative would eliminate the identified northbound collision analysis location at the south end of the viaduct, roughly between S. Massachusetts Street and S. Royal Brougham Way, through improved design of the replacement roadway facility.

The Bored Tunnel Alternative is expected to increase the total volume of traffic on Alaskan Way surface street, which could increase the number of conflicts between vehicles, pedestrians, and cyclists.

5.12.1 2015 Existing Viaduct

Safety aspects of the 2015 Existing Viaduct would be similar to those discussed in Chapter 4, Affected Environment (existing conditions), because the SR 99 roadway would remain as it is currently configured. In general, overall safe operation of the facility would be expected to deteriorate due to higher future volumes and increasing congestion. Additionally, with the increasing residential, commercial, and retail development occurring in South Lake Union and the area immediately east of Seattle Center, the challenges associated with pedestrian access north of the Battery Street Tunnel would increase.

5.12.2 2015 Viaduct Closed (No Build Alternative)

With the 2015 Viaduct Closed (No Build Alternative), operations on I-5 and downtown surface streets would deteriorate considerably as drivers previously using the viaduct would have to divert to these other roadways. The increase in volumes and related congestion on I-5 and the downtown surface streets is expected to increase the potential for conflicts between vehicles, pedestrians, and cyclists.

5.12.3 2015 and 2030 Project (Bored Tunnel Alternative)

Exhibits 5-47 and 5-48 highlight the updated design features for the Bored Tunnel Alternative, which are discussed in the following sections.

Exhibit 5-47. SR 99 Mainline Design Features

Mainline Design Features	Location	Existing Facility	Bored Tunnel Alternative
Access control	Stadium area	Managed vehicle access (access by ramp connections only)	Managed vehicle access (access by ramp connections only)
	Midtown	Managed vehicle access (access by ramp connections only)	Managed vehicle access (access by ramp connections only)
	North	Partially managed (right-on, right-off) access	South of Mercer Street – managed vehicle access (access by ramp connections only); north of Mercer Street – partially managed (right-on, right-off) access
Maximum grade (up or down)	Stadium area	5%	6.5%
	Midtown	4%	4%
	North	5%	4.4%
Lane width	Stadium area	12–13.5 feet	11–12 feet
	Midtown	9.5–13 feet	11 feet
	North	10–13 feet	11–12 feet

Exhibit 5-47. SR 99 Mainline Design Features (continued)

Mainline Design Features	Location	Existing Facility	Bored Tunnel Alternative
Multilevel	Stadium area	Multilevel	Multilevel/barrier
	Midtown	Multilevel	Multilevel
	North	Barrier	Multilevel/barrier
Inside shoulder width	Stadium area	1 foot	2–4 feet
	Midtown	1 foot	2 feet (SB) 6 feet (NB)
	North	1 foot	8 feet (SB) 8 feet (NB)
Outside shoulder width	Stadium area	1 foot	8–12 feet
	Midtown	1 foot	6 feet (SB) 2 feet (NB)
	North	0 feet (sidewalks)	8 feet (SB) 8–10 feet (NB)
Pedestrian accommodation	Stadium area	Pedestrians prohibited; grade-separated crossings provided	Pedestrians prohibited; grade-separated crossings provided
	Midtown	Pedestrians prohibited on the viaduct	Pedestrians prohibited in the tunnel
	North	Sidewalks provided on both sides; undercrossings at Broad and Mercer Streets	Pedestrians prohibited in tunnel/cut to approximately Republican Street; grade-separated crossings provided

NB = northbound
SB = southbound

Exhibit 5-48. SR 99 Ramp Design Features

Ramp Design Features	Location	Existing Facility	Bored Tunnel Alternative
Maximum grade (up or down)	Stadium area	6%	6%–7%
	Midtown	8%	No midtown ramps provided
	North	2%–3%	6%
Outside shoulder width	Stadium area	6 feet	2–8 feet
	Midtown	1 foot	No midtown ramps provided
	North	N/A	4–10 feet
Location of merged on-ramps (left or right side)	Stadium area	N/A	NB on-ramp
	Midtown	Battery Street Tunnel NB on, Columbia Street SB on	None
	North	N/A	SB on-ramp

Exhibit 5-48. SR 99 Ramp Design Features (continued)

Ramp Design Features	Location	Existing Facility	Bored Tunnel Alternative
Ramp design limitations (short deceleration length, limited vehicle storage at termini, or high curvature)	Stadium area	N/A	Potential modified ramp gore design
	Midtown	Seneca Street NB off, Columbia Street SB on, Western Avenue NB off, Western Avenue NB on, Western Avenue SB off	No midtown ramps provided
	North	Denny Way SB off, Broad Street SB off, Mercer Street NB off	Shortened acceleration lane length on the SB on-ramp from Sixth Avenue N.; Reduced gore width on the SB off-ramp to Harrison Street

N/A = not applicable
NB = northbound
SB = southbound

Mainline Design Features

SR 99 is currently a controlled-access facility within the project area and would remain a controlled-access facility. Between S. Royal Brougham Way and Republican Street, SR 99 would be a full limited-access facility. The access points provided by the Bored Tunnel Alternative would be improved through better design of the ramps, consolidation of access points, and elimination of many of the right-turn-on, right-turn-off access points on Aurora Avenue.

Exhibit 5-47 summarizes the design features of the Bored Tunnel Alternative relative to the existing facility. The design of the Bored Tunnel Alternative would provide 11- to 12-foot-wide lanes along the length of SR 99 through the project area, providing drivers with more consistent lane widths and eliminating the excessively narrow (9.5- to 10-foot-wide) and wide (up to 13.5-foot-wide) lanes that exist on the current viaduct. Inside and outside shoulder widths on the Bored Tunnel Alternative would also be considerably improved compared to those on the viaduct and within the Battery Street Tunnel today. This would provide greater clearance between traffic and roadside barriers and additional space on the side of the roadway for disabled vehicles and emergency operations. The existing viaduct typically provides 1 foot for both inside and outside shoulder width, whereas the Bored Tunnel Alternative would provide 2-foot and 6-foot-wide shoulders in the new tunnel, and generally 8 to 10 feet elsewhere. While shoulders inside the tunnel would be improved compared to the viaduct today, they still would be narrower than prescribed by full limited-access facility standards.

In the South Lake Union area, John, Thomas, and Harrison Streets would be connected over SR 99, which would remain in a tunnel or cut section. The redesigned Mercer Street crossing would provide additional pedestrian crossings of SR 99 and physical separation of the corridor from the surrounding street grid. This

is expected to reduce or virtually eliminate the occurrence of illegal pedestrian crossings of the corridor, which have historically led to collisions involving pedestrians on the Aurora Avenue segment north of the Battery Street Tunnel.

Ramp Design Features

Conflicts between entering, exiting, and through traffic contribute to high collision rates on some SR 99 segments today. The Bored Tunnel Alternative would consolidate access locations to fewer ramps and improve the geometric characteristics of these ramps, which is expected to reduce the rate of collision on the mainline as well as at ramp locations.

As shown in Exhibit 5-48, ramp design improvements as part of the Bored Tunnel Alternative mainly address design limitations of short deceleration lengths, limited vehicle storage, and high curvature.

The Bored Tunnel Alternative includes several ramps with design limitations. The northbound on-ramp in the stadium area would have a reduced merge length to the mainline. In the north end, there would be shortened acceleration lane length on the southbound on-ramp from Sixth Avenue N. and reduced gore width on the southbound off-ramp to Harrison Street. However, these ramps would provide improved overall design as compared to the existing facility and safe operations.

Surface Streets

With the 2015 and 2030 Project, additional traffic would use Alaskan Way, especially between the Alaskan Way S. ramps and Spring Street. The increase in volumes is expected to increase the potential for conflicts between vehicles, pedestrians, and cyclists relative to the 2015 Existing Viaduct along Alaskan Way. Conversely, traffic concentrations at former ramp locations downtown (Seneca Street and Columbia Street) would decrease, reducing the potential conflicts at those locations.

5.13 Event Traffic

Key Findings

Phase 2 of the SR 519 Intermodal Access Project has improved stadium area access to and from the east. The S. Holgate Street to S. King Street Viaduct Replacement Project will improve stadium area access to and from the south, with or without the Alaskan Way Viaduct Replacement Project and Program elements in place. Improved ramp connections as a result of these south end projects will enhance overall capacity for events by providing more direct access to and from regional transportation facilities (SR 99, I-90, I-5, etc.).

The convergence of additional traffic streams into and out of the stadium area (due to the new ramp connections) for the 2015 Existing Viaduct, the 2015 and 2030 Project,

and the 2015 and 2030 Program may require extensive traffic management measures for key arterials near the stadiums prior to and following large events.

Improved access to and from SR 99 near the north portal and added network redundancy across SR 99 for the 2015 and 2030 Project would likely result in reduced congestion prior to and following Seattle Center events, compared to the 2015 Existing Viaduct.

Overall levels of traffic congestion are similar for the 2015 Existing Viaduct, the 2015 and 2030 Project, and the 2015 and 2030 Program. The 2015 Viaduct Closed (No Build Alternative) shows higher levels of congestion compared to other modeled conditions.

5.13.1 South Portal Area

By the 2015 and 2030 horizon years, sporting and other major events at Safeco Field and Qwest Field will likely continue to draw large crowds and result in high concentrations of traffic movements into and out of the stadium area prior to and following events. Regardless of the regional connections in place, vehicular and pedestrian-related congestion associated with such events would be managed in a manner similar to current practices in terms of detours, traffic control, and turning movement restrictions. Event-related traffic associated with the stadium facilities in the south end are discussed qualitatively below in the context of the four applicable modeled conditions: 2015 Existing Viaduct, 2015 Viaduct Closed (No Build Alternative), 2015 Project, and 2030 Project.

2015 Existing Viaduct

The roadway network in the south end for the 2015 Existing Viaduct assumes the completion of two major interchange/access projects before the implementation of the Alaskan Way Viaduct Replacement Project: (1) the S. Holgate Street to S. King Street Viaduct Replacement Project, and (2) the SR 519 Intermodal Access Project, Phase 2. The SR 519 Intermodal Access Project, which was completed in spring 2010, has already improved the connection between S. Atlantic Street and I-90/I-5 to accommodate more direct two-way access for stadium area traffic to and from the east. It also converted S. Royal Brougham Way to a local access arterial with a loop ramp section connecting Third Avenue S. to S. Royal Brougham Way on the east side of the BNSF rail line. With the completion of the S. Holgate to S. King Street Viaduct Replacement Project, roadway connections in the south end to and from regional facilities such as SR 99 are expected to be substantially improved. The S. Holgate Street to S. King Street Viaduct Replacement Project will introduce new ramps to and from the south on SR 99, which will add a new level of stadium access that is not provided under existing conditions.

With these new connections in place, traffic congestion during events will likely be reduced compared to pre-2015 Existing Viaduct conditions (i.e., without the

S. Holgate Street to S. King Street Viaduct Replacement Project and SR 519 Intermodal Access Project) due to more direct access to major roadway facilities and generally higher levels of ingress and egress capacity. Improved options for local traffic circulation and regional access will be provided, while opportunities for traffic control and management on key arterials will be maintained.

2015 Viaduct Closed (No Build Alternative)

With the 2015 Viaduct Closed (No Build Alternative), traffic conditions during events in the south end would be negatively affected due to the removal of SR 99 access to and from the north. While connections to and from I-5 would be maintained for regional access, these routes would become more congested as drivers increasingly rely on them to avoid delays on the local street network. North-south arterials in the downtown core such as First and Fourth Avenues would also experience greater levels of demand and congestion as drivers use these routes to continue north to communities such as Ballard and Green Lake.

2015 Project

Whereas new roadway connections in the south end have been and will be introduced by the SR 519 Intermodal Access Project and the S. Holgate Street to S. King Street Viaduct Replacement Project, respectively (as described previously), additional changes to the street system in the stadium area would occur when the Alaskan Way Viaduct Replacement Project is completed.

Roadway elements that are specific to the Bored Tunnel Alternative include the following:

- A new surface frontage road west of First Avenue S. and east of SR 99 (known as the East Frontage Road) would be introduced and would provide access to and from the north.
- First Avenue S. ramps to and from the north (SR 99) would be removed but replaced by similar connections to and from the north off of S. Royal Brougham Way and the new East Frontage Road.
- The southbound weaving section between the Columbia Street on-ramp and First Avenue S. off-ramp would be removed due to the new SR 99 ramp reconfiguration (e.g., removal of Columbia southbound on-ramp).
- New intersections along First Avenue S., Alaskan Way S. (extended segment), and E. Marginal Way S. would be introduced between S. Royal Brougham Way and S. King Street as a result of two design options near the south portal area.

These roadway changes would likely improve circulation and reduce overall congestion levels at critical intersections near the stadiums during large events by providing more direct access to regional facilities such as SR 99 and I-5. In addition, due to less reliance on First Avenue S. for access to and from the north in the

modified roadway network, traffic levels on First Avenue S. between S. Royal Brougham Way and S. King Street may be reduced before and after events.

However, SR 99 ramp access at S. Charles Street (specifically to and from the south) may result in some increases in traffic demand on First Avenue S. north of S. Royal Brougham Way, thereby counteracting potential reductions in demand due to the ramp reconfigurations. Nonetheless, the overall reduction in circulation needed to access regional facilities should result in more efficient distribution of traffic into and out of the stadium area.

Similar opportunities for short-term traffic management and detour routing would be maintained with the new roadway network. Likewise, pedestrian movements would be managed at key crossing points near the stadiums and on major arterials similar to current practices.

The differences in access and general circulation for events between the two design options near the south portal would not be substantial based on operational analysis findings for typical weekday peak period conditions. The second new cross street (S. Charles Street) for the New Dearborn and Charles Intersections option provides some added east-west network redundancy compared to the New Dearborn Intersection option for event traffic but would not result in noticeable benefits in terms of event-related congestion management.

2030 Project

Overall event-based traffic demands for the 2030 Project would likely increase over 2015 Project levels, primarily due to background increases in commute and non-commute peak hour volumes by the 2030 horizon year. As such, sporting and other major events at Safeco Field and Qwest Field that occur near or around afternoon commute periods by 2030 would experience more pronounced levels of congestion compared to 2015 conditions. However, given that the roadway network would be consistent between the 2015 Project and the 2030 Project s in terms of improved access to regional facilities, traffic management practices in place for the 2015 Project should be reasonably effective by the 2030 horizon.

As with the 2015 Project, the two south portal options for the 2030 Project would not be substantially different in terms of accommodating event traffic. The two cross streets included for the New Dearborn and Charles Intersections option would not result in noticeable benefits compared to the New Dearborn Intersection option in terms of handling event-related congestion or opportunities for managing traffic circulation and access.

5.13.2 North Portal Area

As discussed in Chapter 4, Affected Environment, event traffic related to Seattle Center currently relies on Mercer Street, Denny Way, Broad Street, Elliott Avenue,

Western Avenue, and various connections to and from SR 99 for ingress and egress prior to and following sporting events, concerts, festivals, etc. As Seattle Center aims to attract larger numbers of visitors in the future, attendance levels will generally increase and be accompanied by larger background demands on local streets and regional facilities such as SR 99 and I-5.

No major network changes are anticipated in the north end for the 2015 Existing Viaduct outside of Mercer Street conversion to two-way operations east of Ninth Avenue N. Also, the 2015 Viaduct Closed (No Build Alternative) would not include any appreciable differences in network characteristics beyond existing conditions other than relegating the central waterfront viaduct section of SR 99 unavailable for use. However, substantial modifications to the local street system are proposed with the 2015 and 2030 Project, which may improve access to and from SR 99 as well as across SR 99. Changes associated with the Bored Tunnel Alternative would add redundancy in the street grid and potentially reduce congestion during major events. Two alignment options for Sixth Avenue N. from Harrison Street to Mercer Street are also included as part of the north end project elements.

Event-related traffic associated with Seattle Center is discussed qualitatively below for the four applicable modeled conditions: 2015 Existing Viaduct, 2015 Viaduct Closed (No Build Alternative), 2015 Project, and 2030 Project.

2015 Existing Viaduct

With the 2015 Existing Viaduct, the street network near Seattle Center, including connections to and from SR 99, is not expected to change. However, the Mercer East Project is assumed to be completed, which converts Mercer Street into a two-way arterial between Fairview Avenue N. and Dexter Avenue N. At-grade connections to and from SR 99 are maintained, and the northbound off-ramp to Mercer Street and Dexter Avenue N. is also retained.

With no new connections in place to accommodate event trips, traffic congestion during Seattle Center events would be similar to pre-2015 Existing Viaduct conditions. Current (existing conditions) issues related to event-based demand concentrations and capacity constraints would need to be addressed, but with slightly greater requirements in terms of traffic control, directional signage, lane restrictions, etc. due to higher background traffic levels.

2015 Viaduct Closed (No Build Alternative)

Event traffic at Seattle Center for the 2015 Viaduct Closed (No Build Alternative) would present similar challenges as the 2015 Existing Viaduct in terms of high concentrations of traffic prior to and following events. Due to closure of the viaduct south of the Battery Street Tunnel, however, traffic interactions on SR 99 in the South Lake Union area would be more concentrated, and Seattle Center access via the Elliott/Western ramps would no longer be available. As a result, access to and

from the SR 99 corridor between Denny Way and Aloha Street would be compromised to some degree. Nonetheless, requirements for traffic control and management, directional signage, and potential lane restrictions would also be similar to the 2015 Existing Viaduct and existing conditions, although greater use of directional signage and physical channelization may be needed.

2015 Project

The proposed roadway elements with the 2015 Project represent substantial changes to the street network near Seattle Center and areas adjacent to the South Lake Union neighborhood. Key elements associated with the Bored Tunnel Alternative include the following:

- Aurora Avenue would be rebuilt as a multilane surface roadway between Denny Way and Harrison Street.
- Connecting roadways across SR 99 at John, Thomas, and Harrison Streets.
- Removal of the Elliott Avenue and Western Avenue ramps to and from the north and south.
- SR 99 ramps at Harrison Street would connect to Aurora Avenue.
- SR 99 ramps at Republican Street to and from the south.
- SR 99 access maintained at Roy Street and Aloha Street (both directions).
- Two-way Mercer Street from Dexter Avenue N. to Fifth Avenue N. (In the 2015 Existing Viaduct, Mercer Street is converted to two-way from Fairview Avenue N. to Dexter Avenue N.)
- Two alignment options for Sixth Avenue N. (Curved Sixth Avenue and Straight Sixth Avenue).

With greater redundancy in the street network provided by the Bored Tunnel Alternative, improved opportunities for traffic distribution across a more defined grid would be possible, thereby spreading traffic flow over a wider range of arterials and connectors. This would result in greater potential to reduce congestion on major arterials such as Mercer Street by providing alternative east-west routes and better circulating event trips to and from parking garages on the periphery of Seattle Center. While the capacity of Mercer Street to handle egress traffic after events would be reduced to some degree with the conversion of Mercer Street to two-way operations (compared to the original one-way system), the added east-west connectors (John, Thomas, and Harrison Streets) and access improvements to and from SR 99 should serve event traffic more efficiently overall. These benefits would be particularly noticeable for northbound access to Seattle Center prior to events. The two-way configuration of Mercer Street may also provide travel time benefits to traffic from I-5 heading toward Seattle Center before events.

In addition, the surface Aurora Avenue configuration would allow better pedestrian access to Seattle Center from SR 99/Aurora Avenue and across Aurora Avenue, including improved access for those pedestrians who take transit.

The two Sixth Avenue N. alignment options between Harrison Street and Mercer Street would not likely amount to major differences in event-related congestion along Mercer Street. However, due to restrictions on westbound left turns from Mercer Street to Sixth Avenue N. under the Curved Sixth Avenue option, greater use of Dexter Avenue N. for access to the Republican southbound on-ramp may result compared to the Straight Sixth Avenue option. This increase in left turn demand may result in higher turning movement delays from westbound Mercer Street to southbound Dexter Avenue N. and to Fifth Avenue N. This may be particularly noticeable prior to large events when through volumes are most pronounced. Conversely, the absence of this westbound left turn may benefit eastbound through movements *after events* since greater capacity could be allocated to outbound traffic traveling to the I-5 ramps at Fairview Avenue N.

2030 Project

Similar to the south end, peak hour commute and non-commute volumes by the 2030 horizon year would be higher compared to 2015 background traffic levels. As such, traffic related to events at Seattle Center by 2030, especially during afternoon commute periods, would experience more pronounced levels of congestion. However, given the added network redundancy provided by the Bored Tunnel Alternative (as described in the 2015 Project discussion), event-related traffic congestion levels for the 2030 Project would likely be lower than without the Bored Tunnel Alternative in place.

As with the 2015 Project, event-related congestion along Mercer Street would not be substantially different for the two Sixth Avenue N. alignment options. However, due to restrictions on westbound left turns from Mercer Street to Sixth Avenue N. in the Curved Sixth Avenue option, greater use of the left turn movement from westbound Mercer Street to southbound Dexter Avenue N. and to Fifth Avenue N. may add some delays to through traffic on Mercer Street compared to the Straight Sixth Avenue option. The absence of this westbound left turn may benefit eastbound through movements *after events*.

5.14 Potential Tolling Effects

The operational benefits and impacts of tolling for the bored tunnel facility will be investigated as part of a larger tolling study for the Program. Specific toll-based travel demand models are being developed and refined to assess potential levels of diversion that may occur due to various toll rates and user costs. This work will be included in the financial analysis for the Program, with the intent of determining potential levels of alternative funding. The results of the diversion analysis will be used to assess possible effects on non-SR 99 facilities and provide insight as to what traffic-related

mitigation measures (if any) may be needed to minimize or address the effects of tolling on the larger street network. See Chapter 9 of the Supplement Draft EIS for more information.

5.15 Potential 2040 Effects on Operational Performance

This section provides a qualitative discussion of the potential effect of year 2040 conditions on the Bored Tunnel Alternative's operational performance. Exhibit 5-49 shows projected land use in the central Puget Sound region by selected districts. Exhibits 5-50 and 5-51 show the projected growth in population and employment by district from 2005 to 2030 and from 2030 to 2040. Exhibit 5-52 provides a map of the selected districts. The districts that contain the majority of the expected SR 99 corridor users are the Greater Downtown, Northwest Seattle, and West Seattle, and to a lesser extent, the North and South Seattle districts. Generally speaking, the rate of growth for population and households in the corridor's primary market area is approximately the same between 2030 and 2040 as it is between 2005 and 2030, whereas growth in employment is expected to decrease somewhat. Nonetheless, the absolute increase in population and employment in the corridor travelshed between 2030 and 2040 is expected to be substantial and result in a commensurate increase in travel within the corridor.

Travel demand forecasts rely directly on household, population, and employment forecasts. Compared to 2030 projections, there would likely be a somewhat higher level of travel demand in 2040 in the SR 99 Bored Tunnel Alternative corridor. However, the rate of vehicle traffic growth between 2030 and 2040 would likely be less than the rate of land use growth for the reasons provided in the following paragraphs.

Transit mode share to and from downtown as well as within the Seattle city limits is expected to grow as Sound Transit Link LRT and King County RapidRide BRT expand and the roadway system becomes more congested, thereby encouraging higher usage of transit.

Population in the greater downtown area is expected to grow substantially over the next 40 years, resulting in a higher proportion of residents living closer to their jobs—hence, a higher proportion of workers that would either walk or take local transit to work.

Overall, while growth in land use in the areas primarily served by the Bored Tunnel Alternative are expected to grow from 2030 to 2040 by 6 to 7 percent on average, growth in vehicular trips through the bored tunnel is expected to be somewhat less due to the reasons outlined above. As a result, overall effects on operations of the bored tunnel beyond what is projected for 2030 are not expected to be substantial.

Exhibit 5-49. Regional Land Use Forecasts Summarized by District

District Name	Total Households (housing units)			Total Population (persons)			Total Employment (persons employed)		
	2005	2030	2040	2005	2030	2040	2005	2030	2040
Greater Downtown	42,400	75,400	90,900	70,800	116,900	137,600	280,800	354,200	370,700
Northwest Seattle	52,400	61,200	65,200	106,000	116,700	121,200	39,700	54,000	61,400
West Seattle	35,400	38,500	41,300	78,800	80,100	83,300	19,200	26,900	31,400
North Seattle	91,300	110,000	117,800	198,600	223,000	231,900	108,000	138,200	150,400
South Seattle	45,800	55,500	60,800	120,700	135,800	144,600	112,900	135,100	148,400
Snohomish Co. & Shoreline	277,500	421,200	485,500	737,400	1,037,200	1,154,800	251,300	370,100	428,700
East Side	203,500	286,900	320,300	515,900	668,500	721,900	343,000	493,500	540,300
S. King & Pierce Co.	513,300	716,100	815,000	1,350,800	1,748,400	1,923,000	592,800	793,000	906,100
Kitsap County	115,000	169,800	198,000	306,700	417,600	469,900	99,700	132,700	151,800
Regional Total	**1,376,500**	**1,934,600**	**2,194,800**	**3,485,700**	**4,544,200**	**4,988,100**	**1,847,400**	**2,497,700**	**2,789,300**

Source: PSRC 2006b.

Exhibit 5-50. Forecasted Land Use Growth Summarized by District

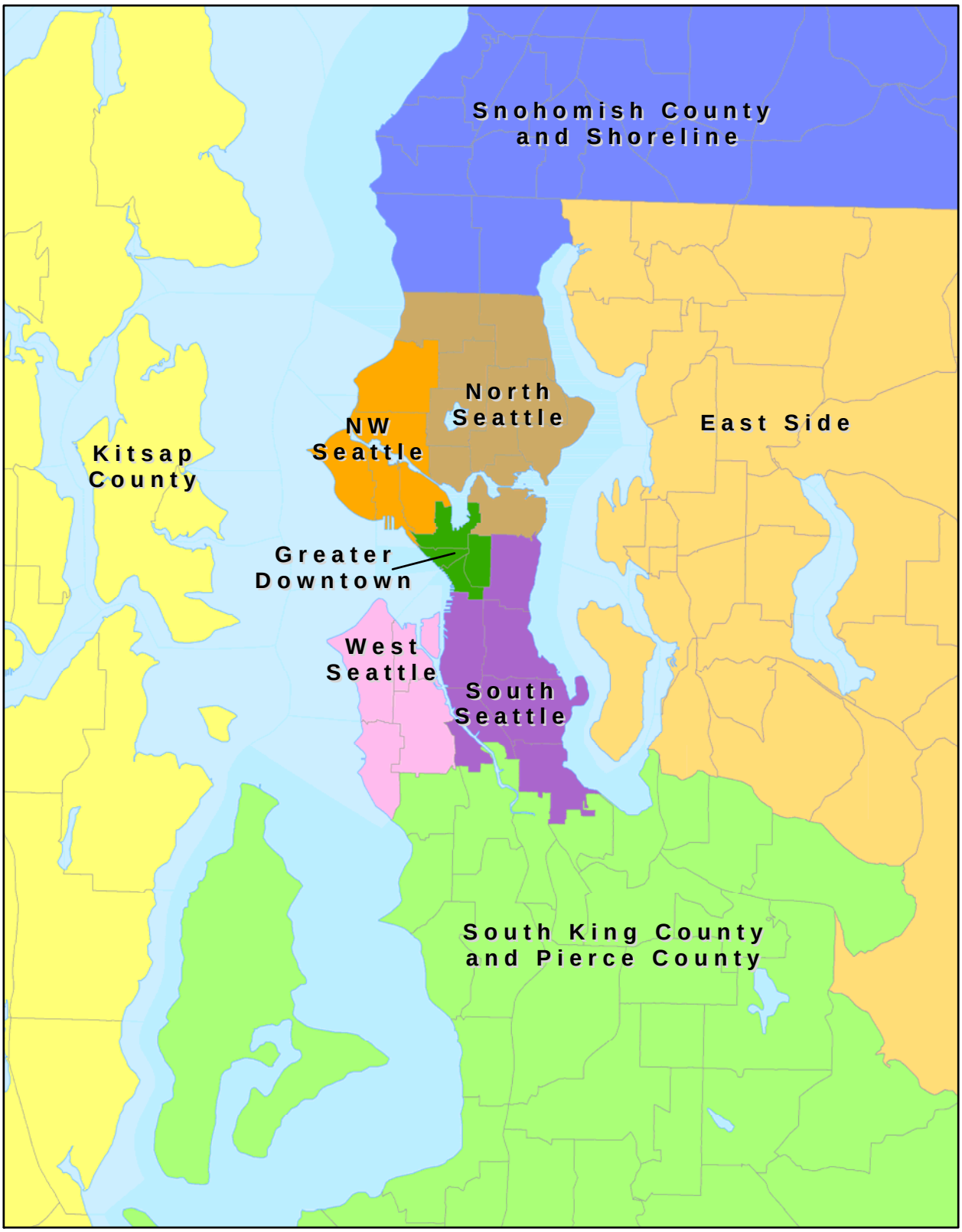
District Name	Household Growth		Population Growth		Employment Growth	
	2005–2030	2030–2040	2005–2030	2030–2040	2005–2030	2030–2040
Greater Downtown	33,000	15,500	46,100	20,700	73,400	16,500
Northwest Seattle	8,800	4,000	10,700	4,500	14,300	7,400
West Seattle	3,100	2,800	1,300	3,200	7,700	4,500
North Seattle	18,700	7,800	24,400	8,900	30,200	12,200
South Seattle	9,700	5,300	15,100	8,800	22,200	13,300
Snohomish Co. & Shoreline	143,700	64,300	299,800	117,600	118,800	58,600
East Side	83,400	33,400	152,600	53,400	150,500	46,800
S. King & Pierce Co.	202,800	98,900	397,600	174,600	200,200	113,100
Kitsap County	54,800	28,200	110,900	52,300	33,000	19,100
Regional Total	**558,100**	**260,200**	**1,058,500**	**443,900**	**650,300**	**291,600**

Source: PSRC 2006b.

Exhibit 5-51. Forecasted Land Use Growth, by Percentage, Summarized by District

District Name	Household Growth		Population Growth		Employment Growth	
	2005–2030	2030–2040	2005–2030	2030–2040	2005–2030	2030–2040
Greater Downtown	78%	21%	65%	18%	26%	5%
Northwest Seattle	17%	7%	10%	4%	36%	14%
West Seattle	9%	7%	2%	4%	40%	17%
North Seattle	20%	7%	12%	4%	28%	9%
South Seattle	21%	10%	13%	6%	20%	10%
Snohomish Co. & Shoreline	52%	15%	41%	11%	47%	16%
East Side	41%	12%	30%	8%	44%	9%
S. King & Pierce Co.	40%	14%	29%	10%	34%	14%
Kitsap County	48%	17%	36%	13%	33%	14%
Regional Total	**41%**	**13%**	**30%**	**10%**	**35%**	**12%**

Source: PSRC 2006b.



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Data Source: Puget Sound Regional Council, 2000.

Exhibit 5-52
Selected Districts for 2040
Land Use Comparison

5.16 Operational Mitigation

Because the operational effects of the Bored Tunnel Alternative would be comparable to those of the 2015 Existing Viaduct and substantially better than the ultimate Viaduct Closed (No Build Alternative), long-term (post-construction) transportation mitigation measures beyond what are outlined in the overall Program are not anticipated for the Bored Tunnel Alternative.

5.17 Operational Benefits

Operational benefits of the Bored Tunnel Alternative can be characterized both in comparison to the 2015 Existing Viaduct and the Viaduct Closed (No Build Alternative). While the 2015 Existing Viaduct itself would improve access in the south portal area in comparison to existing conditions with the addition of the stadium area ramps to and from the south, the Viaduct Closed (No Build Alternative) would substantially reduce mobility throughout the corridor and result in highly congested conditions along the Alaskan Way surface street as well as downtown arterials.

The Bored Tunnel Alternative would substantially improve travel conditions compared to the Viaduct Closed (No Build Alternative).

Peak hour travel times for SR 99 through trips are projected to be 12 to 27 percent faster in the 2015 Project than in the 2015 Existing Viaduct, depending on the peak hour and direction, and three times as fast as for the 2015 Viaduct Closed (No Build Alternative). Regarding other key peak hour travel time routes analyzed, the 2015 Project is projected to be about 3 to 4 minutes slower than the 2015 Existing Viaduct between West Seattle and central downtown Seattle in the AM peak hour due to the removal of the midtown ramps, but 4 minutes faster in the PM peak hour due to the elimination of the congestion projected in the 2015 Existing Viaduct at the First Avenue/Columbia Street intersection as well as on southbound SR 99 between the Columbia Street on-ramp and the First Avenue S. off-ramp. Between Ballard and S. Spokane Street, the 2015 Project using the Alaskan Way surface route is expected to be roughly comparable to the 2015 Existing Viaduct (within 1 minute), which includes the existing Elliott/Western ramps. For the 2015 Project, travel times along this route would be compromised somewhat due to the lack of a connection from Elliott and Western Avenues to the waterfront, causing traffic to use Broad Street, which includes an at-grade rail crossing. For traffic using Mercer Street and the bored tunnel, the 2015 Project is also expected to be comparable to the 2015 Existing Viaduct, i.e., within 1 minute, for both the AM and PM peak hours.

Other benefits of the Bored Tunnel Alternative include the following:

- Improved mobility in the South Lake Union area due to the connection of three east/west streets across SR 99.
- Improved access from Mercer Street to southbound SR 99 as a result of the extension of Sixth Avenue N. to Mercer Street (access from westbound Mercer Street would be more direct with the Straight Sixth Avenue option than the Curved Sixth Avenue option).
- The Sixth Avenue N. extension also would provide access to the bored tunnel from areas south of Mercer Street, including areas east of Aurora Avenue via John, Thomas, and Harrison Streets.
- The Sixth Avenue N. extension would provide a new connection between downtown and Uptown as well. With a signal under the Straight Sixth Avenue option, connections would be made in both directions. If the Curved Sixth Avenue option does not have a signal at Mercer Street, then the northbound to westbound connection would likely not be possible.

Areas where the 2015 Project is expected to cause a decrease in performance as compared to the 2015 Existing Viaduct include the following:

- Alaskan Way is projected to experience 14 to 54 percent heavier traffic than in the 2015 Existing Viaduct, but still 26 to 34 percent less than with the 2015 Viaduct Closed (No Build Alternative).
- Traffic volumes for the 2015 Project would be heavier on First Avenue north of S. King Street (through Pioneer Square) in comparison to the 2015 Existing Viaduct, increasing from about 13,000 vehicles to 18,900 vehicles daily.

In the south portal area, operations under the two options would be roughly the same:

- For the 2015 Project, individual intersection LOS under the New Dearborn and Charles Intersections option is expected to be slightly better than for the New Dearborn Intersection option at the intersections of Alaskan Way S. with S. Dearborn Street and S. Charles Street, as well as the intersections of First Avenue S. at S. Dearborn Street and S. Charles Street. However, travel time along Alaskan Way S. is expected to be somewhat longer for this option because there would be an additional signalized intersection to pass through.
- The New Dearborn Intersection option would provide a longer northbound SR 99 off-ramp to Alaskan Way, and hence more queuing distance on the ramp between the ramp terminus intersection and the SR 99 mainline.
- The New Dearborn and Charles Intersections option would provide an additional east-west surface street connection and pedestrian connection

as compared to the New Dearborn Intersection option. However, the benefits of this connection would be marginalized somewhat due to the lack of pedestrian destinations west of Alaskan Way S.

Concerning the two options for the Sixth Avenue N. extension, the Straight Sixth Avenue option would provide the following transportation benefits:

- The Straight Sixth Avenue option would provide all movements at Sixth Avenue N. and Mercer Street, whereas the Curved Sixth Avenue option, without a signal as assumed for this analysis, would allow only right turns into and out of Sixth Avenue N. from and to Mercer Street.[2]
- The Straight Sixth Avenue option would provide an additional route from downtown to Uptown, and from I-5 via westbound Mercer Street to SR 99 southbound (the Curved Sixth Avenue option without a signal at Mercer Street would provide these movements indirectly).
- The Straight Sixth Avenue option would provide a pedestrian and bicycle crossing of Mercer Street at Sixth Avenue N. connecting to the proposed trail along the north side of Mercer Street.
- The Straight Sixth Avenue option would allow for a better design turn radii and vertical curve transitions at the intersection of the southbound on-ramp to SR 99 from Sixth Avenue N. at Republican Street.

The Curved Sixth Avenue option (without a signal at Mercer Street, as assumed for this analysis[2]) would provide 1- to 2-minute faster peak period travel times for east-west traffic on Mercer Street due to one less signal on Mercer Street. This benefit would be substantial because it would affect a relatively high volume of traffic.

[2] Note that the City is considering an option for a curved Sixth Avenue N. alignment that would incorporate a traffic signal at Mercer Street; however, for the purposes of this analysis an unsignalized intersection is assumed.

Chapter 6 CONSTRUCTION EFFECTS AND MITIGATION

This chapter summarizes the construction activities of the Bored Tunnel Alternative by traffic stage. It reviews the traffic management approaches (detours) and expected performance associated with major construction stages. Finally, mitigation measures to keep people and goods moving during construction are discussed.

6.1 Construction Effects

Given the dynamic nature of construction activities, transportation effects would vary depending on the construction period. Generally, the most disruptive travel effects (i.e., substantial sustained effects) would occur during Traffic Stage 7, when SR 99's capacity would be reduced to the greatest extent and construction activities would also affect nearby surface roadways. This section summarizes the construction stage that was assumed for the analysis (Traffic Stage 7), but actual staging will be developed further and will likely be modified during construction. The assumed traffic stages are described below.

6.1.1 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 would be available to build this project as proposed.
- This schedule is based on obtaining the NEPA ROD by July 2011 and construction starting immediately after the ROD is obtained.
- The existing viaduct would carry SR 99 traffic during the construction of the bored tunnel, with a one-lane reduction in each direction in the south portal construction zone area.
- Construction may occur up to 24 hours per day, 7 days per week for the entire construction period, within permitting requirements.
- Access to the Seattle Ferry Terminal and the ferries would be maintained. Access would also be maintained to Terminal 46 and its cargo operations.
- All utilities can be relocated from Denny Way, Sixth Avenue N., Taylor Avenue N., and Broad Street for the north portal cut-and-cover structure.
- The major electrical transmission line under the existing viaduct would be relocated prior to viaduct demolition activities.
- Service to utility customers would be maintained during construction to the greatest extent possible.
- All of the necessary right-of-way, easements, permits, and construction staging areas would be acquired prior to construction. The locations of

the construction staging areas are described in Appendix B, Alternatives Description and Construction Methods Discipline Report.

- Parking under the viaduct would be removed prior to the removal and demolition of the viaduct.
- Transit access during construction would need to be maintained to the greatest extent possible.

6.1.2 Construction Durations

The Bored Tunnel Alternative would require about 66 months of construction. This can be broken down into eight traffic stages, starting with utility work and early construction activities prior to construction of the south portal. At the end of the bored tunnel construction, a closure of SR 99 for up to 3 weeks would be required to connect SR 99 to the bored tunnel at the end of Traffic Stage 7.

Some construction related to the S. Holgate Street to S. King Street Viaduct Replacement Project would overlap with construction of the Bored Tunnel Alternative. The S. Holgate Street to S. King Street Viaduct Replacement Project will begin construction in May 2010 and continue through mid-2014. Bored tunnel construction activities would continue for approximately 2.5 years after the completion of the S. Holgate Street to S. King Street Viaduct Replacement Project. Aside from the disruptions associated with the S. Holgate Street to S. King Street Viaduct Replacement Project, the primary locations of construction activity that would affect traffic would occur in the north portal area, as well as surface streets along the central waterfront during viaduct demolition in Traffic Stage 8.

In addition, the project assumes that 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. There may be short periods of time when some of the connections may be detoured during key construction activities.

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

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

From November 2010 to April 2011, Alaskan Way would be closed between S. Royal Brougham Way and S. Atlantic Street and would operate with only one lane in each direction from S. King Street to S. Royal Brougham Way. During the same timeframe, First Avenue S. would be reduced to one lane in each direction between Railroad Way S. and the WOSCA site. There would also be periodic evening lane closures.

From April through July 2011, Alaskan Way S. would continue to be closed between S. Royal Brougham Way and S. Atlantic Street, but a detour on the East Frontage Road between S. King Street and S. Royal Brougham Way would be in place until June. First Avenue S. would continue to operate with one lane in each direction between Railroad Way S. and the WOSCA site until June 2011, when it would reopen to two lanes in each direction until Traffic Stage 8 of the Bored Tunnel Alternative construction. SR 99 would operate on the existing viaduct, and the mainline speed limit would be reduced from 50 mph to 40 mph. The southbound off-ramp and northbound on-ramp on the WOSCA detour would be opened in April 2011. These ramps would tie into, and thus replace, the existing First Avenue S. ramps and would be accessed via S. Atlantic Street and S. Royal Brougham Way.

Construction during the S. Holgate Street to S. King Street Viaduct Replacement Project includes construction of the East Frontage Road, the WOSCA detour, the new southbound SR 99 structure, and the shifting of First Avenue S. to the east.

Traffic Stage 1

Traffic Stage 1 would last approximately 4.5 months, roughly from July through December 2011. Significant construction activities are shown in Exhibit 6-1.

Exhibit 6-1. Traffic Stage 1 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (4.5 months)
Support in place or relocate utilities along tunnel corridor	4.5 months (16 months total, continues in Stages 2, 3)
Build Mercer overcrossing and widen Mercer corridor from Fifth to Ninth Avenues N.	4.5 months (17 months total, continues in Stages 2, 3)
Initiate the design and procurement of the tunnel boring machine	4.5 months (16 months total, continues in Stages 2, 3,)
Construct secant pile shoring walls and excavate at Alaskan Way; set up staging yard at WOSCA site	4.5 months (7 months total, continues in Stages 2, 3)
Conduct soil improvements along the tunnel alignment up to Madison Street	4.5 months (16 months total, continues in Stages 2, 3)
North utility relocation – Sixth Avenue, Taylor Avenue, Republican Street, and Denny Way	2.5 months (8 months total, continues in Stages 2, 3)

WOSCA = Washington-Oregon Shippers Cooperative Association

As part of the traffic patterns established by the S. Holgate Street to S. King Street Viaduct Replacement Project, mainline SR 99 would be open from S. Holgate Street to Denny Way with two lanes in each direction, and the SR 99 mainline northbound on-ramp and southbound off-ramp at Railroad Way S. to and from First Avenue S. would be moved to newly constructed transitional ramp structures that would allow access to the area via S. Atlantic Street and S. Royal Brougham Way. The southbound off-ramp would be one lane until widening to two lanes prior to the terminus at

S. Atlantic Street. The speed limit of mainline SR 99 would be reduced from 50 mph to 40 mph from April 2011 until the opening of the bored tunnel in Traffic Stage 8. In the north end, SR 99 would be reduced from three to two lanes from Harrison Street to Mercer Street in the northbound direction and from Broad Street to Harrison Street in the southbound direction to accommodate the City's Mercer Street construction.

S. Royal Brougham Way will be closed permanently from Alaskan Way S. to the East Frontage Road as part of the S. Holgate Street to S. King Street Viaduct Replacement Project. 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 along the following detour: S. Atlantic Street to the East Frontage Road to S. Royal Brougham Way to First Avenue S. to Railroad Way S. to Alaskan Way S., then under the viaduct to S. Jackson Street, and back to Alaskan Way S. This detour would stay in effect until the tunnel opens. S. King Street would be closed between Alaskan Way S. and Railroad Way S. for the duration of Bored Tunnel Alternative construction.

First Avenue S. would operate with two lanes in each direction beginning in June 2011. This would continue until the new bored tunnel alignment is opened at the end of 2015. In the north portal area, the Denny Way ramps would remain open through Traffic Stage 7 when the new alignment would go into effect. However, there would be periodic closures on Sixth Avenue N., Taylor Avenue N., and Broad Street due to utility relocations. The south two lanes of Mercer Street would be closed between Fifth and Ninth Avenues N.

Traffic Stage 1 Traffic Revisions – SR 99

For the 4.5 months of Traffic Stage 1, SR 99 would operate on the existing viaduct. The WOSCA southbound off-ramp and northbound on-ramp would be open with a 25 mph posted advisory speed. The southbound off-ramp would be one lane until widening to two lanes before the terminus at S. Atlantic Street. Northbound and southbound traffic would be reduced by one lane on the existing SR 99: two lanes would be open in each direction (two lanes from near S. Holgate Street to the First Avenue S. on-ramp and three lanes northbound between the First Avenue S. on-ramp and the Western Avenue off-ramp). This would be the case for the duration of the project construction. The speed limit of mainline SR 99 would continue to be 40 mph. SR 99 would be reduced from three to two lanes from Harrison Street to Mercer Street in the northbound direction and from Broad Street to Harrison Street in the southbound direction.

Traffic Stage 1 Traffic Revisions – Surface Streets

Traffic revisions in the south portal area include the following:

- Alaskan Way S. would be closed from S. King Street to S. Atlantic Street. The previously described detour route would be used.

- S. King Street would be closed between Alaskan Way S. and Railroad Way S.

Traffic revisions in the north portal area include the following:

- Mercer Street would have its southern two lanes closed for widening between Fifth and Ninth Avenues N.
- There would be periodic closures on Sixth N. Avenue, Taylor Avenue N., and Broad Street due to utility relocations.

Traffic Stage 2

Traffic Stage 2 would last approximately 5 months, from December 2011 to May 2012. Primary construction activities are shown in Exhibit 6-2. As part of the traffic patterns established by the S. Holgate Street to S. King Street Viaduct Replacement Project, southbound SR 99 would begin operation on the WOSCA detour and new southbound SR 99 structure near S. Royal Brougham Way (also part of the S. Holgate Street to S. King Street Viaduct Replacement Project), which would require a weekend closure for the tie-in. The WOSCA detour would be two lanes and tie into the existing First Avenue S. ramps (also operating two lanes in each direction) with a 25 mph posted advisory speed. The detour would travel along the eastern edge of the WOSCA property and part of the First Avenue S. right-of-way before reconnecting with SR 99 via an aerial structure to the existing First Avenue S. ramps. Northbound SR 99 would continue on the existing viaduct with a one-lane reduction beginning at approximately S. Holgate Street.

Exhibit 6-2. Traffic Stage 2 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (5 months)
Support in place or relocate utilities along tunnel corridor	5 months (16 months total, continues in Stage 3)
Widen Mercer overcrossing and widen Mercer corridor from Fifth to Ninth Avenues N.	5 months (17 month total, continues in Stage 3)
Construct secant pile shoring walls and excavate at Alaskan Way; continue installation of secant pile wall around staging area; continue setup of staging yard	5 months (16 months total, continues in Stage 3)
Initiate the design and procurement of the tunnel boring machine	5 months (16 months total, continues in Stage 3)
Conduct soil improvements in the south along the tunnel alignment north to Madison Street	5 months (16 months total, continues in Stage 3)
North utility relocation – Sixth Avenue, Taylor Avenue, Republican Street, and Denny Way	5 months (8 months total, continues in Stage 3)

The eastbound lanes of Broad Street, Sixth Avenue N. from Thomas Street to Broad Street, and Harrison Street from Sixth Avenue N. to SR 99 would be closed

beginning in February 2012. All other conditions would remain the same as those in Traffic Stage 1. The complete list of traffic operations follows.

Traffic Stage 2 Traffic Revisions – SR 99

Northbound SR 99 would continue to operate on the existing viaduct. Southbound SR 99 would switch to operation on the WOSCA detour and new southbound SR 99 structure, which would require a weekend closure at the beginning of Traffic Stage 2 for the tie-in. Both the southbound off-ramp and northbound on-ramp on the WOSCA detour would remain open. Northbound and southbound traffic would be reduced by one lane on the existing SR 99: two lanes would be open in each direction (three lanes northbound between the First Avenue S. on-ramp and the Western Avenue off-ramp). The speed limit of mainline SR 99 would continue to be 40 mph. SR 99 would continue to be two lanes from Harrison Street to Mercer Street in the northbound direction and from Broad Street to Harrison Street in the southbound direction.

Traffic Stage 2 Traffic Revisions – Surface Streets

Traffic revisions in the south portal area include the following:

- First Avenue S. would operate with two lanes in each direction.
- Alaskan Way S. would be closed between S. King Street and S. Atlantic Street. The detour route established in Traffic Stage 1 would be used.
- S. King Street would be closed between Alaskan Way S. and Railroad Way S.

Traffic revisions in the north portal area include the following:

- Although the Denny Way ramps would remain open, Sixth Avenue N., Taylor Avenue N., and Broad Street would experience lane closures due to utility relocations. The following closures would also be implemented beginning in February 2012: eastbound lanes of Broad Street, Sixth Avenue N. between Thomas Street and Broad Street, and Harrison Street between Sixth Avenue N. and SR 99. Two westbound lanes of Broad Street would remain open.
- The southern two lanes of Mercer Street would continue to be closed throughout this stage for construction by the City of Seattle.

Traffic Stage 3

Traffic Stage 3 would last approximately 7 months, from May to December 2012. Primary construction activities are shown in Exhibit 6-3. Demolition of the viaduct between S. Royal Brougham Way and S. King Street would take approximately 1 month at the beginning of this stage.

In the south end, the S. Holgate Street to S. King Street Viaduct Replacement Project will demolish a section of the viaduct just north of S. Royal Brougham Way that will close SR 99 to all traffic for 1 week. Once this demolition is completed, both SR 99 northbound and southbound traffic would travel on the WOSCA detour at about S. Royal Brougham Way and connect back to SR 99 using the existing ramp from First Avenue S. at Railroad Way S. The northbound on-ramp and southbound off-ramp would remain on the temporary ramps until the new alignment opens at the end of 2015.

Broad Street's eastbound lanes would reopen in September 2012, when the access ramp from Broad Street to Mercer Street is completed. All other conditions would remain the same as those in Traffic Stage 2. The complete list of traffic operations follows.

Exhibit 6-3. Traffic Stage 3 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (7 Months)
Support or relocate utilities along tunnel corridor	7 months
Demolish viaduct between S. Royal Brougham Way and S. King Street	1 month
Widen Mercer overcrossing and widen Mercer corridor from Fifth to Ninth Avenues N.	7 months
Continue installation of secant pile wall around staging area; continue setup of staging yard	7 months
Assemble tunnel boring machine	1 month (continues in Stage 4)
Conduct soil improvements in the south along the tunnel alignment north to Madison Street	3 months
North end – Construct support walls for north portal and tunnel boring machine retrieval pit	6 months

Traffic Stage 3 Traffic Revisions – SR 99

Following the 1-week closure for tie-in by the S. Holgate Street to S. King Street Viaduct Replacement Project, SR 99 would operate on the WOSCA detour and new southbound SR 99 structure in both directions. The WOSCA detour northbound on-ramp and southbound off-ramp would continue to operate. The speed limit of mainline SR 99 would continue to be 40 mph. SR 99 would continue to be two lanes from Harrison Street to Mercer Street in the northbound direction and from Broad Street to Harrison Street in the southbound direction.

Traffic Stage 3 Traffic Revisions – Surface Streets

Alaskan Way S. would operate using the detour route established in Traffic Stage 1. Alaskan Way S. would be closed between S. King Street and S. Atlantic Street.

S. King Street would be closed between Alaskan Way S. and Railroad Way S.

First Avenue S. would operate with two lanes in each direction.

Some of the north portal revisions would remain the same as established in Traffic Stage 2: Sixth Avenue N. closed from Thomas Street to Broad Street, Harrison Street closed from Sixth Avenue N. to SR 99, and the southern two lanes of Mercer Street closed. Broad Street's eastbound lanes would reopen in September when the access ramp from Broad Street to Mercer Street is completed.

Traffic Stage 4

Traffic Stage 4 would last approximately 3 months, from December 2012 to March 2013, as shown in Exhibit 6-4. The only changes in traffic revisions from Traffic Stage 3 are in the north portal area. 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 of Seattle. The complete list of traffic conditions follows.

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

Primary Construction Activity	Approximate Duration (3 Months)
Assemble tunnel boring machine and start tunnel drive	3 to 4 months (14 months total, continues in Stage 5)
Complete overcrossing over Mercer Street	4 months

Traffic Stage 4 Traffic Revisions – SR 99

SR 99 would continue to operate on the WOSCA detour and new southbound SR 99 structure in both directions and use the WOSCA detour ramps at the south end. The speed limit of mainline SR 99 would continue to be 40 mph. SR 99 would continue to be two lanes from Harrison Street to Mercer Street in the northbound direction and from Broad Street to Harrison Street in the southbound direction.

Traffic Stage 4 Traffic Revisions – Surface Streets

Traffic revisions near the south portal of the bored tunnel include the following:

- Alaskan Way S. would continue to be closed from S. King Street to S. Atlantic Street, and the established detour from Traffic Stage 1 would remain open.

- S. King Street would be closed between Alaskan Way S. and Railroad Way S.
- First Avenue S. would operate with two lanes in each direction.

Traffic revisions near the north portal of the bored tunnel include the following:

- Harrison Street would be closed between Sixth Avenue N. and SR 99.
- Mercer Street would be open with two lanes in each direction between Fifth and Ninth Avenues N.
- Sixth Avenue N. would be closed between Thomas and Broad Streets.
- The westbound lanes of Broad Street would be closed.

Traffic Stage 5

Traffic Stage 5 would last approximately 16 months, from March 2013 to July 2014. Primary construction activities are shown in Exhibit 6-5.

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

Primary Construction Activity	Approximate Duration (16 Months)
Drive tunnel boring machine	10 months
Extract tunnel boring machine	1 month
North portal: Construct shoring and excavate for ramp structure, construct SR 99 detour roadway	8 months
North portal: Construct tunnel portal and cut-and-cover tunnel	1 month (12 months total, continues in Stage 6)
Install interior tunnel structures and systems installation	7 months (17 months total, continues in Stages 6, 7)
Construct north tunnel operations building	7 months (10 months total, continues in Stage 6)
Construct south tunnel operations building	4 months (12 months total, continues in Stages 6 and 7)

The h-shaped overcrossing constructed as part of the S. Holgate Street to S. King Street Viaduct Replacement Project will open in May 2014. This overcrossing will provide a bypass for east-west traffic when railroad cars on the BNSF tail track block the at-grade crossing. It will eventually connect Alaskan Way S. to both E. Marginal Way S. and S. Atlantic Street, but the connection to Alaskan Way S. would not be open at this stage because Alaskan Way S. would still be closed north of this point to S. King Street. Broad Street's westbound lanes would continue to be closed, and in May 2013, Broad Street would be completely closed. Mercer Street's two-way operations would continue but would increase from two to three lanes in each direction in May 2013. All other conditions would remain the same as those in Traffic Stage 4. The complete list of traffic revisions follows.

Traffic Stage 5 Traffic Revisions – SR 99

SR 99 would continue to operate in both directions on the WOSCA detour and new southbound SR 99 structure and WOSCA detour ramps. The speed limit of mainline SR 99 would continue to be 40 mph.

Traffic Stage 5 Traffic Revisions – Surface Streets

Traffic revisions near the south portal of the bored tunnel include the following:

- Alaskan Way S. traffic would continue using the detour route established in Traffic Stage 1. Alaskan Way S. would be closed from S. King Street to S. Atlantic Street.
- S. King Street would be closed between Alaskan Way S. and Railroad Way S.
- First Avenue S. would be open with two lanes in each direction as in previous stages.

Traffic revisions near the north portal of the bored tunnel include the following:

- Broad Street's eastbound lanes would be closed; the westbound lanes would be open until May 2013, at which time both directions of Broad Street would be closed.
- Sixth Avenue N. would be closed between Thomas and Broad Streets.
- Harrison Street would be closed between Sixth Avenue N. and SR 99.
- Mercer Street would continue the two-way operations established in the previous stage but would increase to three lanes in each direction in May 2013.

Traffic Stage 6

Traffic Stage 6 would last approximately 9 months, from July 2014 to April 2015. Primary construction activities are shown in Exhibit 6-6. In the north end, southbound SR 99 traffic would be shifted onto the newly constructed Harrison Street/Aurora Avenue ramp. The ramp would carry three lanes of southbound traffic, and travel speed would be reduced to 30 mph, as required with the curves associated with the shifting of the roadway to the west to accommodate construction in the existing SR 99 right-of-way. All other revisions would remain the same as those in Traffic Stage 5. A complete list of traffic conditions follows.

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

Primary Construction Activity	Approximate Duration (9 Months)
Bored tunnel: Install interior concrete and interior systems work, systems commissioning	9 months (17 months total, continues in Stage 7)
South portal: Construct tunnel operations building	9 months
South portal: Construct cut-and-cover tunnel connection	7 months
South portal: Reconstruct East Frontage Road and S. Royal Brougham Way	9 months
North portal: Construct shoring, excavate, and build east half of Harrison Street ramp structure	6 months
North portal: Construct Harrison Street to at-grade structure	1 month (5 months total, continues in Stage 7)
North portal: Construct tunnel operations building	5 months
North portal: Construct cut-and-cover tunnel	7 months

Traffic Stage 6 Traffic Revisions – SR 99

Both directions of SR 99 would continue to operate on the WOSCA detour, southbound SR 99 structure, and WOSCA ramps at the south end.

The speed limit of mainline SR 99 would continue to be 40 mph.

Southbound SR 99 would be shifted onto the new Harrison Street/Aurora Avenue ramp at the north end. The Harrison Street/Aurora Avenue ramp would carry three lanes of southbound traffic at a reduced speed of 30 mph.

Traffic Stage 6 Traffic Revisions – Surface Streets

Traffic revisions near the south portal of the bored tunnel include the following:

- Alaskan Way S. would be rerouted to the previously established detour. Alaskan Way S. would be closed from S. King Street to S. Atlantic Street.
- S. King Street would be closed between Alaskan Way S. and Railroad Way S.
- First Avenue S. would be open for north-south traffic with two lanes in each direction.

Traffic revisions near the north portal of the bored tunnel include the following:

- Broad Street would be closed.
- Sixth Avenue N. would be closed between Thomas and Broad Streets.
- Harrison Street would be closed from Sixth Avenue N. to SR 99.
- Mercer Street would be open in two directions with three lanes each way from Fifth Avenue to I-5.

Traffic Stage 7

Traffic Stage 7 would last approximately 8 months, from April to December 2015, as shown in Exhibit 6-7. In the north end, northbound SR 99 would be shifted onto the east half of the Harrison Street ramp so that both directions of SR 99 would be operating on the ramp during this stage. The northbound on- and off-ramps at Harrison Street would be open, although the southbound on- and off-ramps would not. At the end of Traffic Stage 7, there would be up to a 3-week closure to connect SR 99 to the bored tunnel. The cumulative list of traffic revisions for this stage follows.

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

Primary Construction Activity	Approximate Duration (8 Months)
Bored tunnel: Install interior concrete and interior systems work, systems commissioning	4 months
Bored tunnel: Interior systems commissioning	5 months
South portal: Construct cut-and-cover tunnel connection	5 months
North portal: Construct shoring for NB SR 99; excavate and build NB SR 99	7 months
North portal: Construct Republican Street and Sixth Avenue ramp structures	5 months
North portal: Construct Harrison Street to at-grade structure	4 months
Connect SR 99 to the bored tunnel	3 weeks

NB = northbound

Traffic Stage 7 Traffic Revisions – SR 99

SR 99 would operate on the new southbound SR 99 structure and WOSCA detour ramps.

The speed limit of mainline SR 99 would continue to be 40 mph.

The Harrison Street/Aurora Avenue ramp detour would operate as two lanes in each direction between Harrison Street and Mercer Street, with an assumed design speed of 30 mph. The northbound on- and off-ramps to and from Denny Way would still be open.

At the end of Traffic Stage 7, a closure of SR 99 for up to 3 weeks would be required.

Traffic Stage 7 Traffic Revisions – Surface Streets

Traffic revisions near the south portal of the bored tunnel include the following:

- Alaskan Way S. would be rerouted to the previously established detour. Alaskan Way S. would be closed from S. King Street to S. Atlantic Street.

- First Avenue S. would be open for north-south traffic with two lanes in each direction.

S. King Street would be closed between Alaskan Way S. and Railroad Way S. Traffic revisions near the north portal of the bored tunnel include the following:

- Broad Street would be closed.
- Sixth Avenue N. would be closed between Thomas and Broad Streets.
- Harrison Street would be closed from Sixth Avenue N. to SR 99.
- Mercer Street would be open in two directions with three lanes each way from Fifth Avenue to I-5.

Traffic Stage 8

Traffic Stage 8 would last approximately 13 months, from December 2015 to January 2017, as shown in Exhibit 6-8. 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 Street and Pike Street to allow for the demolition and removal of the viaduct structure. The new cross street(s) in the south end would be constructed. 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. Various city streets between S. King Street and Battery Street would experience periodic street closures to facilitate the viaduct demolition.

Exhibit 6-8. Traffic Stage 8 Construction Activities and Approximate Durations

Primary Construction Activity	Approximate Duration (13 Months)
Demolish and remove existing viaduct	9 months
Decommission the 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, lanes on Denny Way, Harrison Street, Sixth Avenue N., Taylor Avenue N., and Broad Street would be restricted to support utility relocation and surface street restoration activities. The Denny Way ramps would be replaced by a new intersection, and both the northbound and southbound on- and off-ramps to and from SR 99 at Harrison Street would be open. However, the new section of surface Aurora Avenue between Thomas Street and Denny Way would not yet be open; hence, traffic on SR 99 would connect to the portion of Denny Way ramps that would remain open with reduced capacity between Thomas Street and

Denny Way. Construction of the surface street connection in the north portal area would take place during this traffic stage.

Traffic Stage 8 Traffic Revisions – SR 99

The new SR 99 mainline would be open and using the newly constructed bored tunnel.

The Battery Street Tunnel would be decommissioned.

Traffic Stage 8 Traffic Revisions – Surface Streets

Traffic revisions near the south portal of the bored tunnel include the following:

- Periodic street closures on First Avenue S. during removal of the WOSCA detour, approximately December 2015 to January 2017.
- First Avenue S. would be reduced to one lane in each direction from Railroad Way S. to WOSCA.
- Alaskan Way S. would be reduced in width between Pike Street and S. King Street to allow for the demolition and removal of the viaduct structure. Demolition would occur two blocks at a time, with the middle cross street being closed for approximately 2 weeks in duration.
- Alaskan Way S. would be closed from S. King Street to S. Royal Brougham Way until September 2016 and then reopen for traffic.

Traffic revisions near the north portal of the bored tunnel include the following:

- Denny Way, John Street, Thomas Street, and Harrison Street lanes would be restricted to support utility relocation and surface street relocation activities. Sixth Avenue N. would also be affected.
- City streets from S. King Street to Battery Street would experience periodic closures to support viaduct demolition.
- Traffic on Battery Street and on cross streets above the Battery Street Tunnel would be maintained during decommissioning, although there may need to be occasional short-term lane and parking restrictions.
- The Denny Way ramps would remain open but with reduced capacity during surface Aurora Avenue reconstruction between Thomas Street and Denny Way.

6.1.3 Proposed Detours

Throughout the construction of the bored tunnel and associated facilities, a number of traffic detours affecting surface streets or ramps would occur during different stages. Some of the detours, such as those associated with short-duration closures of cross streets during the demolition of the SR 99 viaduct,

would be determined during the construction phase. Other proposed detours are more substantial.

During Traffic Stage 7, both the northbound and southbound traffic would continue to travel on the WOSCA detour. This stage could be considered the most disruptive of the traffic stages for the longest duration (approximately 8 months). The closure of the First Avenue S. ramps near Railroad Way S. that provide access between SR 99 and First Avenue S. is one of the factors making this stage more disruptive. To maintain access to and from the stadium area, a northbound on-ramp to and southbound off-ramp from SR 99 would be built to provide access to the area via S. Royal Brougham Way and S. Atlantic Street. In addition, Alaskan Way S. from S. King Street to the WOSCA property would be rerouted to a new alignment just east of SR 99. First Avenue S. would remain open, carrying two lanes of traffic in each direction.

Throughout construction in the north end, alternative travel routes may need to be designated for Seattle Center inbound and outbound traffic, especially during major events.

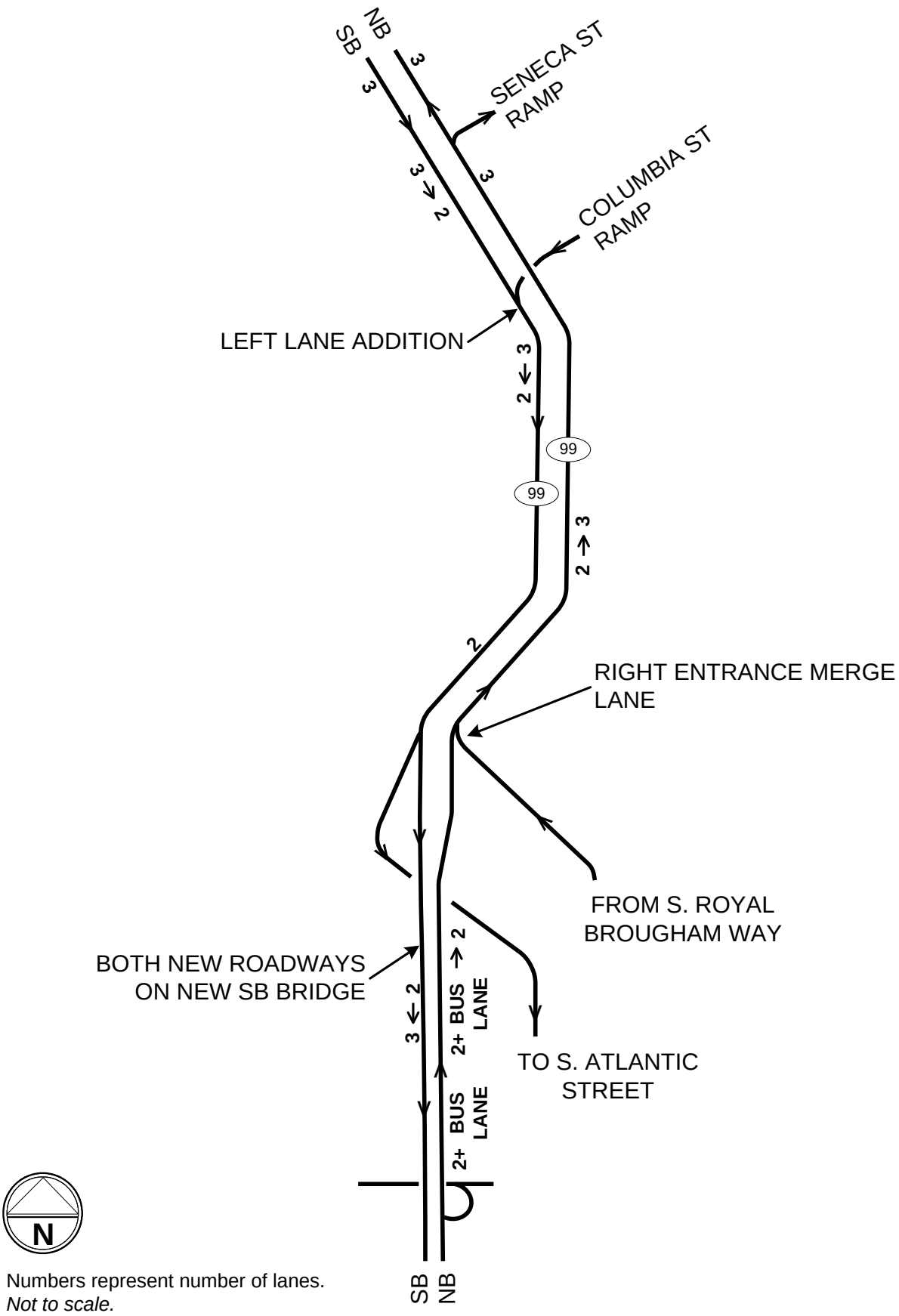
6.1.4 Traffic Congestion on SR 99

This section provides a qualitative discussion of anticipated congestion levels on SR 99 through the project area for the construction period primarily defined by Traffic Stage 7, which would last about 8 months. The primary measures for mainline SR 99 performance are average speeds and travel times for representative trips. Vehicle delays on SR 99 during this 8-month (estimated) construction period are expected to increase somewhat compared to the 2015 Existing Viaduct. The decreases in speeds and increases in travel times would be heavily influenced by temporary changes to the SR 99 configuration in the north and south, which are expected to reduce mainline capacity. Refer to Exhibits 6-9 and 6-10 for diagrams of the roadway configuration during Traffic Stage 7.

As described in the construction staging summary, northbound and southbound SR 99 under Traffic Stage 7 would be reduced by one lane on the existing SR 99, so two lanes would be open in each direction (three lanes northbound between the First Avenue S. on-ramp and the Western Avenue off-ramp). In the north during Traffic Stage 7, SR 99 would be operating with two lanes in each direction. The design speed would be reduced to 30 mph.

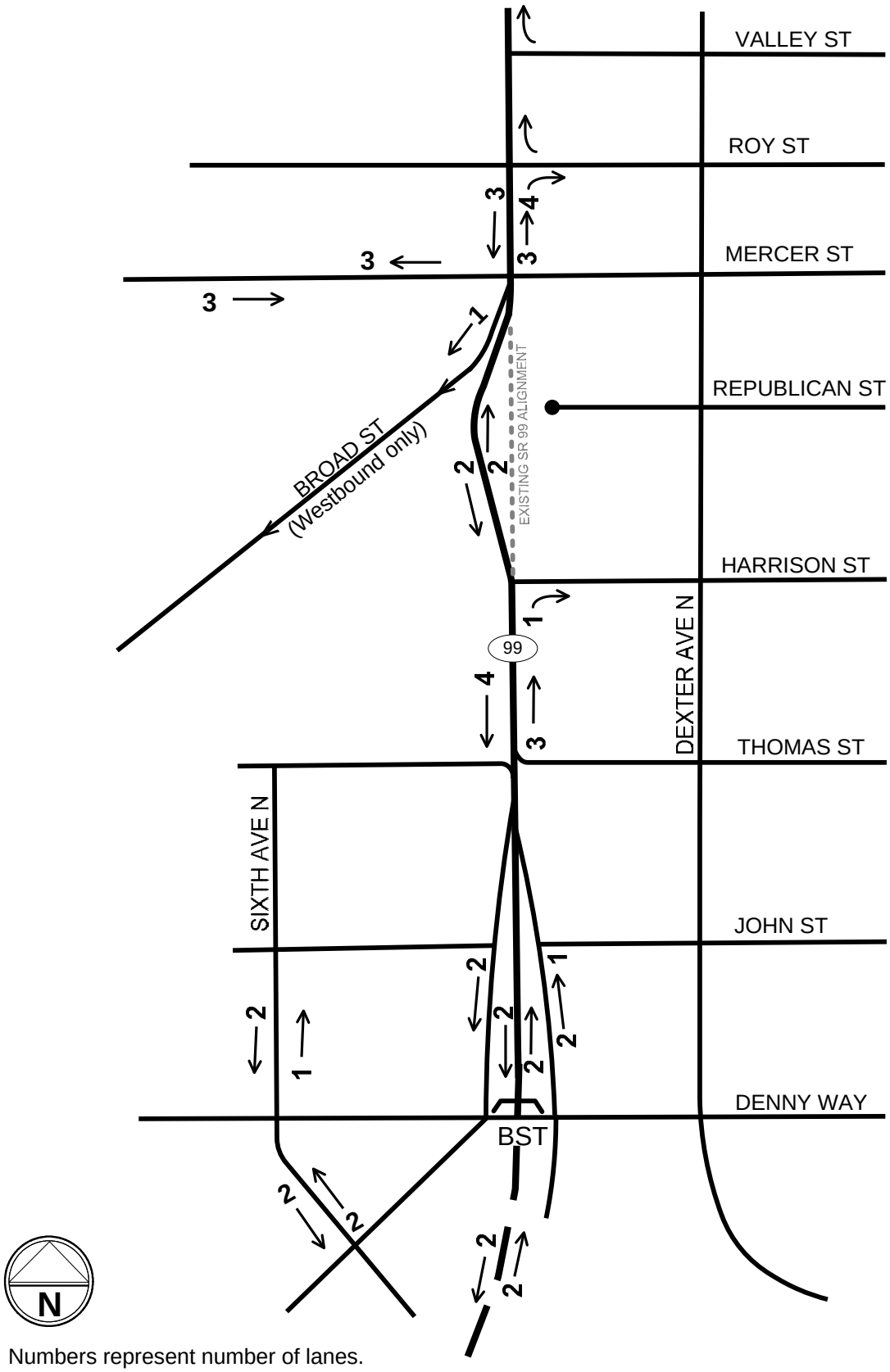
Travel Speeds

On SR 99 in the project area between S. Atlantic Street and Mercer Street, travel speeds in both directions are expected to be very similar to the 2015 Existing Viaduct.



Numbers represent number of lanes.
Not to scale.

Exhibit 6-9
SR 99 Roadway Configuration
during Traffic Stage 7 - South End



Numbers represent number of lanes.
Not to scale.

Exhibit 6-10
SR 99 Roadway Configuration during Traffic Stage 7- North End

Although it is not possible to compare identical segments due to the closure and relocation of some ramps during construction, it is possible to report general patterns.

For the PM peak hour, the SR 99 mainline northbound segments are expected to generally operate at speeds similar to or higher than during the 2015 Existing Viaduct south of the Western Avenue on-ramp. However, through the Battery Street Tunnel and to the north, speeds are expected to be slower than 2015 Existing Viaduct speeds, due to the restricted capacity on SR 99 beginning north of Denny Way. In the southbound direction, a comparison of travel speeds between Traffic Stage 6 and the 2015 Existing Viaduct indicates similar speed patterns north of the Elliott Avenue on-ramp. South of the Elliott Avenue on-ramp, speeds are expected to be reduced due to the reduction of capacity and detour at the First Avenue S. ramps.

For the AM peak hour in the northbound direction, the slow speeds (about 17 mph) predicted for the segment between the Seneca Street and Western Avenue off-ramps are pushed upstream due to the reduced capacity segment of SR 99 in the stadium area that would occur during Traffic Stage 7. As a result, northbound traffic in the segment between S. Spokane Street and S. King Street is predicted to experience much slower speeds during construction, with estimated speeds reduced from approximately 37 mph to 16 mph for this segment. However, north of the bottleneck speeds increase to approximately 31 to 36 mph for the remainder of the project area.

In the southbound direction during the AM peak hour, speeds during construction are generally similar to those in the 2015 Existing Viaduct, with the exception of the segment between the Columbia Street on-ramp and First Avenue S. off-ramp, which would be as slow as 19 mph due to reduced capacity and the detour, similar to the PM peak hour.

Travel Times

Travel time was used to gauge the potential effects of project construction activities for two typical trips that use the SR 99 corridor: Woodland Park to S. Spokane Street and Ballard to S. Spokane Street, both via the Alaskan Way Viaduct. In the AM peak southbound direction, travel times for both routes during Traffic Stage 7 would be higher than the 2015 Existing Viaduct. Increases of 1 minute and 3 minutes were noted for the Woodland Park to S. Spokane Street and Ballard to S. Spokane Street routes, respectively. PM peak northbound trips during construction would be similar or slightly higher in duration compared to the 2015 Existing Viaduct. Differences in non-peak direction travel times (northbound in AM and southbound in PM) between the 2015 Existing Viaduct and 2015 Construction are expected to be more pronounced than for the peak

direction, with the greatest increase noted for the northbound Ballard to S. Spokane Street route during the AM peak.

The primary factors leading to higher travel times for the 2015 Construction compared to the 2015 Existing Viaduct are generally tied to the physical constraints of the roadways in the north portal area and south portal area. These constraints include reductions in the number of lanes provided (two lanes in each direction compared to three in each direction for the 2015 Existing Viaduct) and temporary changes to the horizontal and vertical geometry within these bottleneck areas, which directly affects vehicle performance and driver behavior. In all cases, travel time impacts could be greater if traffic volumes for the 2015 Construction exceed those projected and used for the mainline analysis.

A closure of SR 99 for up to 3 weeks would be required to connect SR 99 to the bored tunnel at the end of Traffic Stage 7. During this closure, congestion levels on local arterials in the downtown core are expected to increase noticeably compared to congestion during other stages of construction due to a pronounced diversion of SR 99 traffic to alternative routes, particularly on city streets and other major freeway facilities such as I-5 and I-90. Consequently, point-to-point travel times during the closure period would be significantly longer than those during other stages and would approach travel times anticipated for the 2015 Viaduct Closed (No Build Alternative). A representative travel time analysis for the 2015 Viaduct Closed (No Build Alternative) is discussed in Section 5.4, AM and PM Peak Hour Travel Times.

6.1.5 Traffic Congestion on Surface Streets

This section provides a qualitative discussion of anticipated congestion levels at intersections or intersection groupings for the construction period primarily defined by Traffic Stage 7 of the Bored Tunnel Alternative. Vehicle delays at intersections within the three project sub-areas during this 8-month (estimated) construction period are expected to increase somewhat compared to the 2015 Existing Viaduct. Such delay increases would be heavily influenced by temporary changes to the SR 99 configuration in the north and south, which are expected to reduce mainline capacity, modify access at critical points along the corridor, and potentially lead to the redistribution of north-south mainline traffic demands to local arterials and other parallel regional facilities such as I-5.

While specific technical data are not provided in this section, conclusions drawn from preliminary analysis results are given to highlight areas where potential congestion issues may occur. The 3-week closure of SR 99 at the end of Traffic Stage 7 would result in conditions similar to those of the 2015 Viaduct Closed (No Build Alternative), discussed in Sections 5.3.1, 5.3.2, and 5.3.3, so this closure is not specifically discussed in this section.

South Portal Area

Intersection traffic operations in the south portal area during critical stages of construction are likely to show similar or slightly greater levels of congestion than in the 2015 Existing Viaduct. Intersections affected by shifts in traffic demand away from mainline SR 99 to local arterials may experience slightly higher delays. As described in the construction staging summary in the south end, northbound and southbound traffic would use the WOSCA detour. The ramps to First Avenue S. would be closed and traffic would continue to use the temporary northbound on-ramp and southbound off-ramp to access SR 99. Traffic on these ramps is projected to be substantially lower than the First Avenue S. ramps with the 2015 Existing Viaduct.

Redistribution of traffic to local arterials would potentially cause additional congestion on major north-south routes such as Second and Fourth Avenues. Preliminary delay results reflecting the 2015 Construction (e.g., Traffic Stage 7) indicate that delays at the majority of intersections investigated would not change substantially compared to the 2015 Existing Viaduct. However, those intersections that do show potential increases in delay for the construction period are generally located along S. Atlantic Street and north of S. Jackson Street along First, Second, and Fourth Avenues.

Central Sub-Area

During the 2015 Construction, again primarily reflecting Traffic Stage 7, traffic congestion at intersections in the central sub-area would be similar to conditions with the 2015 Existing Viaduct. While peak hour volumes are generally expected to increase for the majority of intersections along north-south arterials such as First, Second, and Fourth Avenues, the magnitude of these increases would not result in high levels of congestion for most of these locations. Exceptions include the intersection of Second Avenue at Marion Street during both the AM and PM peak hours and Fourth Avenue at Marion Street during the PM peak hour.

North Portal Area

The primary changes to the traffic network in the north end, outside of widening and conversion of Mercer Street (from Fifth Avenue N. to Dexter Avenue N.) to a two-way corridor, are the restrictions on access to and from SR 99 south of Mercer Street. These access modifications would shift a portion of peak hour traffic to upstream or downstream connections to and from the street grid. In the southbound direction, access at Republican Street and Harrison Street would be restricted. Southbound traffic would need to shift to access points to the north or south. The southbound Broad Street off-ramp would be open during Traffic Stage 7.

In the northbound direction, traffic would not be able to exit SR 99 at Republican Street, but all other northbound exits (Harrison Street, Roy Street, and Aloha Street)

should be operational during Traffic Stage 7. Traffic would likely shift to Harrison Street south of Republican Street or Roy Street to the north.

Peak hour congestion levels at intersections near these affected on- or off-ramp connections or along affected arterials would potentially increase due to higher concentrations of peak hour traffic demand. Also, preliminary analysis data indicate that Mercer Street reconstruction would result in increases in construction period congestion at critical convergence locations such as Mercer Street at Dexter Avenue N., Mercer Street at Fifth Avenue N., Broad Street at Fifth Avenue N., and Mercer Street at Westlake Avenue N. due to increases in north-south traffic volumes.

6.1.6 Roadway Connectivity and Access

As outlined previously, eight traffic stages have been identified for the Bored Tunnel Alternative, with each stage varying in roadway connectivity and access.

During Traffic Stage 1, which would last approximately 4.5 months, mainline SR 99 would be open from S. Holgate Street to Denny Way. Ramp connections would be maintained, except for the First Avenue S. ramps; these ramps would be replaced by the WOSCA detour ramps, which are accessed via S. Atlantic Street and S. Royal Brougham Way. Roadway connectivity and access north of Denny Way would be unaltered. Mercer Street's southern two lanes would be closed for City of Seattle construction.

During Traffic Stage 2, which would last approximately 5 months, southbound traffic would switch to operation on the WOSCA detour and new southbound SR 99 structure, which would require a weekend closure as part of the S. Holgate Street to S. King Street Viaduct Replacement Project. Northbound traffic would continue operation on the existing viaduct. Access to SR 99 at the south end would continue to be through the WOSCA detour ramps. The Denny Way ramps would remain open, as would other ramps north of the stadium area. Southbound SR 99 would not be accessible via Harrison Street since it would be closed from SR 99 to Sixth Avenue N. Other roadway connectivity and access north of Denny Way would be unaltered. The southern two lanes of Mercer Street would continue to be closed for City of Seattle construction.

During Traffic Stage 3, which would last approximately 7 months, the SR 99 northbound traffic would be switched from the existing viaduct to the WOSCA detour and new southbound SR 99 structure, requiring a 1-week closure as part of the S. Holgate Street to S. King Street Viaduct Replacement Project. Following this closure, both northbound and southbound traffic would travel on the WOSCA detour and new southbound SR 99 structure. The northbound on-ramp and southbound off-ramp would be on the WOSCA detour. As in Traffic Stage 2, ramps north of the stadium area would remain open, but southbound SR 99 would not be accessible via Harrison Street. Other roadway connectivity and access north of

Denny Way would be unaltered. The southern two lanes of Mercer Street would continue to be closed for City of Seattle construction.

During Traffic Stage 4, which would last approximately 3 months, both northbound and southbound SR 99 would be on the WOSCA detour and new southbound SR 99 structure, with the northbound and southbound ramps open. Ramps north of the stadium area would remain open for use, but southbound SR 99 would not be accessible via Harrison Street. Mercer Street would be open with two lanes in each direction between Fifth and Ninth Avenues N., and two-way operations would have already begun between Ninth Avenue N. and I-5.

During Traffic Stage 5, which would last approximately 16 months, SR 99 northbound and southbound traffic would continue to travel on the WOSCA detour and new southbound SR 99 structure. The northbound and southbound ramps would be operational on the WOSCA detour. The Denny Way ramps would remain open, as would other ramps north of the stadium area. However, as in previous stages, southbound SR 99 would not be accessible via Harrison Street. Mercer Street would increase its two-way operations from two lanes to three lanes in each direction from Fifth Avenue N. to I-5 in May 2013. This will be the permanent alignment of Mercer Street.

During Traffic Stage 6, which would last approximately 9 months, the SR 99 northbound and southbound traffic would continue to travel on the WOSCA detour and new southbound SR 99 structure, and the northbound and southbound WOSCA detour ramps would be open. Southbound SR 99 traffic would be shifted to the Harrison Street ramp at the north end, while northbound traffic would continue on the existing alignment. The Denny Way ramps would remain open, but southbound SR 99 would not be accessible via Harrison Street.

During Traffic Stage 7, which would last approximately 8 months, SR 99 northbound and southbound traffic would continue to travel on the WOSCA detour and new southbound SR 99 structure. The northbound and southbound ramps would be operational on the WOSCA detour. At the north end, northbound SR 99 traffic would shift to the Harrison Street ramp, so both directions of traffic would operate on the Harrison Street ramp during this stage. Harrison Street would remain closed, so southbound SR 99 would not be accessible from that location, but the Denny Way ramps would remain open.

During Traffic Stage 8, the SR 99 mainline would be open and using the newly constructed bored tunnel. The Denny Way ramps would be replaced by an intersection, and the ramps at Harrison Street would be open.

Local Street Access

Construction activities would result in disruptions to several streets within the project area, most notably S. Royal Brougham Way, S. Atlantic Street, Alaskan

Way S., First Avenue S., Sixth Avenue N., and John, Thomas, Harrison, Republican, and Mercer Streets.

Given the closure of S. Royal Brougham Way between the existing Alaskan Way S. alignment and East Frontage Road by the S. Holgate Street to S. King Street Viaduct Replacement Project, maintaining access on S. Atlantic Street is of critical importance. This roadway would remain open throughout the construction period. A minimum of four lanes would be provided east of Colorado Avenue S., with two or more lanes connecting to E. Marginal Way S.

Construction activities would relocate Alaskan Way S. east of its current alignment and would modify connections between S. Atlantic Street and E. Marginal Way S. Temporary connections would be provided as necessary to maintain these routes throughout the construction period.

Alaskan Way S. would be closed from S. King Street to S. Atlantic Street from Traffic Stages 1 to 7. Railroad Way S. would be used as a detour during that time. Traffic would be also be detoured onto East Frontage Road from S. Atlantic Street to S. Royal Brougham Way from Traffic Stages 3 to 7. During Traffic Stage 8, Alaskan Way S. would be open, but reduced in width from Pike Street to S. King Street. It would also be closed from S. King Street to S. Royal Brougham Way from January to September 2016.

The relocated southbound off-ramp from SR 99 would direct traffic to southbound Alaskan Way S. and S. Atlantic Street. A minimum of two southbound/eastbound lanes would be maintained on these streets to accommodate these trips.

S. King Street would be closed between Alaskan Way S. and Railroad Way S. from Traffic Stage 1 through Traffic Stage 7.

First Avenue S. would be open with two lanes in each direction from Traffic Stages 1 through 7. During Traffic Stage 8, it would be reduced to one lane in each direction from Railroad Way S. to S. Royal Brougham Way and would experience periodic street closures during the removal of the WOSCA detour in January 2016.

Denny Way, Sixth Avenue N., and John, Thomas, and Harrison Streets would be subject to lane closures and/or restricted use in Traffic Stages 2, 3, 4, and 7 to support utility work. Mercer Street would be subject to lane closures and temporary minor realignments in Traffic Stages 4, 5, and 6 to accommodate the conversion of the segment between Fifth Avenue N. and Dexter Avenue N. to two-way operations.

Sixth Avenue N., Taylor Avenue N., and Broad Street would be disrupted during Traffic Stage 1 for utility relocation. From February 2012 until the new alignment opens, Sixth Avenue N. would be closed from Thomas Street to Broad Street and Harrison Street would be closed from Sixth Avenue N. to SR 99.

The eastbound lanes of Broad Street would be closed from February to September 2012. The westbound lanes of Broad Street would be closed from December 2012 to May 2013, when both directions of Broad Street would be closed.

Local access to businesses within the project area would be maintained throughout the construction period.

6.1.7 Transit Services

During Traffic Stage 7, two lanes in each direction would be maintained on SR 99. Also, connections to and from SR 99 would be maintained in areas where current access exists; locations include the Seneca Street off-ramp and Columbia Street on-ramp in downtown Seattle. King County Metro bus services using SR 99 would be affected by lane reductions during the construction period. During construction, congestion is expected to increase and result in slower travel speeds on SR 99, which in turn would result in increases in travel times ranging from 1 to 3 additional minutes as compared to those for the 2015 Existing Viaduct. Therefore, buses using SR 99 (primarily those that travel between West Seattle/South King County and downtown) would experience slightly longer travel times. Although transit access routes would be maintained, King County Metro may decide to make some routing changes to help lessen the expected congestion effects.

Traffic that is projected to divert from SR 99 and use either First Avenue S. or Fourth Avenue S. would affect overall traffic operations, including bus service. Additionally, during construction closures within the project area on nights and weekends, buses would need to use alternate routes. Options include SR 99, First Avenue S., and Fourth Avenue S., each with various possible transit priority treatments along the alignment.

Exhibit 6-11 identifies travel time variations for general traffic on major bus corridors due to construction during Traffic Stage 7. The corridors assessed are Ballard/downtown Seattle along Elliott Avenue and West Seattle/downtown Seattle and South King County (Burien/downtown Seattle) using SR 99.

For Elliott Avenue, travel times would be generally similar for the 2015 Existing Viaduct and the 2015 Construction. This would be the case for inbound and outbound travel in both the AM and PM peak hours. One exception involves outbound travel in the AM peak hour when travel time during construction would exceed the 2015 Existing Viaduct by 2 minutes. However, this travel time increase is for the off-peak direction, which involves substantially fewer transit passengers than AM peak hour inbound travel.

Exhibit 6-11. Traffic Stage 7 Construction-Related Travel Times (Minutes) Along Major Transit Travel Corridors

	2015 Existing Viaduct	2015 Construction	Change	2015 Existing Viaduct	2015 Construction	Change
	AM Peak Hour			PM Peak Hour		
Elliott Avenue (South of the Ballard Bridge to Denny Way)						
Inbound	8	10	+2	8	8	0
Outbound	8	8	0	7	7	0
Aurora Avenue (South of Aurora Bridge to Denny Way)						
Inbound	5	8	+3	5	4	-1
Outbound	4	4	0	4	6	+2
SR 99 – South End (S. Spokane Street to Seneca/Columbia Street ramps)						
Inbound	7	8	+1	6	7	+1
Outbound	3	4	+1	5	5	0

Along Aurora Avenue, some increases in travel times are expected during construction as compared to the 2015 Existing Viaduct. Increased travel time would occur for AM peak hour inbound trips (3 minutes), PM peak hour inbound trips (1 minute), and PM peak hour outbound trips (2 minutes).

For travel along SR 99 between S. Spokane Street and the ramps at Seneca and Columbia Streets, the durations would be generally similar. With construction, the travel time for inbound trips in the AM peak hour would be about 1 minute longer than those for the 2015 Existing Viaduct. This variation account is attributable to the proposed inbound transit lane that would start north of S. Spokane Street leading up to the point where the northbound mainline transitions from three to two lanes (approximately S. Holgate Street). This lane, to be in place prior to Traffic Stage 7, would allow transit vehicles to bypass much of the potential peak period congestion. The result would be transit travel times approximating the times in the 2015 Existing Viaduct, as well as increased reliability related to transit travel times.

6.1.8 Truck Traffic and Freight

All traffic, including freight, would be hampered during Traffic Stage 7 of the Bored Tunnel Alternative, which is deemed to be the most disruptive stage in terms of traffic effects. Traffic Stage 7 is generally considered the most disruptive stage to traffic because it is expected to last for 8 months (from April to December 2015), it would have the most significant capacity restraints on SR 99, and construction activities would affect nearby surface roadways. In addition, the use of I-5 as an alternative route for trucks during this stage would likely involve the use of east-west city streets to access the freeway.

South Sub-Area

Freight traffic needs to access important freight facilities in the south portion of the study area, including Port of Seattle terminals along the waterfront and the Duwamish industrial area, and to access I-5 and I-90 for longer inter- and intra-region trips. Prior to Traffic Stage 7, the S. Holgate Street to S. King Street Viaduct Replacement Project will provide improved access to freight traffic via an h-shaped overcrossing that extends from the S. Atlantic Street/Colorado Avenue S. intersection to the S. Atlantic Street/E. Marginal Way S. intersection. A more complete description of the overcrossing can be found in Section 4.5.4. It should be noted that through this project, a direct connection between Alaskan Way S. and First Avenue S. via S. Royal Brougham Way will be removed. On the eastside of SR 99, S. Royal Brougham Way will be connected between First Avenue S. and the East Frontage Road.

During Traffic Stage 7, both northbound and southbound SR 99 traffic would use the WOSCA detour, which features two lanes in each direction with a 25 mph design speed. Because of the anticipated congestion brought about by this temporary detour, many longer-distance freight trips may be diverted to I-5 or shift to off-peak periods. In the later part of Stage 7, for up to 3 months, southbound trucks on SR 99 would not be able to exit to either S. Atlantic Street or Royal Brougham Way S. Alternate routes to port facilities along the waterfront would be via Alaskan Way or exit at S. Spokane Street. Northbound trucks on E. Marginal Way S. would be required to use S. Atlantic Street and the East Frontage Road (or First Avenue S.) because Alaskan Way S. would be closed from S. Atlantic Street to S. King Street. A northbound on-ramp to SR 99 would be provided at the S. Royal Brougham/East Frontage Road intersection.

Traffic delays may also be incurred on those routes designated for hauling construction materials and spoils to and from the construction sites. In the south sub-area, the primary construction material haul route would likely use the area around the southbound WOSCA detour off-ramp to S. Atlantic Street. Southbound haul egress would be provided on the existing ramp (which connects to the WOSCA detour). Northbound ingress would feature a temporary adjoining roadway from S. Atlantic Street connecting to the southbound on-ramp at about S. Charles Street. Over-legal loads to the south end of the project area would likely travel via SR 599 to First Avenue S. to the jobsite. Over-legal loads traveling within the city are required to obtain a special permit, and appropriate routes are selected via the permit approval process.

Central Sub-Area

Freight access to and from the Seattle Ferry Terminal at Colman Dock would be maintained during all construction stages. During Traffic Stage 7, two lanes of traffic in each direction would be maintained on the Alaskan Way Viaduct (three

lanes northbound between the First Avenue S. on-ramp and the Western Avenue off-ramp). Due to constrained capacity under this configuration, speeds for all traffic, including eligible freight vehicles, are expected to be slower than those for the 2015 Existing Viaduct. Access to the southbound viaduct structure would be provided via the temporary WOSCA detour. Access for freight would still be provided on Alaskan Way along the central waterfront; however, access at S. King Street is precluded due to its closure between Alaskan Way S. and Railroad Way S. Trucks desiring to access Alaskan Way S. north of S. King Street would be routed underneath the viaduct.

North Sub-Area

During Traffic Stage 7, SR 99 traffic would be diverted onto the Harrison Street/Aurora Avenue ramp, which would be limited to two lanes in each direction between Harrison and Mercer Streets. The design speed would be reduced to 30 mph. Freight traffic could still use the Denny Way southbound off-ramp and northbound on-ramp. Mercer Street would be open in both directions with three lanes each way from Fifth Avenue N. to I-5. The southbound off-ramp to Broad Street and the northbound off-ramp to Mercer Street would be closed. Street closures in place during this stage include Broad Street, Sixth Avenue N. between Thomas and Broad Streets, and Harrison Street between Sixth Avenue N. and SR 99.

Mobility and access for freight would be hampered by major construction activities in this area during Traffic Stage 7. Northbound access to SR 99 would be provided by the Denny Way on-ramp. Southbound egress from SR 99 can be made at a temporary off-ramp onto Broad Street, connecting to Fifth Avenue N. Freight trips from I-5 and to the central waterfront would likely use Mercer Street to Fifth Avenue N. and then to Broad Street. In general, it is likely that many freight vehicles would consider using alternate routes, such as I-5, to bypass congestion and delay caused by major construction activities in this area.

Preliminary routes designated for hauling construction materials and spoils have been identified, including I-5 to Denny Way to Dexter Avenue N. to the jobsite and I-5 to Mercer Street to the jobsite. SR 99 to and from the north is also available as a potential haul route.

Over-legal loads would likely be allowed to travel on state highways during off-peak hours during the day, from 9:00 p.m. to 5:00 a.m. Monday through Friday, and during all hours on the weekends. As noted previously, over-legal loads traveling within the city are required to obtain a special permit, and appropriate routes are selected via the permit approval process.

Freight travel in the corridor may be hampered during project construction because construction activities may occur up to 24 hours per day, 7 days per week for the entire construction period within permitting requirements.

6.1.9 Parking

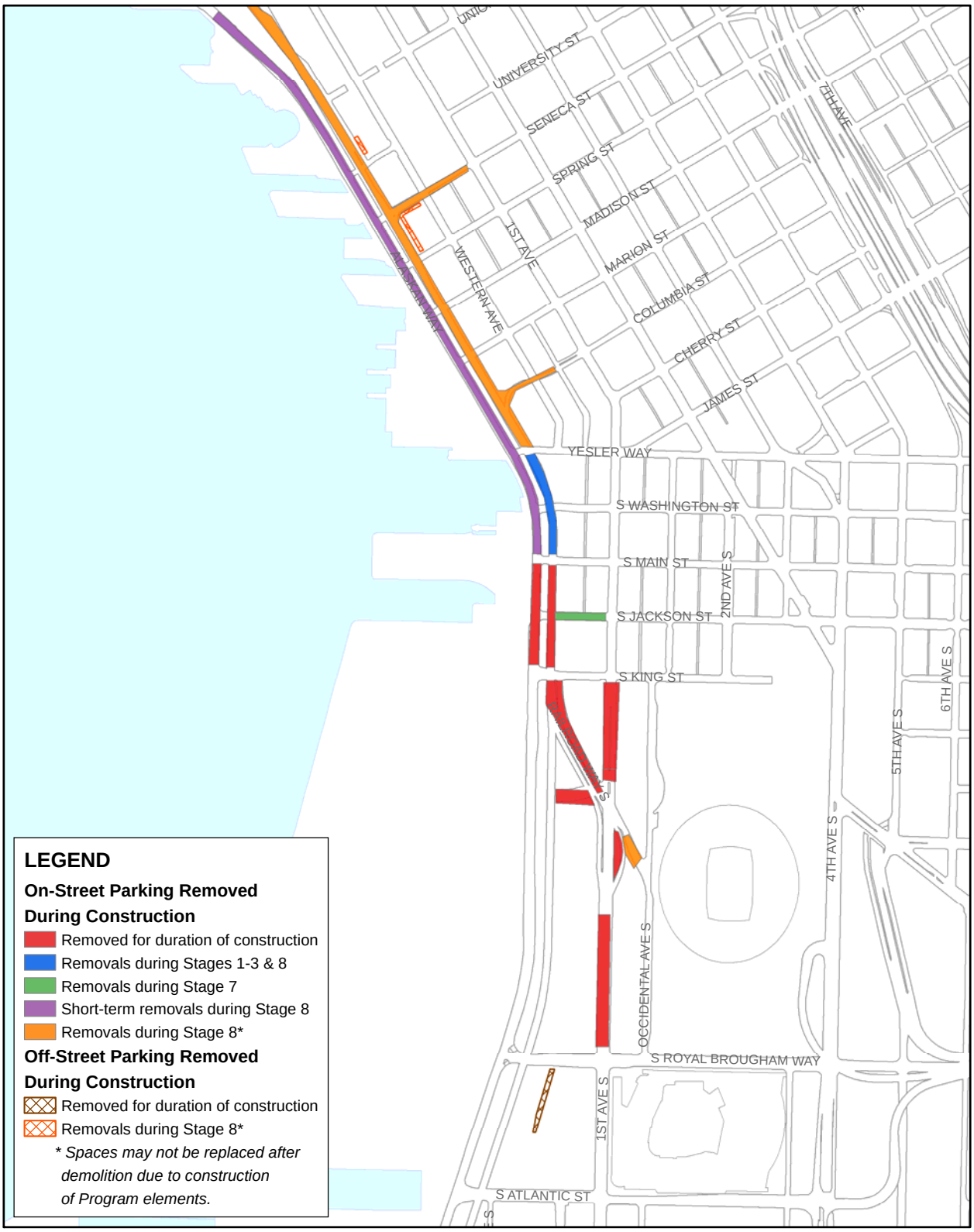
Removal of parking spaces during construction generally includes the spaces that would be permanently affected (as described in Chapter 5), plus those spaces that are needed for construction, staging, or demolition activities. In the whole project area, the maximum number of on-street spaces that would be affected at one time during construction and demolition would be about 1,160 on-street spaces and about 240 off-street spaces, for a total of up to about 1,400 spaces. During Traffic Stages 1 through 7, prior to demolition of the viaduct in Traffic Stage 8 (in early 2016), 680 to 760 on-street spaces and 50 off-street spaces would be affected. Thus, for most of the construction period, a total of 730 to 810 spaces would be affected.

The locations of parking removals are shown in Exhibits 6-12 and 6-13. The amount of parking affected varies by traffic stage. Exhibit 6-14 summarizes the parking effects during Traffic Stages 1 through 7. Exhibit 6-15 summarizes the parking effects during Traffic Stage 8, which would be the stage with the greatest number of parking removals, due to viaduct demolition. In addition to the spaces identified in the exhibits, there may be short-term (such as peak period) parking restrictions on some streets near the portals to help accommodate transit or general-purpose traffic during construction. Relatively short parking restrictions may be needed on Battery Street and on cross streets above the Battery Street Tunnel during decommissioning. Utility relocations also could affect some parking spaces in the project area for a short time. There also may be short-duration parking removals adjacent to some of the buildings above the bored tunnel during the compensation grouting activities.

South Portal Area

In the south portal area, south of S. King Street, about 230 on-street and 50 off-street spaces would be removed during construction. Of the on-street spaces, most are short-term parking, although about 50 long-term spaces would be removed as well. The majority of the on-street parking space removals would be along Railroad Way S. and under the ramps. The 50 off-street spaces that would be affected are located in a public pay lot south of S. Royal Brougham Way, behind Pyramid Alehouse.

The 200 off-street parking spaces on the WOSCA property are currently unavailable due to S. Holgate Street to S. King Street Viaduct Replacement Project construction. Because their removal was accounted for by the S. Holgate Street to S. King Street Viaduct Replacement Project, they are not included as a construction removal for the Bored Tunnel Alternative and are not included in Exhibits 6-14 and 6-15.

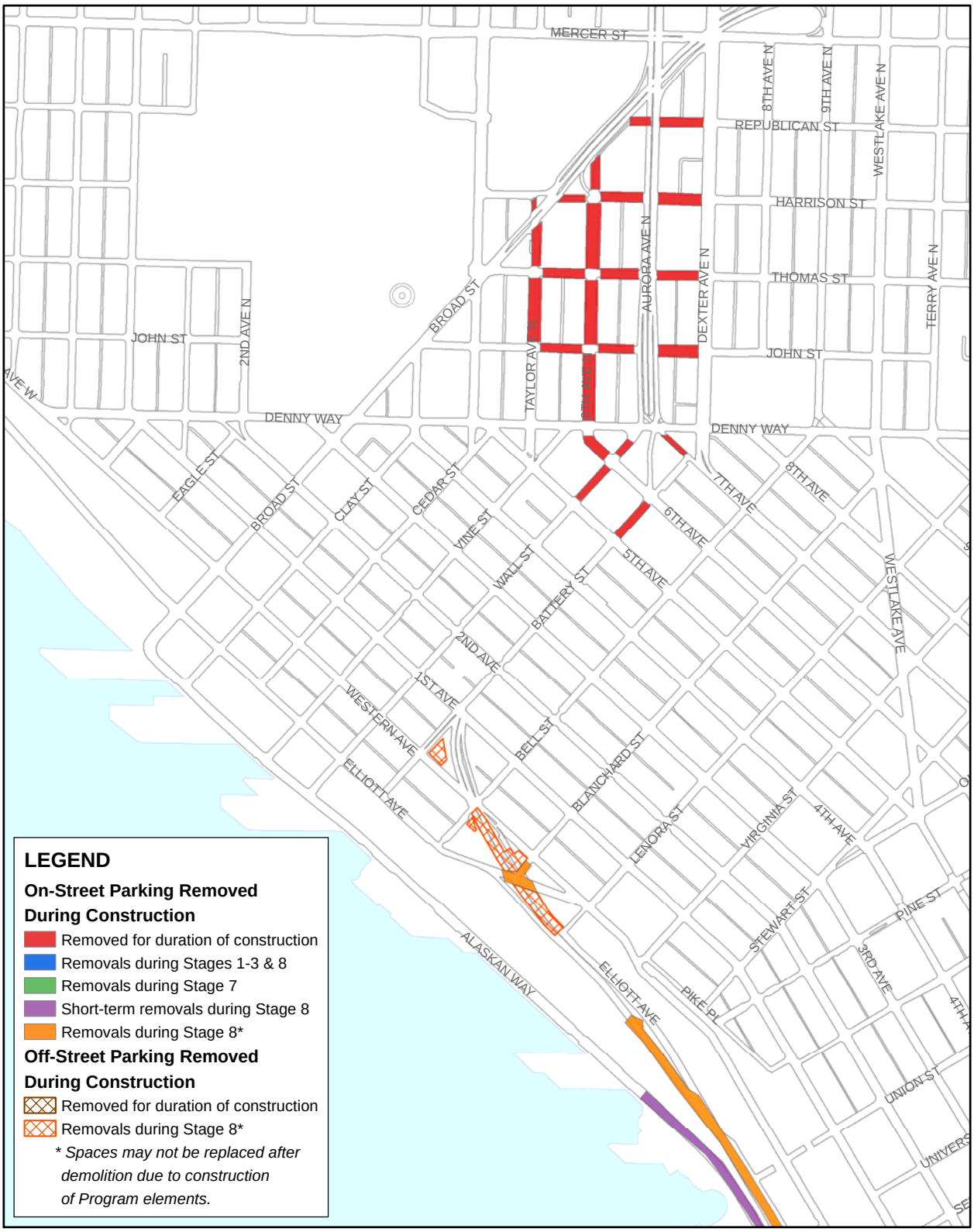


N

0 1,000 Feet

Source: City of Seattle, 2009.

Exhibit 6-12
Locations of Public Parking Affected During Construction - South



N

0 1,000 Feet

Source: City of Seattle, 2009.

Exhibit 6-13
Locations of Public Parking Affected During Construction - North

Exhibit 6-14. Construction Parking Effects of the Bored Tunnel Alternative, Traffic Stages 1 Through 7

	On-Street Spaces			Off-Street Spaces	Total Spaces
	Short-Term	Long-Term	Subtotal		
South portal area	180	50	230	50	280
Central	70 to 150	10	80 to 160	0	80 to 160
North portal area	140	230	370	0	370
Total	390 to 470	290	680 to 760	50	730 to 810

Exhibit 6-15. Construction Parking Effects of the Bored Tunnel Alternative, Traffic Stage 8

	On-Street Spaces			Off-Street Spaces	Total Spaces
	Short-Term	Long-Term	Subtotal		
South portal area	180	50	230	50	280
Central	540 to 550	10	550 to 560	Up to 190	Up to 750
North portal area	140	230	370	0	370
Total	Up to 870	Up to 290	Up to 1,160	Up to 240	Up to 1,400

The removal of about 280 parking spaces in the south portal area is not anticipated to cause a large effect, although some drivers may be slightly inconvenienced. The on-street parking removals along First Avenue S. between S. King Street and Railroad Way S. may affect customer parking for adjacent businesses. However, on-street parking would continue to be available a block to the north and along S. King Street.

Although parking would be reduced compared to today's conditions, ample parking would be available in pay lots near the stadiums. Pay lots in the stadium area are abundant and underutilized on non-event days. The off-street parking utilization rate for the stadium area is about 31.1 percent on an average non-event weekday (PSRC 2006a), suggesting that it is relatively easy to find a pay parking space in the stadium area. In addition, most surface streets in the SODO area allow on-street parking, and some of it is long-term, particularly farther south.

During events such as Seahawks, Mariners, and Sounders games, parking is currently highly utilized, and private lots charge a premium for event parking. Only about 50 off-street parking spaces would be removed during project construction, which is not expected to noticeably affect the overall parking supply in the stadium area. Approximately 6,900 off-street parking spaces are available in the major parking facilities near the stadiums.

Central Sub-Area

In Traffic Stages 1 through 7, there would be up to 150 short-term and 10 long-term spaces in the central sub-area affected by project construction, as shown in

Exhibit 6-14. These spaces are under the viaduct and along Alaskan Way S. south of Yesler Way. In Traffic Stage 8, in early 2016, viaduct demolition would begin to affect parking under the viaduct and along Alaskan Way, quantified in Exhibit 6-15. Approximately 540 on-street parking spaces under the viaduct and ramps from S. King Street to the Battery Street Tunnel portal would be affected during viaduct demolition. Directly following viaduct demolition and removal, the City of Seattle expects to begin work on the waterfront promenade and the new Alaskan Way surface street. Construction of these projects will likely affect parking availability until they are completed in 2018. These projects are separate from the Alaskan Way Viaduct Replacement Project and are discussed in more detail in Section 7.3.4, Parking, in the Cumulative Effects chapter. Prior to viaduct demolition, some parking adjacent to the viaduct would be affected when utilities now on the viaduct are relocated to nearby areas.

There are about 50 on-street parking spaces along Alaskan Way between S. King Street and Pine Street. Although on-street spaces along the Alaskan Way surface street are not under the viaduct, they would be affected because demolition activities would likely encroach on Alaskan Way. To maintain traffic lanes, parking would need to be restricted along several blocks of Alaskan Way. The parking on Alaskan Way between S. King Street and Pine Street is anticipated to be affected at some point during viaduct demolition, but all of these spaces would not be removed at the same time. It is anticipated that two demolition crews would each work on two blocks at a time, so four blocks of parking would be affected for approximately 1 month at a time during demolition. Much of the on-street parking along Alaskan Way consists of loading and taxi waiting areas. These types of spaces would likely be able to be accommodated within a block or two of their existing locations and would only be relocated for a month or two at a time. Up to about 560 on-street parking spaces along Alaskan Way and under the viaduct could be affected at the same time during viaduct demolition.

Up to 190 off-street spaces in the central sub-area (S. King Street to the Battery Street Tunnel) would be affected by viaduct demolition (Traffic Stage 8). Portions of two parking lots just east of the viaduct, one at Seneca Street and one at University Street, would result in a loss of about 40 spaces for about a month, if they are affected at the same time.

Near Elliott and Western Avenues, up to about 140 off-street spaces in the parking lots under the viaduct between Lenora Street and Bell Street would be removed during demolition of this section of the viaduct. Of the 140 spaces, 75 of these are available to the public only during evening/weekend hours. A small public parking lot on the northeast corner of Battery Street and Western Avenue also would be affected during viaduct demolition and Battery Street Tunnel decommissioning, resulting in a total of 150 affected spaces in this area.

The 150 to 190 affected off-street spaces do not include the parking lot on Pier 48 at about S. Main Street, adjacent to Pioneer Square, which may be used for construction staging or construction worker parking. Although this lot is currently used for some public parking, the public parking is a temporary condition, and public pay parking is not an allowable permanent use on that pier.

In addition to the public parking that would be affected during viaduct demolition, about 140 private and reserved spaces are located under or adjacent to the viaduct that are not listed in Exhibit 6-15. Individual block faces have between 0 and 30 private or reserved spaces along the west side of the buildings/ loading docks, with an average of about 15 of these spaces per block. Each block would experience parking removals due to viaduct demolition activities. The private and reserved spaces are primarily used by adjacent businesses for customer and employee parking, and for loading in some cases. Loading zones may be temporarily relocated to adjacent side streets during viaduct demolition.

Many of the piers along the central waterfront have loading spaces and employee and customer parking on the piers, with access from Alaskan Way. Although there would be on-street parking removals along Alaskan Way, access to the piers is not anticipated to be restricted during viaduct demolition, so the parking and loading on the piers would remain available.

With the parking removals during viaduct demolition, it may become more difficult to find parking along the central waterfront and in Pioneer Square during demolition activities. This could result in drivers looking for parking spaces several blocks farther from their destinations than they would normally seek parking, or entering pay lots instead of finding on-street parking.

There are numerous off-street parking lots near the central waterfront. Based on PSRC data from 2006 on off-street parking lots and garages, over 2,700 off-street parking spaces are available within about one block of the viaduct between S. King Street and the Battery Street Tunnel south portal. The large parking garage across from Bell Harbor Conference Center on Western Avenue between Wall and Bell Streets (the Pier 66/Art Institute garage) provides an additional 1,700 spaces.

The City of Seattle commissioned a parking count on a Saturday in August 2006 to capture the parking demands for a busy summer weekend near the central waterfront (Nelson\Nygaard Consulting Associates 2008). The study found that surface lots were fullest, reaching close to 100 percent capacity, by 2:00 pm. The Pike Place Market garage also reached close to 100 percent capacity by 2:00 pm. Other garages farther from Pike Place Market, such as the Pier 66/Art Institute garage, were less full, filled to between 52 and 64 percent of capacity throughout the day.

North Portal Area

In the north portal area, about 370 on-street spaces would be removed during construction. The removals would be needed to accommodate new transit lanes, construction traffic, utility relocations, and other construction activities. No public pay lots would be affected in this area. Of the affected on-street parking spaces, the majority are long-term spaces, as identified previously in Exhibit 6-14. The on-street parking removals include spaces on the following streets:

- Sixth Avenue from Wall Street to Broad Street
- John Street from Taylor Avenue N. to Dexter Avenue N.
- Thomas Street from Taylor Avenue N. to Dexter Avenue N.
- Harrison Street from Broad Street to Dexter Avenue N.
- Republican Street from Broad Street to Dexter Avenue N.
- Taylor Avenue N. between John and Harrison Streets
- Wall Street between Fifth Avenue and Denny Way
- Battery Street between Fifth Avenue and Sixth Avenue
- Seventh Avenue between Battery Street and Denny Way

Several blocks of parking on John Street and Taylor Avenue N., listed above, would be affected due to utility relocations for only 6 months or less. Some private and business parking would be affected by property acquisitions; however, these are not parking lots available to the public. These properties are addressed in the property acquisitions discussion in Appendix G, Land Use Discipline Report, and include the private parking within the fenced lot to south of the existing building between Sixth Avenue N. and Harrison Street, on the east side of Sixth Avenue N., and employee parking spaces in a lot on the north side of Harrison Street, west of Aurora Avenue.

Near the north portal, on-street parking would still be available within several blocks of the spaces that would be removed. Furthermore, there are numerous off-street lots within several blocks of the parking removals. Over 3,100 pay spaces are available between Denny Way and Roy Street, and Fifth Avenue N. and Dexter Avenue N., according to 2006 PSRC data. The 3,100 spaces take into account the removal of spaces for Gates Foundation construction and the new Fifth Avenue Parking Garage. There are no anticipated direct effects on access to these garages during project construction, although there might be construction activities in the vicinity that could affect overall mobility in general. With the removal of 370 parking spaces, there would continue to be nearby parking options; however, it may become slightly more difficult to find parking on event days, and parking in some lots could potentially become more expensive in response to the reduction in the adjacent parking inventory. The PSRC study

found that the total number of off-street parking stalls in the Uptown area totaled 18,564 in 2006, with an occupancy rate of 47.4 percent.

Construction Worker Parking

The number of construction workers is anticipated to start at around 250 workers and ramp up to 500 for 4 years, then taper off toward the end of construction. The work areas for these construction workers would be located in several different locations, with concentrations near the south portal, north portal, and central waterfront as demolition is occurring. Construction workers who are not able to park within the construction zone may seek available long-term parking in the area, first pursuing on-street spaces, then pay lots.

Parking Mitigation

The following strategies could help minimize the use of visitor/customer parking by construction workers during project construction.

- Require a construction worker parking management plan that identifies appropriate parking options for construction workers and discourages use of short-term visitor/customer parking in the project vicinity.

Consider changing some of the all-day metered spaces, particularly those near the north portal, to short-term spaces. Enforcement of the short-term parking regulations in the immediate project area (two- to three-block radius) would likely be needed to maintain turnover. The goal is to ensure a constant supply of short-term parking for customers and to prevent use of these spaces by construction workers.

In addition to the strategies for addressing construction worker parking, a number of parking mitigation strategies could be implemented to address parking disruption by construction activities. These are broad strategies, such as implementing an electronic parking guidance system, that are discussed in more detail in the discussion of cumulative effects in Section 7.3.4.

6.1.10 Pedestrians

Major construction efforts are disruptive to all forms of transportation, and pedestrian travel in and around the construction zone would experience disruption of sidewalk and trail facilities use. Localized sidewalk closures for utility relocation, construction, demolition, and restoration activities would require detours of short duration and distance for pedestrians. However, the duration of disruption and out-of-direction travel would be minimized to the extent practicable to maintain pedestrian mobility and access.

Traffic diverting to arterial and local streets during construction could make it more difficult for pedestrians to cross streets. In particular, First Avenue S.,

Fourth Avenue S., Denny Way, and Dexter Avenue N. are anticipated to carry increased volumes of traffic during construction.

South Portal Area

Pedestrian access in the south portal area would be maintained during all phases of construction via the Port Side Pedestrian/Bike Trail on the western edge of the project area, which runs adjacent to the Port of Seattle facilities. The Port Side Pedestrian/Bike Trail would extend from S. King Street to S. Atlantic Street and would connect to existing pedestrian facilities, requiring minimal to no out-of-direction travel.

First Avenue S. from S. Royal Brougham Way to S. Jackson Street would experience intermittent sidewalk closures, as well as additional traffic on First Avenue S. due to the closures on Alaskan Way S. When a sidewalk closure is required, pedestrians would experience a limited amount of out-of-direction travel to use sidewalk facilities on the opposite side of the roadway or might be required to detour to parallel roadways.

East-west travel within the construction zone (S. King Street to S. Royal Brougham Way) would be restricted for a majority of the traffic stages. East-west access by pedestrians would be largely restricted to S. Atlantic Street and S. Jackson Street, due to the presence of construction staging areas and the need for temporary roadway facilities in this area.

North Portal Area

Pedestrian facilities and access in the north portal area to the east of SR 99 are not expected to be greatly affected during construction of the Bored Tunnel Alternative. Pedestrian facilities and access west of SR 99 between Mercer Street and Denny Way are expected to be affected by both construction activities and construction staging locations.

The area most affected by construction staging locations encompasses the area from Broad Street south to John Street and from SR 99 in the east to Taylor Avenue N. to the west. Intermittent detours and sidewalk closures are expected during Traffic Stage 1 for utility relocations. Sixth Avenue N. between Thomas and Harrison Streets and Harrison Street between SR 99 and Sixth Avenue N. would be closed during Traffic Stages 2 and 3. These areas, along with the sidewalks immediately adjacent to SR 99 between Harrison Street and Denny Way, would experience restrictions and possible closures to complete surface street restoration in the construction area and fill the Battery Street Tunnel portal.

East-west pedestrian travel on Mercer and Broad Streets would experience restrictions during construction activities. East-west pedestrian mobility in this area is already challenging due to limited crossings of SR 99. Particular attention

would be given to minimize the duration of closures and out-of-direction travel by maintaining sidewalk facilities on the opposite side of the roadway. Sidewalks on SR 99 may be closed during construction of the SR 99 overcrossing of Mercer Street.

6.1.11 Bicycles

Generally, bicyclists would face the same lane reductions and closures as other traffic. Bicyclists riding in the street may face increased potential for conflicts with vehicles, given the expected higher traffic volumes and limited travel lanes and reduced space to maneuver on some streets. In particular, First Avenue S., Fourth Avenue S., Denny Way, and Dexter Avenue N. are anticipated to carry increased volumes of traffic during construction.

South Portal Area

As was noted for pedestrians, during all phases of construction bicycle access would be maintained on the Port Side Pedestrian/Bike Trail on the western edge of the project area, which runs adjacent to the Port of Seattle facilities. The Port Side Pedestrian/Bike Trail would extend from S. King Street to S. Atlantic Street and would connect to existing bicycle facilities on either end with minimal to no out-of-direction travel.

First Avenue S. from S. Royal Brougham Way to S. Jackson Street would be reduced to one lane of traffic during much of the construction period. Bicyclists would have the options of continuing to use First Avenue S., using the Port Side Pedestrian/Bike Trail on the western edge of the project area, or diverting to Occidental Avenue S. in the immediate project area. Depending on the origin or destination of the cyclist, they may choose to travel on Fourth Avenue S., sharing the roadway with other vehicular traffic, but avoiding the construction activities in the south portal area. The existing in-street bicycle lanes on Second Avenue and Fourth Avenue through downtown would be maintained throughout the construction period.

As noted for pedestrians, east-west bicycle travel between S. King Street and S. Atlantic Street would be restricted during nearly all traffic stages.

North Portal Area

Generally, bicyclists would face the same lane reductions and closures as other traffic in the north portal area. The in-street, southbound bicycle lane on Dexter Avenue N. would be maintained during all construction activities. However, increased traffic volumes are expected on Dexter Avenue N. and other parallel facilities, which may increase the potential for automobile and bicycle conflicts.

East-west bicycle travel on Mercer Street would experience the same lane reductions and temporary closures as those expected for automobile traffic. As noted for pedestrian travel, particular attention would be given to minimize the duration of closures and, when possible, to schedule closures during less disruptive times.

6.1.12 Ferries

The Seattle Ferry Terminal at Colman Dock at Pier 52 services the largest number of Washington State Ferries customers of any terminal in the system. More recently, the adjacent terminal at Pier 50 is also being used by passenger-only ferry service provided by King County. The Seattle-Bainbridge route carried over 6 million passengers in 2008, with approximately 3 million of those passengers walking onto the ferry and the remainder driving or riding in a vehicle. The Seattle-Bremerton route carried approximately 2.5 million passengers in 2008, with approximately 1.5 million of those walking onto the ferry (PSRC 2009a). Ferry operations, by their nature, result in a very sporadic flow of people and vehicles moving to and from the terminal and put unique demands on the surrounding transportation infrastructure.

The primary construction activities that would affect access to and from the Seattle Ferry Terminal are as follows:

- Alaskan Way would be closed between S. Atlantic Street and S. King Street in Traffic Stages 1 through 7. The permanent alignment would include a new connection for E. Marginal Way S. between S. Dearborn Street and S. Atlantic Street.
- Demolition of the Alaskan Way Viaduct would close sections of Alaskan Way two blocks at a time and would close selected cross streets. Ferry passengers would need to be informed of street closures and short-term detours that may affect their route to and from the Seattle Ferry Terminal.
- Demolition of the Alaskan Way Viaduct would eliminate the pedestrian overpass that currently connects Colman Dock to First Avenue. Until an alternate structure is constructed (as part of the project), pedestrians would need to cross at the street level.

As planning and design of the project and construction staging progresses, coordination with Washington State Ferries staff will continue to take place to ensure that disruptions or degradations to access to and from the Seattle Ferry Terminal are minimized or avoided.

6.1.13 Safety

Driving in a work zone is more dangerous than on other parts of the road. Drivers can become confused by unfamiliar traffic patterns, signage, and cones or barricades in roadway work zones.

FHWA published the Work Zone Safety and Mobility Rule on September 9, 2004, in the Federal Register (69 FR 54562). In accordance with this rule, the project would develop a temporary traffic control plan. Building off of WSDOT's Work Zone Traffic Control Guidelines, this plan would address traffic safety and control throughout the work zone. Work zone management strategies may include using Intelligent Transportation Systems (ITS), traveler information, real-time work zone monitoring, traffic incident management, and enforcement components. WSDOT is also likely to assign a work zone traffic control engineer to the project.

6.1.14 Event Traffic

South Portal Area

Based on existing Safeco Field patronage counts, up to 47,000 attendees can be expected for a full-house baseball event, which may translate to roughly 14,000 additional vehicles on local arterials and regional facilities. Seahawks games, though typically held on Sundays, draw even larger crowds and result in greater levels of traffic demand. While a portion of patrons for both types of events travel via ferry or public transit (5,000 to 7,000 persons), with some growth in these modes projected in the future, the majority of these event-goers are likely to continue to travel via private vehicle and/or carpool.

Event-related access to and from the stadium area during the construction period would continue to rely on key north-south arterials such as First Avenue S. and Fourth Avenue S., but also on the new two-way S. Atlantic Street facility west of First Avenue S. since Phase 2 of the SR 519 Intermodal Access Project has been completed. Event traffic would also continue to use the SR 99 ramps to and from the north off of First Avenue S. (north of S. Royal Brougham Way).

As discussed in Section 6.1.3, during construction of the project elements in the south end, access to and from the stadium area would be similar to existing conditions, including the reconfigured access related to Phase 2 of the SR 519 project, which was completed in early 2010. For the SR 99 corridor, explicit short-term detours and temporary structures would be used while the project elements in the south portal area are being constructed. These detours would occur for Traffic Stages 3 through 7 of the construction schedule and would result in capacity reductions on SR 99. Stadium area ramps to and from the north would be maintained, allowing for similar connections as existing conditions. However,

the southbound off-ramp into the area would be temporarily directed to S. Atlantic Street, which eventually converges with heavy traffic on First Avenue S. and regional trip activity on S. Atlantic Street/SR 519 west of First Avenue S.

The results of construction activity and changes to ramp connections would include potentially higher levels of congestion in the immediate vicinity of the stadiums and, therefore, longer travel times into and out of parking facilities, particularly during large events. Despite the localized effects of the construction period, mainline traffic congestion would not be affected substantially, based on preliminary construction phase analysis results. Specific pedestrian paths and dedicated barriers through construction may be needed to delineate nonmotorized routes near the stadiums. The need for temporary detours, lane closures, and general traffic management for all modes prior to and following events would continue throughout the construction period. Particular emphasis on the intersection of S. Atlantic Street and First Avenue S. would be required, because substantial traffic conflicts and demands would occur for all approaches at this location.

North Portal Area

Based on data collected in 2007 and 2008, over 5,000 events are documented annually at Seattle Center, with the largest concentrations of people and traffic occurring during major Key Arena events such as high-profile concerts, Seattle Storm playoff games, and large-scale weekend festivals. Attendance at regional events such as Bumbershoot, Folklife festival, and the Bite of Seattle has been shown to reach up to 60,000 persons daily. Peak loads can be as high as 17,000 person-trips for a Key Arena event, and as high as 200,000 during a festival weekend such as Folklife or Bumbershoot. Such attendance levels translate fairly directly to high levels of traffic demand in terms of volumes circulating within and around the Seattle Center area.

Construction activity in the north end could cause major disruptions to these large events at Seattle Center due to temporary lane closures, detours, and access modification to SR 99 ramps, especially during early stages of the Mercer Street and north portal construction. However, these disruptions should be reasonably well managed due to the temporary retention of critical access ramps and mainline SR 99 capacity. For Traffic Stage 7 (deemed a worst-case snapshot for the SR 99 corridor), the reconfiguration of Mercer Street to a two-way arterial from Dexter Avenue N. to Fifth Avenue N. is assumed to be largely complete. However, Sixth Avenue N. remains closed during this stage, thereby limiting any benefits of new SR 99 crossings (from Thomas Street to Broad Street) while they are under construction. SR 99 in the vicinity of Harrison Street is assumed to operate on a temporary construction-phase structure that reduces the current

cross-section of three lanes in each direction to two lanes in each direction. The horizontal geometry of this temporary structure is expected to only accommodate mainline speeds of 35 to 40 mph, thereby limiting capacity in this section of SR 99.

Based on these Traffic Stage 7 changes, the primary effects to event traffic would likely be related to mainline SR 99 capacity reductions and to a lesser degree the temporary absence of connections across SR 99 on arterials between Denny Way and Mercer Street.

A full suite of measures related to signage, signal timing and operations, road closures, and detours would be critical for maintaining reasonable levels of traffic flow and circulation near Seattle Center during major events, particularly onto and off of SR 99. Flaggers or police details at key intersections may also be needed during major events at Seattle Center to establish clear event way-finding routes and detours, including turn restrictions. In addition, Seattle Center's Fiftieth Anniversary celebration will be held from April to October 2012 and may require consideration of additional mitigation measures due to potentially higher-than-average patronage. Ongoing coordination with Seattle Center would help identify issues and target specific potential mitigation measures.

6.2 Construction Mitigation

WSDOT, King County, and the City of Seattle have developed Transportation Improvements to Minimize Traffic Effects During Construction to keep people and goods moving during construction of the Program. These enhancements and improvements are independent projects that will benefit all pending Program elements. They are designed to increase transit options, shift traffic away from construction areas, and provide drivers with the information they need to choose less congested routes.

These plans include the following elements:

- Variable speed signs and travel time signs on I-5 to help maximize safety and traffic flow.
- Funding for SR 519 Phase 2 to improve connections from I-5 and I-90 to the waterfront. This project is now completed.
- Funding for the S. Spokane Street Viaduct Widening Project, which includes a new Fourth Avenue S. off-ramp for West Seattle commuters.
- Funding for some increased bus service in the West Seattle, Ballard/ Uptown, and Aurora Avenue corridors during the initial portions of the construction period, as well as a bus travel time monitoring system.
- New traffic technology on SR 99 and major routes leading to SR 99 to keep people and goods moving.

- Upgraded traffic signals and driver information signs for the Elliott Avenue W./15th Avenue W., south of downtown, and West Seattle corridors to support transit and traffic flow.
- Information about travel alternatives and incentives to encourage use of transit, carpool, and vanpool programs.

Many of these build upon projects already underway by King County and the City of Seattle to fully fund critical projects and advance elements of Metro's RapidRide services. Transit enhancements and improvements to the street system will play a major role in keeping people and goods moving during construction of the S. Holgate Street to S. King Street Viaduct Replacement Project, starting in 2010. These improvements will remain useful to travelers during construction of the Bored Tunnel Alternative.

In addition to the Transportation Improvements to Minimize Traffic Effects During Construction and the transit-related projects, more localized mitigation measures will be developed as construction details are refined. Some localized construction mitigation measures specific to this project might include the following:

- Construction of temporary signals.
- Provision of flaggers at certain intersections to facilitate freight and general-purpose traffic movements, as well as to expedite emergency vehicles.

In addition, preparation of a traffic management plan will be required, to be accepted by the City of Seattle, to ensure that construction effects on local streets, property owners, and businesses are minimized. The traffic management plan will include at a minimum the following measures:

- Descriptions of traffic phasing to accommodate construction staging. The phasing will include conceptual maintenance of traffic (MOT) plans, expected general-purpose traffic restrictions by construction phase and roadway, and transportation-mode-specific impacts and mitigation.
- Descriptions of the requirements for temporary roadways.
- Procedures to identify and incorporate the needs of transit operators, utility owners, ferry traffic, Port of Seattle traffic, and business owners in the project area.
- Procedures to identify and incorporate pedestrian and bicycle flow needs and impacts, including mitigation for sidewalk closures, requirements related to the Americans with Disabilities Act (ADA), etc.
- Procedures for obtaining concurrence of stakeholders and implementing road and lane closures.

- Procedures to identify and incorporate the needs of local agencies affected by the work, specifically but not limited to the Port of Seattle and access to Terminal 46, etc.
- Processes for signing transitions during construction from one stage to the next, and from interim to permanent signing.
- Procedures to identify and incorporate the needs of emergency service providers, fire, law enforcement entities, and other related corridor users, as well as procedures to ensure all information required by these agencies to protect the public is made available.
- Provisions for incident and emergency response.
- Processes to identify, produce, and receive acceptance for designs of temporary traffic signals.
- Methods and frequency of inspection and maintenance of all traffic control throughout the project area.
- Descriptions of contact methods, personnel available to make decisions and ensure that issues are addressed in a timely and appropriate manner, and response times for any conditions requiring attention and response 24 hours a day.
- Identification of measurable limits for the repair and replacement of traffic control devices, including temporary and permanent pavement markings.
- Processes to determine the needs for revised traffic signal timings, and if revisions are required, detail the procedures for the development, review and acceptance, implementation, testing, and maintenance of all affected signals.
- Provisions to maintain existing access to all properties.
- Provisions to provide continuous access to established truck routes, hazardous material routes, transit routes, and school bus routes.
- Procedures to modify the plans as needed to adapt to current project circumstances.
- Procedures for incorporating the needs of event traffic.
- Procedures to determine detour routes.
- Procedures to communicate MOT information to project public information personnel, and to notify the public of MOT issues.
- Procedures to accommodate adjacent project's MOT plans, if applicable.
- Procedures to accommodate the MOT plans when the staging schedule of the project or any adjacent project changes.
- Identification of temporary access connections between facilities.
- Identification of haul routes.

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Chapter 7 CUMULATIVE EFFECTS

Cumulative effects are effects on the environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions.

The Bored Tunnel Alternative would replace SR 99 between S. Royal Brougham Way and Roy Street and includes associated improvements, such as the relocation of utilities located on or under the viaduct, the removal of the viaduct, the decommissioning of the Battery Street Tunnel, and improvements to the surface streets in the tunnel's south and north portal areas. Also included are improvements to the Mercer Street corridor from Dexter Avenue N. to Fifth Avenue N., and to Sixth Avenue N. from Wall Street to Mercer Street. In addition, Broad Street would be closed from Taylor Avenue N. to Ninth Avenue N.

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. One or two new surface streets would be constructed between S. Royal Brougham Way and S. King Street. Full northbound and southbound access to and from SR 99 would be provided near Harrison and Republican Streets. The existing on- and off-ramps provided at Denny Way would be 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.

The project complements a number of other independent projects that would improve safety and mobility along SR 99 and the Seattle waterfront, from the SODO area to Seattle Center. Collectively, these individual projects are often referred to as the Program. This collection of projects is categorized into three groups: roadway elements, non-roadway elements, and projects under construction. The roadway and non-roadway elements are conceptual in nature at this stage and will be the subject of separate environmental processes. The cumulative effects of the Project and the other Program elements are described in Section 7.1. The analysis of cumulative effects discussed in Section 7.2 includes the combined effect of the Bored Tunnel Alternative, other Program elements, and other past, present, and future projects that are anticipated to add to the transportation effects in the study area. Section 7.3 discusses cumulative effects during construction.

7.1 Cumulative Effects of the Project and Other Program Elements

Assessment of the cumulative effects of the Program includes an assessment of the Bored Tunnel Alternative plus other Program elements. This section discusses the same performance measures as those discussed in Section 5.1, but it focuses on the differences between the Program and the Bored Tunnel Alternative.

The following modeled conditions are compared in this section:

- 2015 Project (Bored Tunnel Alternative) compared to 2015 Program (Bored Tunnel Alternative plus all Program elements except the First Avenue Streetcar Evaluation and King County Metro transit improvements) and 2015 Program Plus Enhanced Transit (Bored Tunnel Alternative plus all Program elements).
- 2030 Project (Bored Tunnel Alternative) compared to 2030 Program.

The Program elements are described below. They are categorized into roadway elements and non-roadway elements, which are conceptual at this time.

7.1.1 Description of Program Elements

Roadway Elements

The roadway elements are conceptual and continue to be refined. Conceptual project descriptions are provided below.

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

The new Alaskan Way surface street is conceptual at this stage and will be the subject of a separate environmental review process and design effort. 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, a bicycle facility, parking and loading zones, and signalized pedestrian crossings at cross streets.

Elliott/Western Connector – Pike Street to Battery Street

The Elliott/Western Connector is conceptual at this stage and will be the subject of a separate environmental review process. 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 provide a grade-separated crossing of the BNSF mainline railroad tracks. 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 downtown Seattle (including Ballard and Magnolia). The new roadway would include bicycle and pedestrian facilities. The grade would be a maximum of about 6 percent. The Lenora Street pedestrian bridge would connect to an at-grade pedestrian crossing of this new connector arterial, whereas today it is a grade-separated crossing.

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.

Non-Roadway Elements

The non-roadway elements are conceptual and continue to be refined. Conceptual project descriptions are provided below.

First Avenue Streetcar Evaluation

The First Avenue streetcar is currently planned to run between S. Jackson Street and Republican Street along First Avenue and would include an extension, via Stewart Street, to the South Lake Union streetcar line. The First Avenue streetcar would connect to the First Hill streetcar line. The maintenance base would likely be either at the extension of the South Lake Union line or at a new maintenance base that would be built as part of the First Hill streetcar line. The First Avenue streetcar is not included in the 2015 Program, but it is included in the 2015 Program Plus Enhanced Transit.

Transit Enhancements

A variety of transit enhancements would be provided to support planned transportation improvements associated with the Program and accommodate future demand. These 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 South Lake Union and Uptown, (4) local bus changes (such as realignments and a few additions) to several West Seattle and northwest Seattle routes, (5) transit 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. These transit enhancements are not included in the 2015 Program, but they are included in the 2015 Program Plus Enhanced Transit.

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 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, the promenade 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 spaces 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.

Projects Under Construction

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

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 (FHWA and WSDOT 2008), and the Finding of No Significant Impact was published in February 2009 (FHWA and WSDOT 2009). Construction began in mid-2009 with early utility relocations, and project construction is expected to be completed at the end of 2014. This project is included in the 2015 Existing Viaduct.

Transportation Improvements to Minimize Traffic Effects During Construction

Several transportation improvements are underway to help offset traffic effects during construction of the projects included in the Program. Construction or implementation of these improvements is underway and includes the following:

- Adding variable speed signs and travel time signs on I-5 to help maximize safety and traffic flow.
- Providing funding for the S. 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.

7.1.2 Regional Context and Travel Patterns

Vehicle Miles of Travel

Key Findings

There is little difference in VMT among the 2015 Project, Program, and Program Plus Enhanced Transit for Seattle's Center City area. This pattern generally holds true for the four-county Puget Sound region as well.

Percentage growth in VMT (from 2015 to 2030) is higher outside of Seattle's Center City area despite the higher growth rates in jobs and population. This is likely due to the disproportionately higher number of trips to and from downtown that are expected to be accommodated by transit in the future as compared to the rest of the region.

VMT for the 2015 Project, Program, and Program Plus Enhanced Transit and the 2030 Project and Program is shown in Exhibit 7-1.

Exhibit 7-1. Vehicle Miles of Travel

Performance Measure	2015				2030	
	Existing Viaduct	Project	Program	Program + Transit[1]	Project	Program
Seattle's Center City						
AM	433,100	427,000	427,800	427,800	443,800	444,600
PM	537,500	530,600	530,900	530,900	557,400	558,100
Daily	2,432,700	2,406,700	2,407,700	2,407,600	2,533,900	2,535,100
Four-County Region						
AM	18,028,300	18,020,100	18,023,300	18,021,000	20,292,700	20,292,000
PM	21,233,700	21,227,300	21,229,400	21,227,400	24,008,900	24,004,000
Daily	97,233,000	97,213,100	97,219,300	97,213,100	109,718,600	109,710,800

[1] Program Plus Enhanced Transit

As shown in Exhibit 7-1, for Seattle's Center City area during the AM and PM peak period, the 2015 Project, Program, and Program Plus Enhanced Transit show approximately the same level of VMT. Due to growth in population and employment, both the 2030 Project and the 2030 Program during the AM and PM peak periods show increases in VMT of about 4 to 5 percent over the comparable 2015 Project and 2015 Program levels. Daily VMT levels increase for both the 2030 Project and 2030 Program by about 5 percent over the comparable 2015 Project and 2015 Program levels (around 127,000 miles for each). There is little difference in VMT between the 2015 Program and the 2015 Program Plus Enhanced Transit. This is primarily because the additional transit service provided in the 2015 Program Plus Enhanced Transit is relatively small compared to the transit service already included in the 2015 Program. Furthermore, the additional transit service in the 2015 Program Plus Enhanced Transit attracts riders

from other transit trips (e.g., the First Avenue streetcar attracts riders from buses), so overall, the share of vehicle traffic does not change substantially.

In looking at the four-county region, there is no meaningful difference in VMT among the 2015 Project, the 2015 Program, and the 2015 Program Plus Enhanced Transit and between the 2030 Project and the 2030 Program. In general, for all time periods, VMT for the 2030 Project and 2030 Program increases by about 13 percent over the comparable 2015 Project and the 2015 Program levels (a daily increase of about 12.5 million miles in both cases). Despite the fact that population and employment are expected to grow at a faster rate in the Center City area in comparison to the four-county region as a whole, the 2015 to 2030 VMT growth rate for the four-county region is higher than that of the comparable Center City growth rate (about 4 to 5 percent). This is likely due to the increased use of transit for travel to and from the Center City area in the future, which allows the accommodation of more trips in relatively fewer vehicles. Increased parking and automobile operating costs as well as future investments in higher-density housing within the Center City may also help to reduce the growth in VMT by inducing more pedestrian and bicycle trips.

Vehicle Hours of Travel

Key Findings

There is no meaningful difference in VHT among the 2015 Project, Program, and Program Plus Enhanced Transit for the Center City area. This pattern also holds true for the four-county Puget Sound region.

While percentage growth in VHT (from 2015 to 2030) is higher outside of the Center City, which is similar to the VMT pattern, VHT growth is more pronounced than what was seen for VMT. This is likely the result of a greater increase in congestion in suburban communities than on Seattle streets, which are already congested during peak travel periods, as well as an increased emphasis on transit to and from the Center City area.

VHT for the 2015 Program and Program Plus Enhanced Transit and the 2030 Project and Program is shown in Exhibit 7-2.

As shown in Exhibit 7-2, for Seattle's Center City area during the AM and PM peak period, the 2015 Project, Program, and Program Plus Enhanced Transit show approximately the same level of VHT. Due to growth in population and employment, both the 2030 Project and the 2030 Program during the AM and PM peak period show increases in VHT of almost 9 percent in the AM and 25 to 26 percent in the PM peak period over the comparable 2015 Project and 2015 Program levels. Daily VHT levels increase for both the 2030 Project and 2030 Program by 14 to 15 percent (12,900 and 12,600 hours, respectively) over the comparable 2015 Project and 2030 Program levels.

There is little difference between the 2015 Program and the 2015 Program Plus Enhanced Transit, which corresponds with the fact that overall VMT did not change significantly between these modeled conditions. Again, this is because the enhanced transit service did not tend to change the share of vehicle traffic to any substantial degree.

Exhibit 7-2. Vehicle Hours of Travel

Performance Measure	2015				2030	
	Existing Viaduct	Project	Program	Program + Transit[1]	Project	Program
Seattle's Center City						
AM	16,800	17,200	17,000	17,000	18,700	18,500
PM	23,800	24,500	24,200	24,200	30,700	30,400
Daily	87,200	88,500	87,800	87,800	101,400	100,400
Four-County Region						
AM	747,200	747,600	747,300	747,100	1,104,500	1,104,400
PM	858,100	858,900	859,100	858,900	1,232,700	1,232,400
Daily	3,311,300	3,312,900	3,312,800	3,312,200	4,428,000	4,427,300

[1] Program Plus Enhanced Transit

In looking at the four-county region, there is no meaningful difference in VHT among the 2015 Project, the 2015 Program, and the 2015 Program Plus Enhanced Transit and between the 2030 Project and the 2030 Program. Again, in comparing the growth between 2015 and 2030, the percentage growth in VHT is more pronounced than what was seen for VMT, which could be caused by increased delay due to more traffic congestion on regional streets and highways. For the AM peak period, the 2030 Project and Program VHT increases by about 48 percent over that of the comparable 2015 Project and Program levels. For the PM peak period, the 2030 Project and Program VHT increases about 44 percent over the comparable 2015 Project and Program levels. Daily VHT growth between 2015 and 2030 for the above modeled conditions is about 34 percent (1.1 million hours for each).

Vehicle Hours of Delay

Key Findings

There is no meaningful difference in VHD among the 2015 Project, Program, and Program Plus Enhanced Transit for the Center City area. This pattern also holds true for the four-county Puget Sound region.

The percentage growth in VHD (from 2015 to 2030) is higher than what was seen in the VHT results, because delay continues to be a growing problem throughout the Center City area and four-county Puget Sound region.

By 2030, the higher percentage growth in VHD is projected to occur outside the city of Seattle, reflecting the higher number of trips to and from downtown that are expected to be accommodated by transit in the future.

VHD for the 2015 Project, Program, and Program Plus Enhanced Transit and the 2030 Project and Program is shown in Exhibit 7-3.

Exhibit 7-3. Vehicle Hours of Delay

Performance Measure	2015				2030	
	Existing Viaduct	Project	Program	Program + Transit[1]	Project	Program
Seattle's Center City						
AM	5,300	5,700	5,500	5,500	6,700	6,500
PM	9,100	9,900	9,700	9,700	15,200	14,900
Daily	22,700	24,300	23,700	23,700	33,300	32,400
Four-County Region						
AM	253,500	254,000	253,700	253,600	533,100	533,000
PM	271,700	272,600	272,700	272,600	549,900	549,800
Daily	678,200	679,700	679,800	679,300	1,374,900	1,374,600

[1] Program Plus Enhanced Transit

As shown in Exhibit 7-3, forecasts of total VHD in Seattle's Center City area remain relatively constant for the 2015 Project, Program, and Program Plus Enhanced Transit for all time periods. Both the 2030 Project and 2030 Program for the AM and PM peak period show increases in VHD. For the AM, the increase is about 18 percent, and for PM the increase is about 54 percent over the comparable 2015 Project and Program levels. Daily VHT levels increase for both the 2030 Project and 2030 Program by about 37 percent (9,000 and 8,700 hours, respectively) over the comparable 2015 Project and Program levels. Once again, there was not a notable difference in VHD between the 2015 Program and the 2015 Program Plus Enhanced Transit. This is consistent with the results for VMT and VHT, which reflect the lack of appreciable change in the share of vehicle traffic due to the enhanced transit service (most new transit trips diverted from a different transit route).

For the four-county Puget Sound region, there is no meaningful difference in VHD among the 2015 Project, the 2015 Program, and the 2015 Program Plus Enhanced Transit and between the 2030 Project and the 2030 Program during all time periods. In comparing 2015 and 2030, the percentage growth in VHD is more pronounced than what was seen for VHT, which could be the result of more traffic encountering more congested road conditions, particularly in the growing urban centers outside of the Center City area. For the AM peak period, the 2030 Project and Program VHD increases by about 110 percent over the comparable 2015 Project and Program levels. For the PM peak period, the 2030 Project and Program VHD increases by about

102 percent over the comparable 2015 Project and Program levels. The increase in daily VHT between 2015 and 2030 for the above modeled conditions is also about 102 percent (around 695,000 hours in both cases). In looking at the Center City area increases noted in the preceding paragraph, the increase in VHD between 2015 and 2030 is less pronounced than for the full region. This is likely because a higher number of trips to and from downtown are expected to be accommodated by transit in the future in comparison to the region as a whole.

Vehicle Volumes on Screenlines and Key Facilities and Arterials

To evaluate cumulative effects on parallel streets and highways, AM and PM peak period and daily traffic volumes were assessed for the 2015 Project, 2015 Program, 2015 Program Plus Enhanced Transit, 2030 Project, and 2030 Program. The same six screenlines evaluated in Chapter 5 were used in this assessment.

Key Findings

The Spokane, south, and central screenline totals are fairly consistent across the 2015 Project, 2015 Program, 2015 Program Plus Enhanced Transit, 2030 Project, and 2030 Program.

Growth in screenline volumes between the 2015 Project, Program, and Program Plus Enhanced Transit and the 2030 Project and Program is generally marginal because streets and highways are already congested for many hours of the day, and more trips are expected to be accommodated by transit to and from and within the Center City area in the future.

For the 2015 Program, the 2015 Program Plus Enhanced Transit, and the 2030 Program, the Elliott/Western Connector improves connectivity and access for Alaskan Way traffic, thus attracting higher demand on this facility in the 2015 Program and 2030 Program as opposed to the 2015 Project and 2030 Project.

Vehicle volumes on east-west arterials north of the Ship Canal have very minor differences across the 2015 Project, Program, and Program Plus Enhanced Transit and the 2030 Project and Program, indicating that the differences in the roadway networks provided by the 2015 Program and 2030 Program versus the 2015 Project and 2030 Project do not affect east-west travel north of the Ship Canal.

Screenline Vehicle Volumes

Exhibit 7-4 provides a comparison of the screenline totals by modeled condition and time period for the four Center City screenline locations.

Exhibit 7-4. Model-Estimated Vehicle Volumes at Screenlines

Performance Measure	2015				2030	
	Existing Viaduct	Project	Program	Program + Transit[1]	Project	Program
Spokane Screenline (North of S. Spokane Street)						
AM peak hour	33,340	33,040	33,110	33,100	34,680	34,760
PM peak hour	37,270	36,770	36,870	36,880	38,590	38,700
Daily	473,700	469,000	469,900	470,100	497,300	498,600
South Screenline (South of S. King Street)						
AM peak hour	36,670	36,150	36,320	36,340	37,540	37,730
PM peak hour	42,730	42,110	42,360	42,400	43,640	43,980
Daily	534,100	536,500	538,800	539,200	561,400	564,800
Central Screenline (North of Seneca Street)						
AM peak hour	33,250	32,790	33,050	33,070	33,970	34,280
PM peak hour	37,270	36,710	37,100	37,100	37,810	38,240
Daily	483,100	477,700	480,600	480,800	496,600	500,800
North Screenline (North of Thomas Street)						
AM peak hour	39,500	39,050	38,390	38,400	40,440	40,020
PM peak hour	43,130	43,460	42,590	42,560	46,070	45,330
Daily	544,700	550,200	537,900	538,100	582,300	569,700

[1] Program Plus Enhanced Transit

Spokane Screenline

The Spokane screenline volumes are extremely consistent across the 2015 Project, Program and Program Plus Enhanced Transit and between the 2030 Project and Program, as shown in Exhibit 7-4. The growth in volume from 2015 to 2030 for was 5 percent in the peak periods and 6 percent daily (an increase of 28,300 and 28,700 hours) for the Project and the Program, respectively. This relatively low growth in vehicle trips is reflective of the higher transit use to and from downtown Seattle expected in the future, and the already high utilization of roadway capacity in the 2015 Project, Program, and Program Plus Enhanced Transit, which limits the amount of traffic growth that can occur.

Since the Spokane screenline is farther from the cumulative effects elements in the 2015 Program and 2030 Program, the volume differences between the 2015 Project and 2015 Program and the 2030 Project and the 2030 Program are all very minor.

South Screenline

Similar to the Spokane screenline, as shown in Exhibit 7-4, the vehicle volumes at the south screenline are fairly consistent across the 2015 Project, Program, and Program Plus Enhanced Transit for all time periods. The same can also be said for the 2030 Project and Program. Growth in screenline volumes between 2015 and 2030 is generally marginal, as volumes for the 2030 Program are almost 4 percent higher than the comparable 2015 Program levels for the AM and PM peak periods.

The daily volume growth between the 2015 Project and 2030 Project and the 2015 Program and 2030 Program is 5 percent (24,900 and 26,000 trips, respectively). As with the Spokane screenline, the limited growth is due in part to increased transit usage and high utilization of roadway capacity. Percentage growth in volumes for the 2030 Project over the comparable 2015 Project is slightly lower than that for the 2030 Program versus the 2015 Program (2015 to 2030). The reason that volumes between 2015 and 2030 grow slightly more for the Program than for the Project is likely because the Elliott/Western Connector along with the enhanced Alaskan Way along the waterfront provide the Program with a little more capacity to grow compared to the Project.

Central Screenline

Like the results for the Spokane and south screenlines, the vehicle volumes at the central screenline (see Exhibit 7-4) are fairly consistent across the 2015 Project, Program, and Program Plus Enhanced Transit for all time periods. The same can also be said for the 2030 Project and Program. Growth in volumes between 2015 and 2030 is generally marginal, as volumes for both the 2030 Project and Program are about 3 to 4 percent higher than the comparable 2015 Project and Program in the peak periods and 4 percent higher (18,900 and 20,200 trips, respectively) daily.

North Screenline

Continuing the trend shown in the Spokane, south, and central screenlines, the vehicle volumes at the north screenline (see Exhibit 7-4) are fairly consistent across the 2015 Project, Program, and Program Plus Enhanced Transit for all time periods. The same can also be said for the 2030 Project and Program. Although the numbers are similar between Project and Program for the 2015 and 2030 modeled conditions, this is the only screenline where Program volumes were lower than the same year Project (by about 2 percent for both 2015 and 2030). Growth in volumes between 2015 and 2030 is slightly higher than what was seen in the south and central screenlines, which could be the result of higher population and employment growth in the South Lake Union area. Vehicle volumes for the 2030 Project and Program are about 4 percent higher during the AM peak period and 6 percent higher during the PM peak period than the comparable 2015 Project and Program. Daily vehicle volumes for the 2030 Project and Program are 6 percent higher (32,100 and 31,800 trips, respectively) compared to the comparable 2015 Project and Program. Percentage growth in volumes for the 2030 Project over the 2015 Project is slightly lower than that for the 2015 Program versus the 2015 Program (2015 to 2030) for all time periods. Increases in volume at this screenline range from 3 percent to over 6 percent, regardless of the time period.

Volumes on Key Facilities and Arterial Screenlines

Exhibits 7-5 and 7-6 graphically compare daily volumes for the 2015 Project and 2030 Project versus the 2015 Program and 2030 Program at key locations on SR 99, I-5, and Alaskan Way and across selected screenlines for arterial volumes (i.e., these screenlines do not include SR 99 or I-5 volumes) at locations generally similar to the four summarized in tabular format in Exhibit 7-4.

Two screenlines, measuring volumes traveling east and west near Aurora Avenue in north Seattle, as outlined in Chapter 5, were also evaluated. Exhibit 7-7 shows these volumes graphically.

S. Spokane Street Area Facilities

The S. Spokane Street area facility volumes are extremely consistent across all modeled conditions for both 2015 and 2030. Daily traffic on the arterials shows the same consistency on this screenline, shown in Exhibit 7-6, and the projected volumes on SR 99 (Exhibit 7-5).

South Area Facilities

As shown in the graphic in Exhibit 7-5, volumes on individual streets can fluctuate greatly depending on the effects of certain modeled conditions regardless of the fairly consistent total volume across the entire screenline. A case in point is Alaskan Way S. south of S. King Street. At this location, with the 2015 Project and 2030 Project, daily volumes are significantly lower than the 2015 Program, 2015 Program Plus Enhanced Transit, and 2030 Program. The higher capacity waterfront boulevard as well as the inclusion of the Elliott/Western Connector in the respective modeled Program conditions helps to improve capacity, connectivity, and access to the central waterfront and Alaskan Way, which attracts higher demand at this location. For the north-south arterials along the south screenline between SR 99 and I-5, as seen in Exhibit 7-6, the three modeled Program conditions (2015 Program, 2015 Program Plus Enhanced Transit, and 2030 Program) all show slightly lower volumes than the comparative 2015 Project and 2030 Project. These vehicle volumes are lower because Alaskan Way, which is not included in this screenline, is attracting more traffic in the modeled Program conditions, reducing volumes that enter, exit, or travel through downtown via other arterials.

Central Area Facilities

Like the south screenline, the 2015 Program , 2015 Program Plus Enhanced Transit, and 2030 Program all show slightly lower volumes than the 2015 Project and 2030 Project for north-south arterials west of I-5 (see Exhibit 7-6). Again, these vehicle volumes are lower because Alaskan Way, which is not included in the screenline, is attracting more traffic in the modeled Program conditions, reducing volumes that

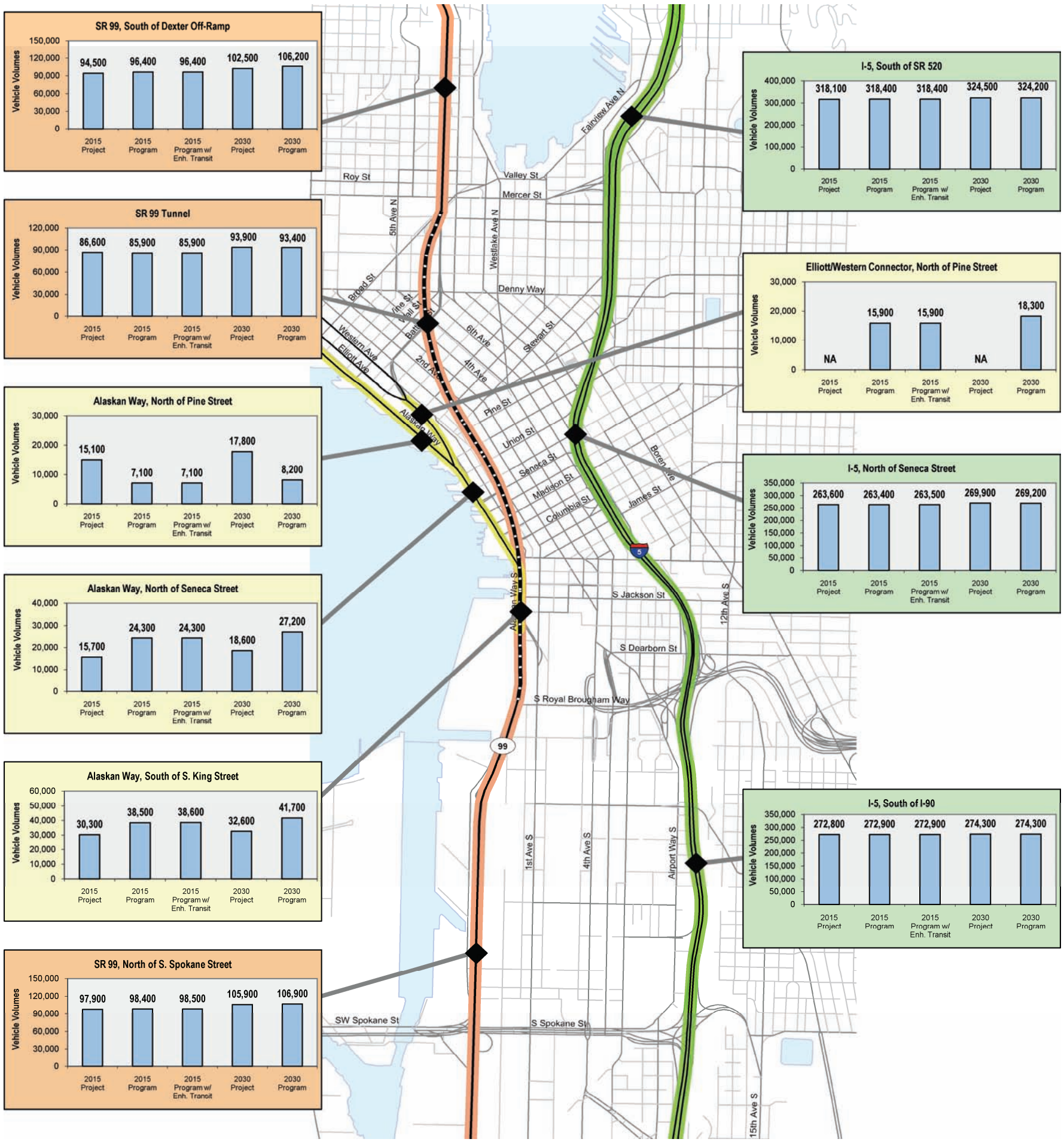
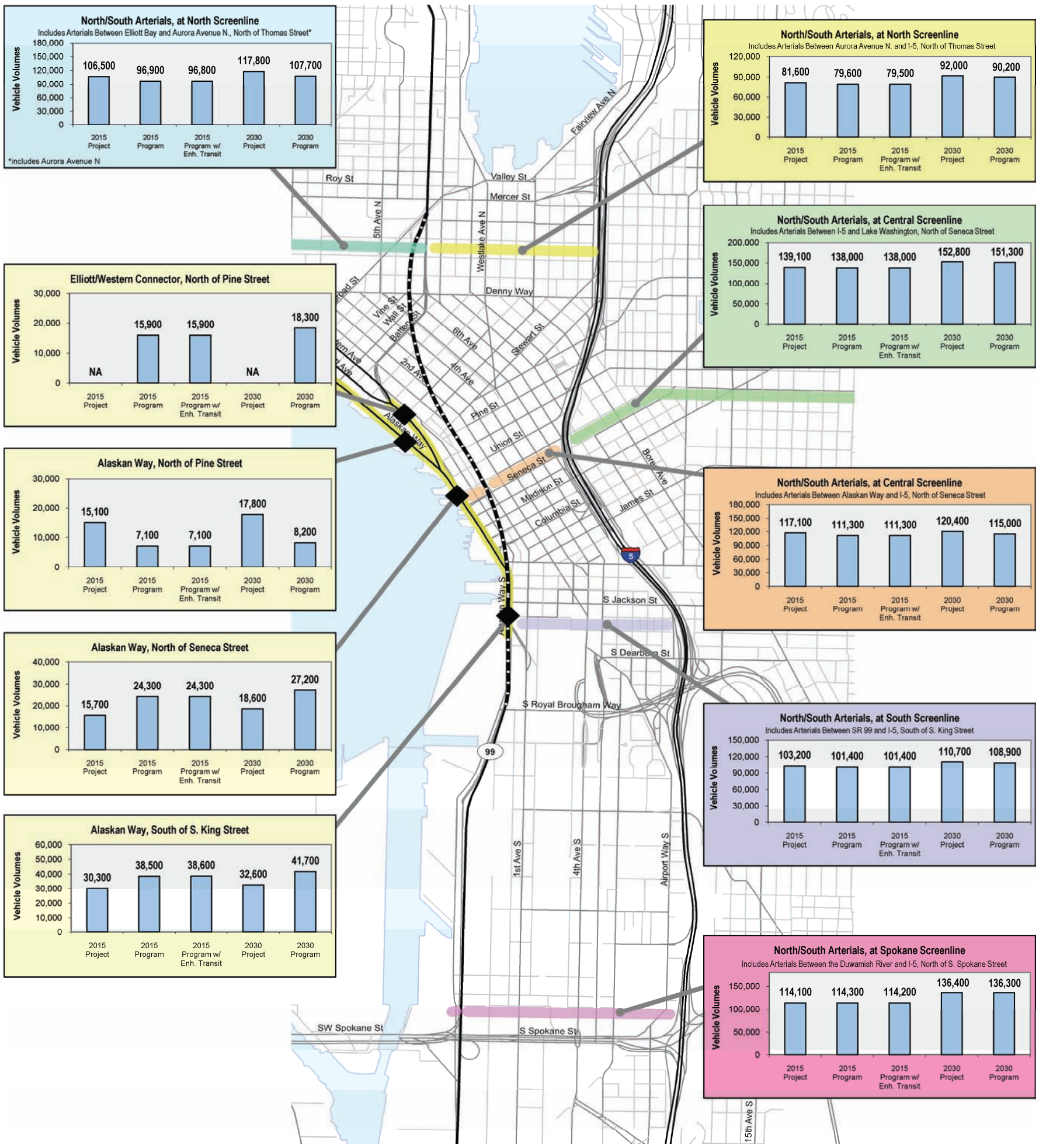


Exhibit 7-5
Daily Vehicle Volumes on I-5, SR 99 and Alaskan Way for 2015 Project, 2015 Program, 2015 Program plus Enhanced Transit, 2030 Project, and 2030 Program



Arterial screenlines do not include I-5, SR 99, Aurora Avenue, or Alaskan Way volumes, unless noted.

N

Exhibit 7-6
Daily Vehicle Volumes on Arterials for 2015 Project, 2015 Program, 2015 Program plus Enhanced Transit, 2030 Project, and 2030 Program

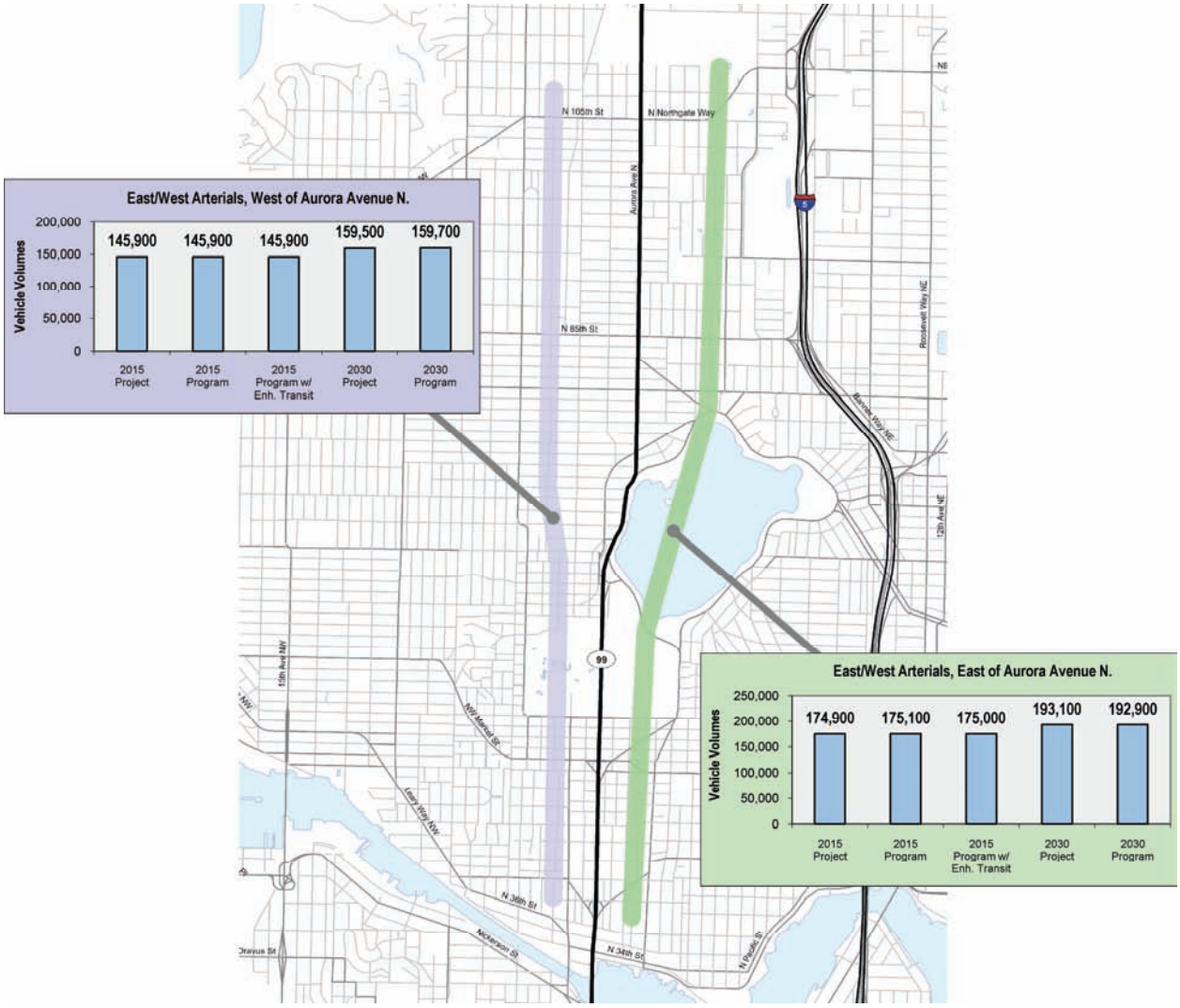


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Exhibit 7-7
Daily Vehicle Volumes on Arterials in North Seattle for 2015 Project, 2015 Program, 2015 Program plus Enhanced Transit, 2030 Project, and 2030 Program

enter, exit, or travel through downtown via other arterials. For north-south arterials east of I-5 though, the difference between the Project and Program is minimal, as the modeled conditions have much less impact in this area. Also, vehicle volumes on I-5 near the central screenline (see Exhibit 7-5) are generally the same regardless of the modeled conditions, as I-5 is at capacity many hours of the day and cannot absorb large increases in demand. Note that projected daily volumes on SR 99 through the bored tunnel (see Exhibit 7-5) are slightly less in the 2015 Program and 2030 Program compared to the 2015 Project and 2030 Project. This is likely due to the addition of the Elliott/Western Connector and the enhanced waterfront along Alaskan Way in the Program that attracts more of the Elliott/Western trips away from the Mercer Street/bored tunnel route in the Project.

North Area Facilities

The differences among the modeled conditions with respect to growth in arterial traffic volume become more pronounced at the north screenlines (see Exhibit 7-6). Similar to the south and central screenlines, fewer vehicles on north-south arterials west of Aurora Avenue (SR 99) cross the screenline in the 2015 Program, 2015 Program Plus Enhanced Transit, and 2030 Program in comparison to the comparable 2015 Project and 2030 Project. However, this result is primarily due to the conversion of Mercer Street to two-way traffic between Fifth Avenue N. and Elliott Avenue in the 2015 Program, 2015 Program Plus Enhanced Transit, and 2030 Program, which makes Mercer Street a more attractive westbound route between SR 99 (and points east) and Elliott Avenue. In the 2015 Project and 2030 Project, many of these westbound trips instead travel southbound to Denny Way and then back north via Elliott Avenue, in many cases crossing the screenline twice, resulting in higher screenline volumes than those in the 2015 Program, 2015 Program Plus Enhanced Transit, and 2030 Program. Vehicle volumes on the east side of Aurora Avenue for the year 2015 are relatively consistent, while in the 2030 Project and Program, they increase about 13 percent over 2015, likely due to growth in employment and population in the South Lake Union area. Projected volumes on SR 99 south of the Dexter Avenue N. southbound off-ramp show modest traffic volume increases for the 2015 Program, 2015 Program Plus Enhanced Transit, and 2030 Program over the comparable 2015 Project and 2030 Project.

North Seattle Area Facilities

Vehicle volumes on east-west arterials north of the Ship Canal are similar across the 2015 Project, 2015 Program, 2015 Program Plus Enhanced Transit, 2030 Project, and 2030 Program for all time periods. The small scale of these differences, all well less than 0.5 percent, is due to the distance of these arterials from the locations of the projects being evaluated for cumulative effects. In

addition, it indicates that the differences in the roadway networks provided by the 2015 Program and 2015 program Plus Enhanced Transit versus the 2015 Project and 2030 Project do not affect east-west travel north of the Ship Canal.

Person Throughput

Person throughput was estimated for the 2015 Project, Program, and Program Plus Enhanced Transit, as well as the 2030 Project and Program for the same key screenlines as those analyzed in Chapter 5.

Key Findings

Both the 2015 Program and 2015 Program Plus Enhanced Transit carry a marginally higher number of persons in comparison to the 2015 Project. This is likely due to the increase in transit service provided in the 2015 Program Plus Enhanced Transit and improved street connections provided in the 2015 Program.

Exhibit 7-8 presents the person-trips per day for the 2015 Project, 2015 Program, 2015 Program Plus Enhanced Transit, 2030 Project, and 2030 Program. In observing the ability of the street network to carry persons (as opposed to vehicles), each of the modeled conditions carry roughly the same amount of persons at the study area screenlines, regardless of time period.

Exhibit 7-8. Model-Estimated Daily Person Throughput (Person-Trips)

Performance Measure	2015				2030	
	Existing Viaduct	Project	Program	Program + Transit[1]	Project	Program
South Screenline (South of S. King Street)						
AM	55,120	54,250	54,540	54,720	65,420	65,930
PM	67,860	66,800	67,190	67,390	79,080	79,830
Daily	782,300	777,400	781,600	782,900	883,500	889,600
Central Screenline (North of Seneca Street)						
AM	53,080	52,350	52,730	52,810	60,560	61,140
PM	62,430	61,550	62,090	62,190	70,070	70,860
Daily	734,400	725,300	729,700	730,500	805,300	812,400
North Screenline (North of Thomas Street)						
AM	59,330	58,790	58,030	58,200	67,550	67,460
PM	69,140	69,760	68,580	68,750	80,400	79,710
Daily	794,600	803,700	787,300	788,200	902,800	888,700

[1] Program Plus Enhanced Transit

For the south and central screenlines, both the 2015 Program and the 2015 Program Plus Enhanced Transit carry a marginally higher number of persons in comparison to the 2015 Project. This may be due to the increase in transit service and improved street connections provided in the 2015 Program and 2015 Program Plus Enhanced Transit. Comparing the 2030 Project and 2015 Project and the 2030 Program and 2015 Program, person-trips increase by almost 21 percent in the AM peak period, 18 to 19 percent in the PM peak period, and 14 percent (106,100 and 108,000 person-trips, respectively) over the south screenline. Similarly, for the central screenline, person-trips increase 16 percent, 14 percent, and 11 percent (80,000 and 82,700 person-trips) for the AM, PM, and daily time periods, respectively.

As shown in Exhibit 7-8, the overall differences in person-trips among the 2015 Project, 2015 Program, and 2015 Program Plus Enhanced Transit are relatively small for the south and central screenlines. The north screenline shows higher daily person-trips for the 2015 Project in comparison to the 2015 Program and the 2015 Program Plus Enhanced Transit. Similar to the screenline vehicle trip volumes, this result is primarily due to the conversion of Mercer Street to two-way traffic between Fifth Avenue N. and Elliott Avenue in the 2015 Program and the 2015 program Plus Enhanced Transit, which makes Mercer Street a more attractive westbound route between SR 99 (and points east) and Elliott Avenue. In the 2015 Project and 2030 Project, many of these westbound trips instead travel southbound to Denny Way and then north again via Elliott Avenue, in many cases crossing the screenline twice, resulting in a higher number of screenline person-trips than the number in the 2015 Program, 2015 Program, and 2015 Program Plus Enhanced Transit. Comparing the 2030 Project and 2015 Project and the 2030 Program and 2015 Program, person-trips increase by 12 to 16 percent for all time periods, with an absolute increase of 99,100 and 101,400 daily person-trips for the Project and Program modeled conditions, respectively.

7.1.3 Traffic Operations on SR 99

Key Findings

Volume estimates for the 2015 Program are generally similar to the 2015 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown.

Volume estimates for the 2030 Program are generally similar to the 2030 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown.

With the 2015 Program, the mainline LOS is generally projected to be similar to that projected for the 2015 Project.

The mainline LOS for the 2030 Program is generally expected to be similar to that projected for the 2030 Project.

Travel speeds for the 2015 Program and the 2030 Program confirm the LOS findings. Projected speeds are similar to those for the 2015 Project and 2030 Project, with the exception of decreases in northbound speeds in the southern part of the project area during the AM peak hour and decreases in northbound bored tunnel speeds during the PM peak hour.

Alaskan Way Viaduct Mainline and Ramp Traffic Volumes

This section describes the AM peak hour, PM peak hour, and daily traffic volume estimates for the 2015 Program and the 2030 Program. Anticipated changes from the 2015 Project and 2030 Project are discussed in detail below.

AM Peak Hour Traffic Volumes

Exhibits 7-9 and 7-10 show the traffic volumes in the AM peak hour for the 2015 Program and the 2030 Program, respectively.

2015 Program

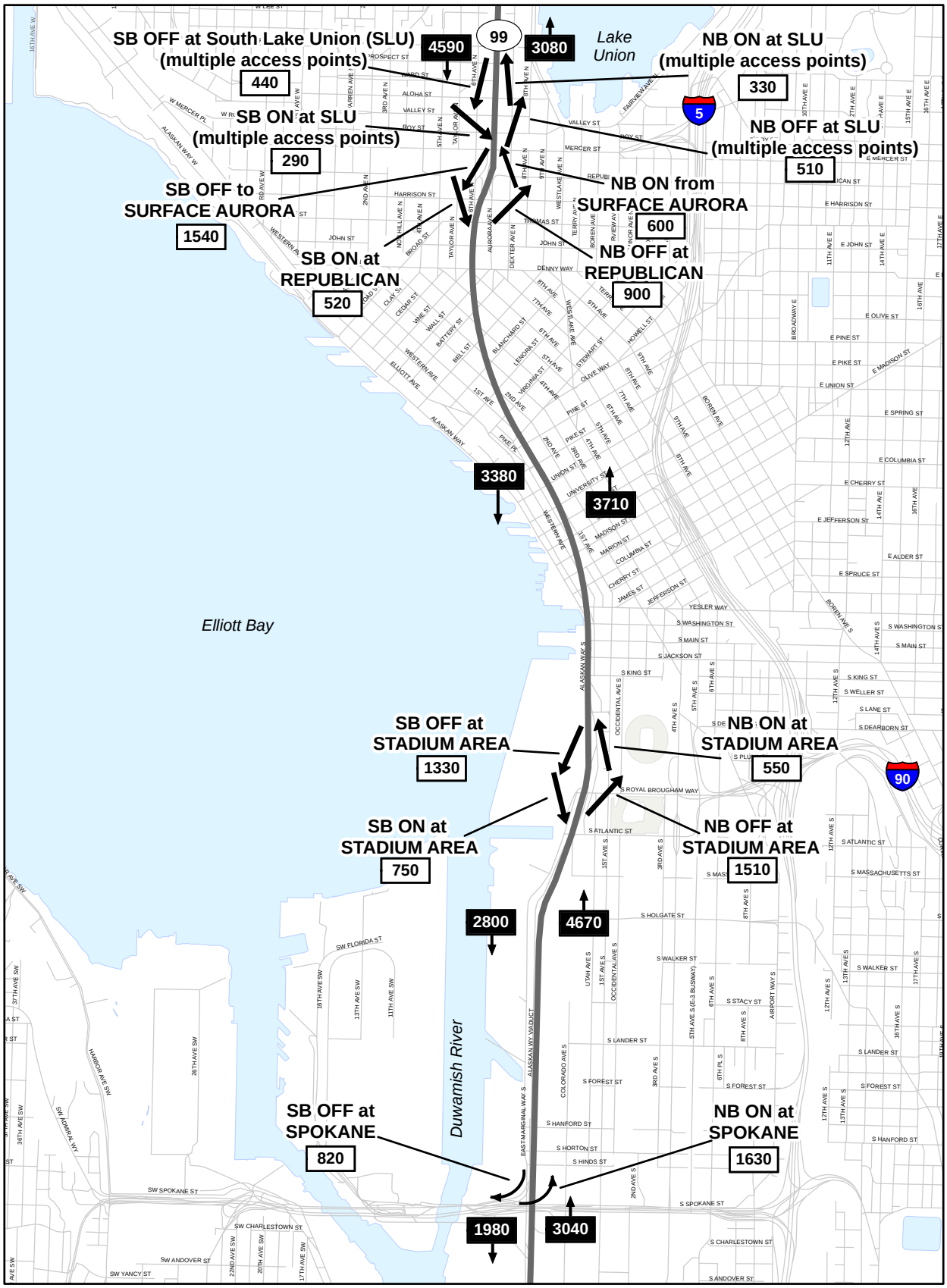
Volume estimates for the 2015 Program are generally similar to the 2015 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown. Slight vehicle volume decreases are expected in the bored tunnel due to the new Elliott/Western Connector. With the connection in place, some vehicles that would otherwise use the bored tunnel would now use the connection to the central waterfront. AM peak hour mainline ramp volumes forecasted for the 2015 Program are shown in Exhibit 7-9.

2030 Program

Volume estimates for the 2030 Program are generally similar to the 2030 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown. As with the 2015 Program, slight vehicle volume decreases are expected in the bored tunnel due to the new Elliott/Western Connector. AM peak hour mainline ramp volumes forecasted for the 2030 Program are shown in Exhibit 7-10.

PM Peak Hour Traffic Volumes

Exhibits 7-11 and 7-12 show the traffic volumes in the PM peak hour for the 2015 Program and 2030 Program, respectively.



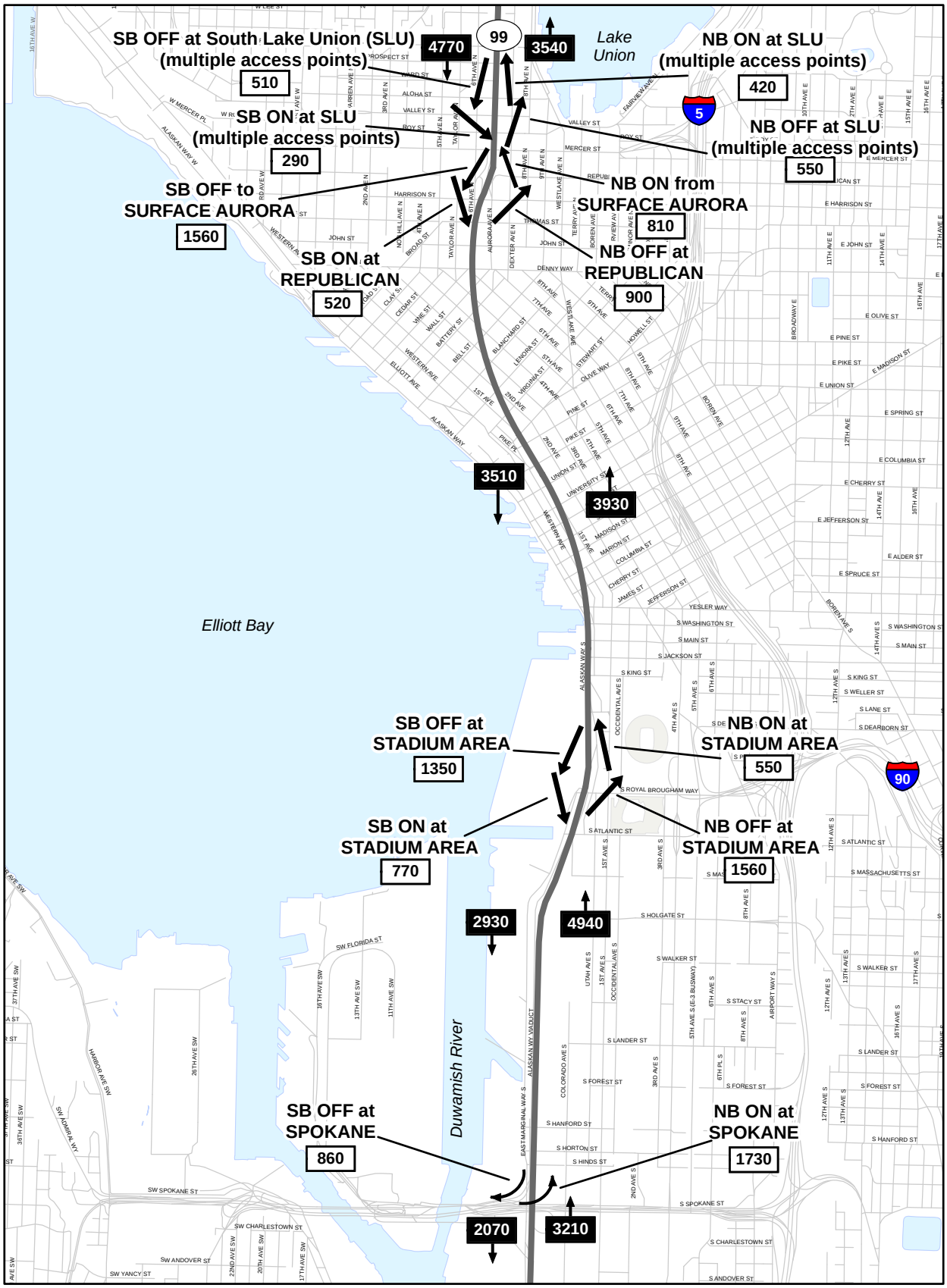
N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 7-9
AM Peak Hour Mainline and Ramp Volumes - 2015 Program



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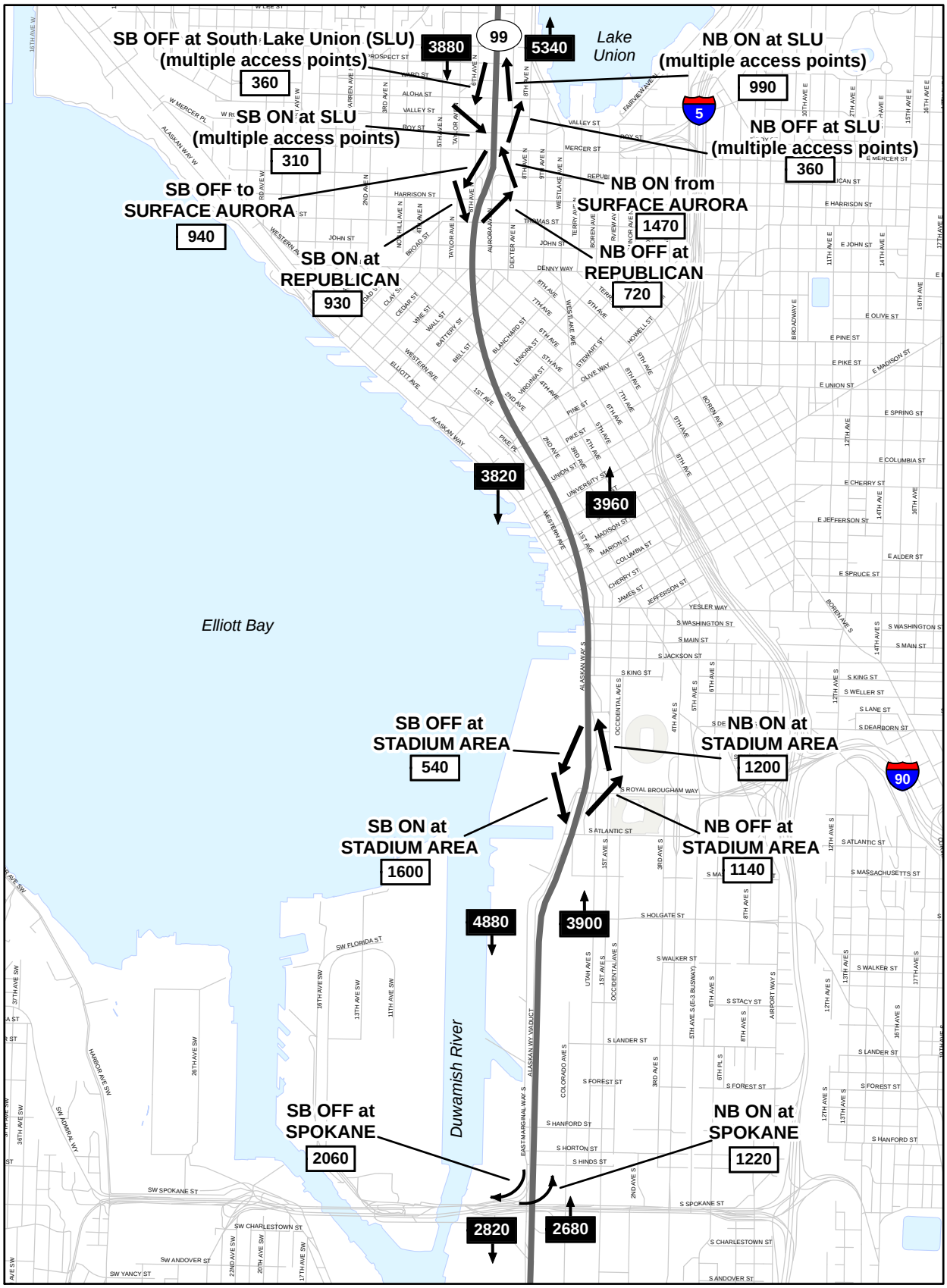
0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 7-10
AM Peak Hour Mainline and Ramp Volumes - 2030 Program



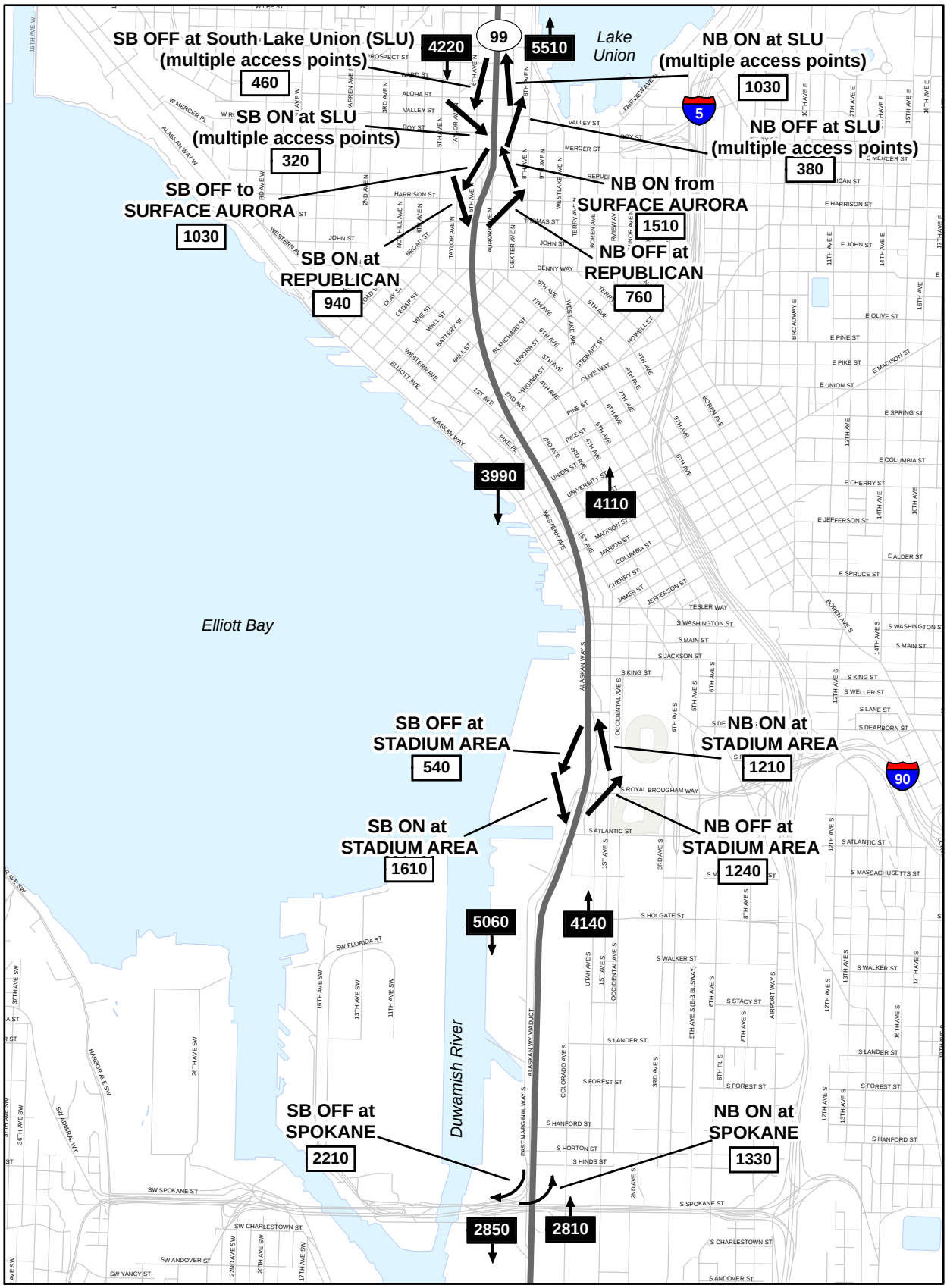
N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 7-11
PM Peak Hour Mainline and Ramp Volumes - 2015 Program



N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Exhibit 7-12
PM Peak Hour Mainline and Ramp Volumes - 2030 Program

2015 Program

As in the AM peak hour, volume estimates for the 2015 Program are generally similar to the 2015 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown. A slight vehicle volume decrease is expected in southbound traffic in the bored tunnel due to the new Elliott/Western Connector. With the connection in place, some vehicles that would otherwise use the bored tunnel would now use the connection to the central waterfront. PM peak hour mainline ramp volumes forecasted for the 2015 Program are shown in Exhibit 7-11.

2030 Program

Volume estimates for the 2030 Program are generally similar to the 2030 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown. As with the 2015 Program, slight vehicle volume decreases are expected in the bored tunnel due to the new

Elliott/Western Connector. PM peak hour mainline ramp volumes forecasted for the 2030 Program are shown in Exhibit 7-12.

Daily Traffic Volumes

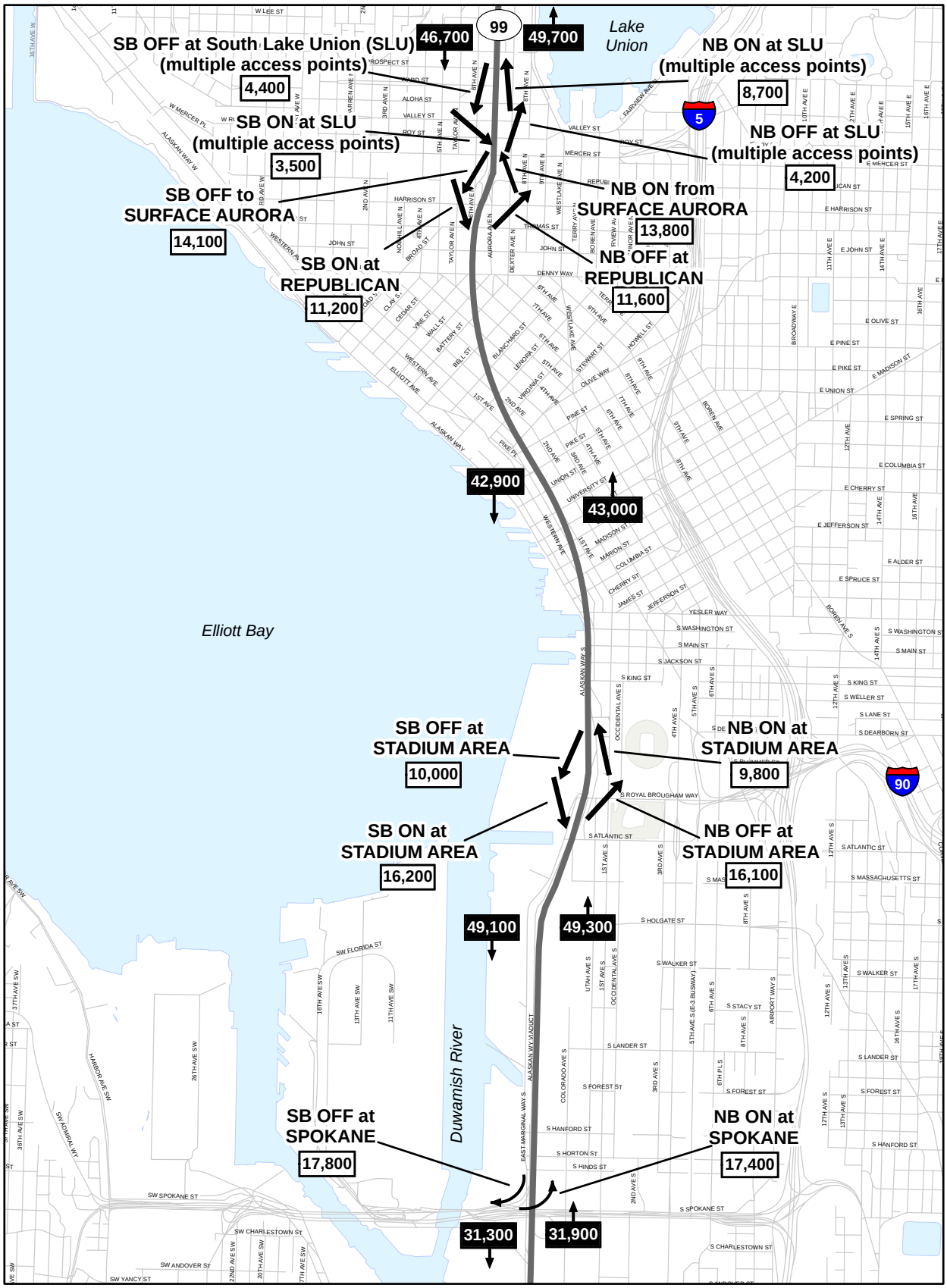
Exhibits 7-13 and 7-14 show the daily traffic volumes for the 2015 Program and 2030 Program, respectively.

2015 Program

As in the AM and PM peak hours, volume estimates for the 2015 Program are generally similar to the 2015 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown. A slight vehicle volume decrease is expected in southbound traffic in the bored tunnel due to the new Elliott/Western Connector. With the connection in place, some vehicles that would otherwise use the bored tunnel would now use the connection to the central waterfront. Daily mainline ramp volumes forecasted for the 2015 Program are shown in Exhibit 7-13.

2030 Program

Volume estimates for the 2030 Program are generally similar to the 2030 Project forecasts, with modest increases in volumes for most mainline and ramp segments south of downtown, modest decreases in the bored tunnel, and increases north of downtown. As with the 2015 Program, a slight vehicle volume decrease is expected



N

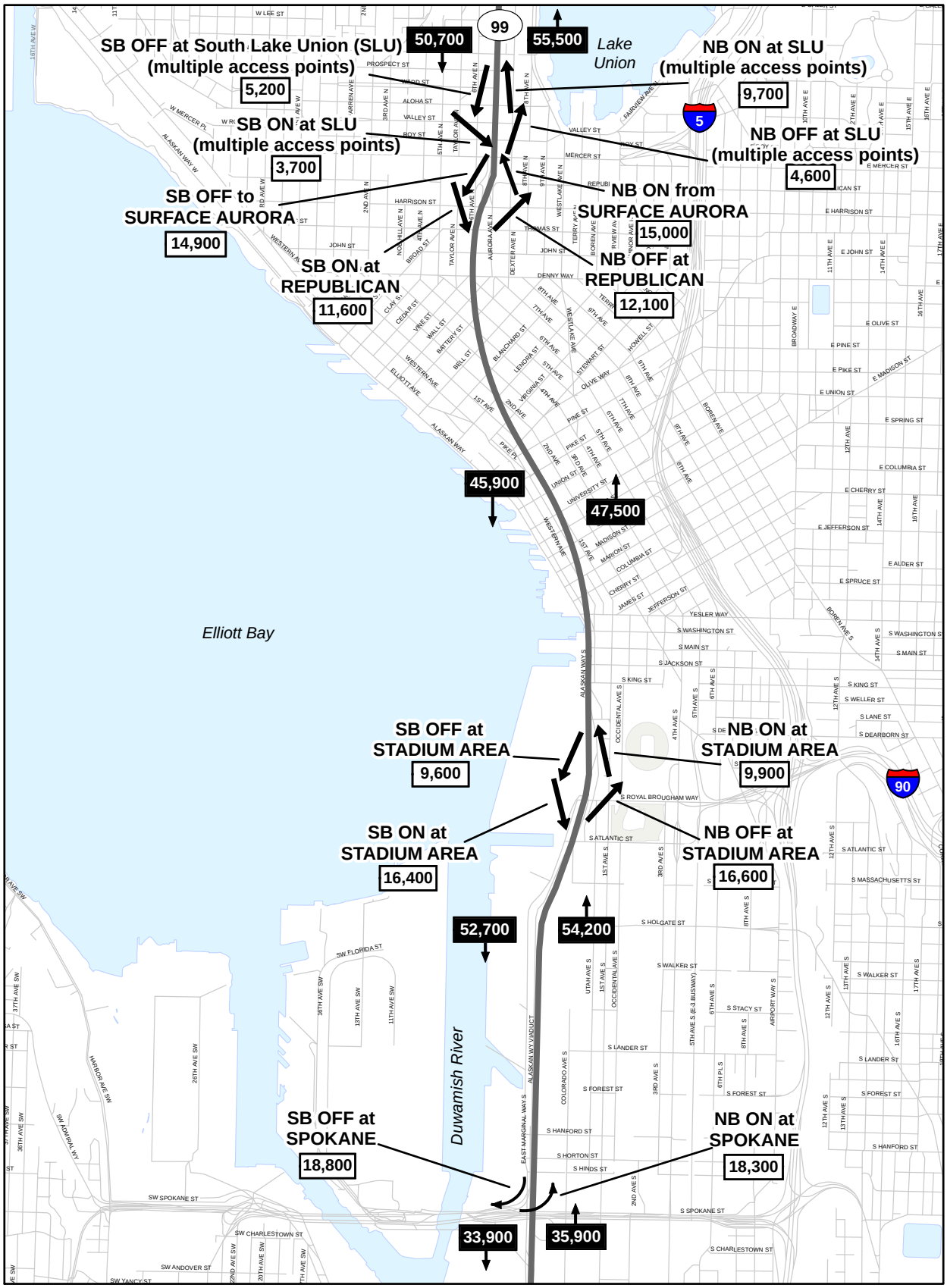
0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Note: Totals may not sum due to rounding.

Exhibit 7-13
Daily Mainline and Ramp Volumes - 2015 Program



N

0 2,500
Feet

XXX Ramp Volumes

XXX SR 99 Mainline Volumes

Note: Totals may not sum due to rounding.

Exhibit 7-14
Daily Mainline and Ramp Volumes - 2030 Program

in southbound traffic in the bored tunnel due to the new Elliott/Western Connector. Daily mainline ramp volumes forecasted for the 2030 Program are shown in Exhibit 7-14.

SR 99 Mainline Level of Service

This section describes the AM and PM peak hour LOS for corridor segments under the 2015 Project, 2015 Program, 2030 Project, and 2030 Program. While LOS provides a general gauge of how a facility performs overall, it is not considered a comprehensive measure for comparing the modeled conditions on the SR 99 mainline because the ramp locations and segment arrangements may vary considerably among the modeled conditions. Additionally, as indicated in Chapter 2, because SR 99's posted speeds are less than the speeds on a typical freeway, the LOS as based on the HCM density ranges for freeways would likely be lower than the actual speeds on the facility. The mainline LOS results are therefore better suited for a relative comparison between scenarios as opposed to a true indication of operating performance. Projected speeds and travel times along the facility are better indicators of expected performance. The SR 99 mainline LOS is summarized by segment for the 2015 Project, 2015 Program, 2030 Project, and 2030 Program in Exhibits 7-15 to 7-18, reflecting both directions in the AM and PM peak hours.

Exhibit 7-15. AM Peak Hour Southbound SR 99 Segment Level of Service

Southbound – AM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
Stadium on to S. Spokane Street	C	C	C	C
Midtown				
Bored tunnel	E[1]	E[1]	E[1]	E[1]
North Corridor				
North of bored tunnel	E	E	F	F

HCM = *Highway Capacity Manual*
LOS = level of service
[1] LOS shown for the bored tunnel was calculated using HCM analysis methodology, based on 55 mph free-flow speed. The actual bored tunnel facility would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

Exhibit 7-16. AM Peak Hour Northbound SR 99 Segment Level of Service

Northbound – AM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
S. Spokane Street to stadium off-ramp	E	E	E	F
Midtown				
Bored tunnel	E[1]	E[1]	E[1]	E[1]
North Corridor				
North of bored tunnel	D	D	E	E

HCM = *Highway Capacity Manual*
LOS = level of service
[1] LOS shown for the bored tunnel was calculated using HCM analysis methodology, based on 55 mph free-flow speed. The actual bored tunnel facility would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

Exhibit 7-17. PM Peak Hour Southbound SR 99 Segment Level of Service

Southbound – PM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
Stadium on to S. Spokane Street	E	D	F	F
Midtown				
Bored tunnel	E[1]	E[1]	F[1]	E[1]
North Corridor				
North of bored tunnel	E	E	E	E

HCM = *Highway Capacity Manual*
LOS = level of service
[1] LOS shown for the bored tunnel was calculated using HCM analysis methodology, based on 55 mph free-flow speed. The actual bored tunnel facility would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

Exhibit 7-18. PM Peak Hour Northbound SR 99 Segment Level of Service

Northbound – PM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
S. Spokane Street to stadium off-ramp	D	D	D	D
Midtown				
Bored tunnel	E[1]	F[1]	F[1]	F[1]
North Corridor				
North of bored tunnel	F	F	F	F

HCM = *Highway Capacity Manual*
LOS = level of service
[1] LOS shown for the bored tunnel was calculated using HCM analysis methodology, based on 55 mph free-flow speed. The actual bored tunnel facility would have a lower design speed (50 mph) and posted speed (50 mph or lower); therefore, LOS shown should be considered conservative. Actual performance is better measured through projected speed comparisons.

2015 Program Level of Service

With the 2015 Program, the mainline LOS is generally expected to be similar to that projected for the 2015 Project. The bored tunnel segment of the mainline is projected to operate at LOS E in the southbound direction during both the AM and PM peak hours, similar to the 2015 Project. In the northbound direction, operations are projected to remain at LOS E during the AM peak hour and would degrade to LOS F during the PM peak hour.

In the south end of the project area from approximately S. Spokane Street to the stadium off-ramp area, northbound SR 99 speeds and densities would remain at LOS E levels during the AM peak hour and at LOS D during the PM peak hour. Mainline performance in the southbound direction would remain at LOS C in the AM peak hour and would improve to LOS D in the PM peak hour.

In the north end of the project area, southbound conditions are expected to remain at LOS E during the AM peak hour and improve to LOS D during the PM peak hour. Northbound conditions would remain at LOS D in the AM peak hour and at LOS F in the PM peak hour.

2030 Program Level of Service

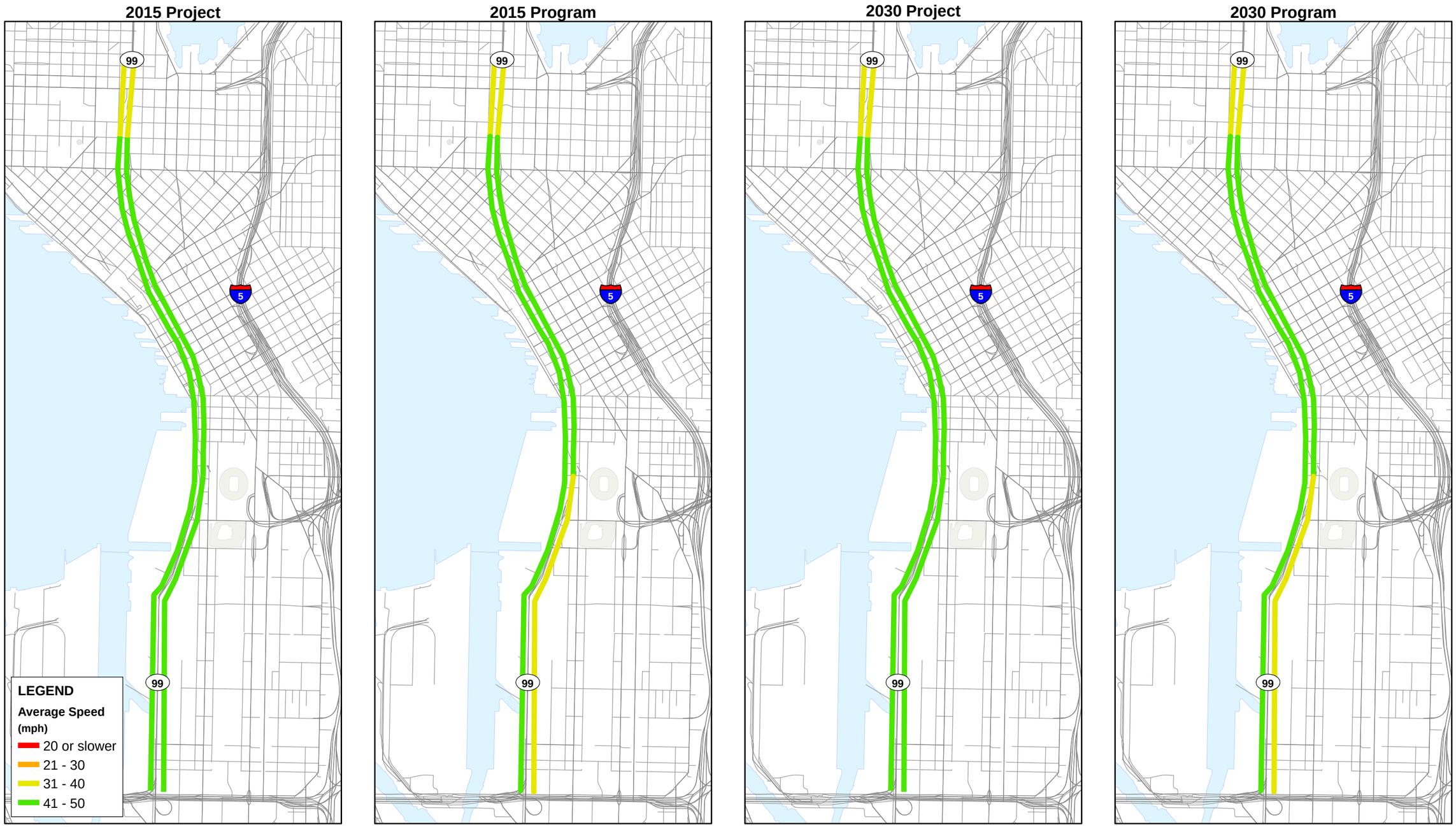
Similar to the 2015 Program, the 2030 Program is generally projected to result in similar mainline traffic operations as those with the 2030 Project. The bored tunnel segment of the mainline is projected to remain at LOS E in the southbound direction during the AM peak hour and improve to LOS E in the PM peak hour. Northbound operations are projected to remain at LOS E during the AM peak hour and at LOS F during the PM peak hour.

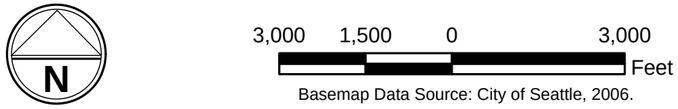
In the south end of the project area from approximately S. Spokane Street to the stadium area off-ramp, northbound SR 99 speeds and densities would degrade to LOS F levels during the AM peak hour, but would remain at LOS D during the PM peak hour. Mainline performance in the southbound direction would remain at LOS C in the AM peak hour and at LOS F in the PM peak hour.

In the north end of the project area, southbound conditions are expected to remain at LOS F during the AM peak hour, while remaining at LOS E during the PM peak hour. Northbound conditions would remain at LOS E in the AM peak hour and at LOS F in the PM peak hour.

SR 99 Mainline Speeds

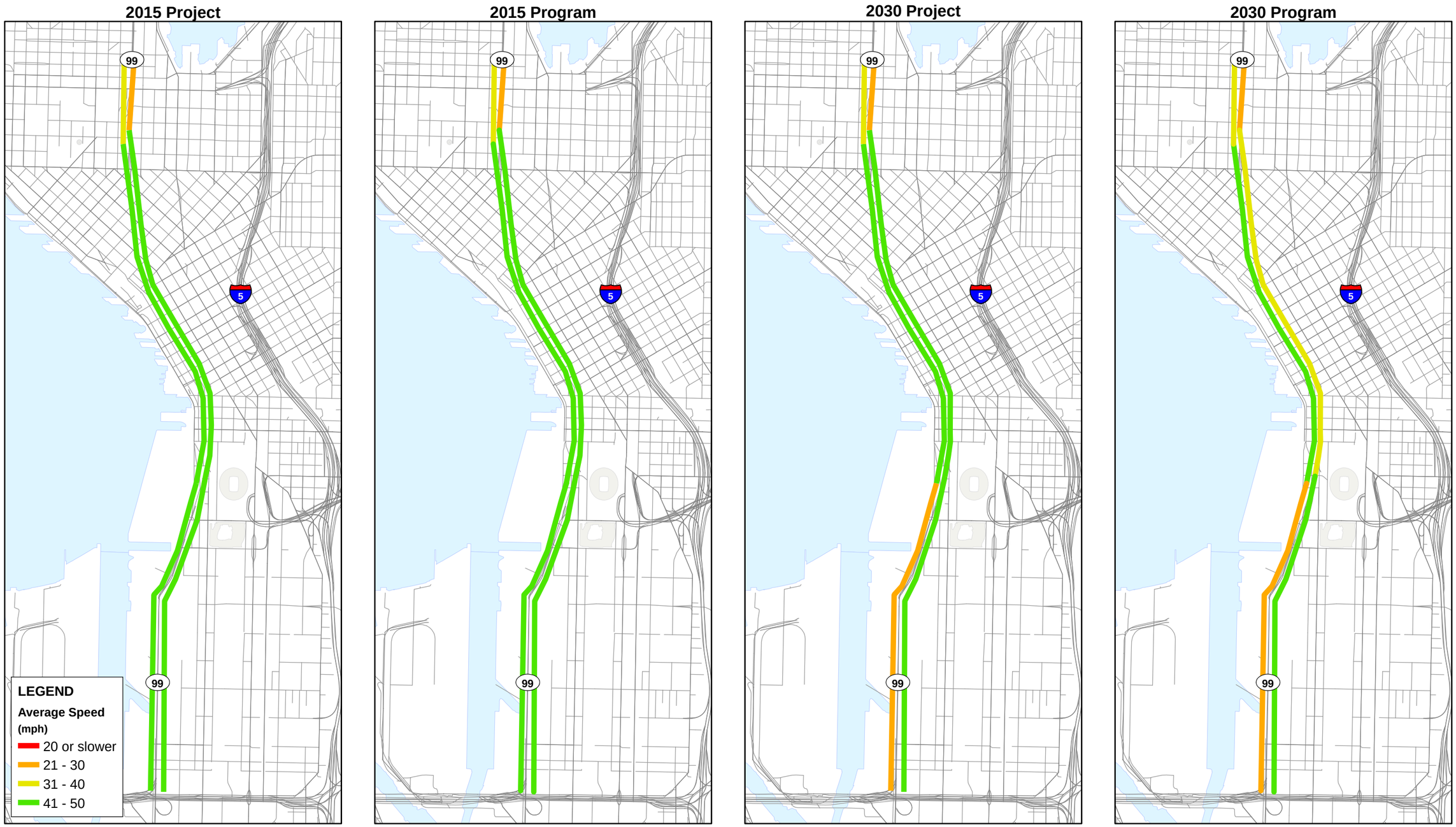
This section discusses the AM and PM peak hour travel speeds for corridor segments under the 2015 Project, 2015 Program, 2030 Project, and 2030 Program. As with LOS, comparing travel speeds between the modeled conditions can present certain challenges because the ramp and segment arrangements vary among the modeled conditions. To assist in this comparison, the results are presented side by side graphically in Exhibits 7-19 and 7-20. The speeds are also presented in tabular format in Exhibits 7-21 to 7-24.

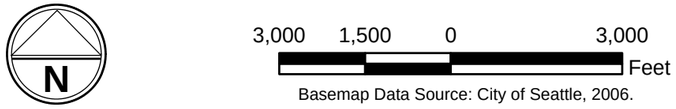




Basemap Data Source: City of Seattle, 2006.

Exhibit 7-19
Average Speed Comparison on SR 99 Segments - AM Peak





Basemap Data Source: City of Seattle, 2006.

Exhibit 7-20
Average Speed Comparison on SR 99 Segments - PM Peak

Exhibit 7-21. AM Peak Hour Southbound SR 99 Segment Speeds (Miles per Hour)

Southbound – AM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
Stadium on to S. Spokane Street	48	48	48	48
Midtown				
Bored tunnel	45	46	45	46
North Corridor				
North of bored tunnel	36	35	34	34

Exhibit 7-22. AM Peak Hour Northbound SR 99 Segment Speeds (Miles per Hour)

Northbound – AM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
S. Spokane Street to stadium off-ramp	44	40	41	34
Midtown				
Bored tunnel	45	45	44	45
North Corridor				
North of bored tunnel	33	33	32	32

Exhibit 7-23. PM Peak Hour Southbound SR 99 Segment Speeds (Miles per Hour)

Southbound – PM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
Stadium on to S. Spokane Street	44	45	30	29
Midtown				
Bored tunnel	46	46	43	45
North Corridor				
North of bored tunnel	37	36	36	36

Exhibit 7-24. PM Peak Hour Northbound SR 99 Segment Speeds (Miles per Hour)

Northbound – PM	2015 Project	2015 Program	2030 Project	2030 Program
South Corridor				
S. Spokane Street to stadium off-ramp	48	47	47	47
Midtown				
Bored tunnel	44	44	41	36
North Corridor				
North of bored tunnel	29	29	27	27

Segment travel speed results for the 2015 Program and 2030 Program confirm the LOS findings, with speeds on most segments projected to be generally similar to those projected for the 2015 Project and 2030 Project. Southbound speeds in the bored tunnel are expected to remain at approximately 43 to 46 mph in both the AM and PM peak hours in both the 2015 Program and the 2030 Program. Likewise, in the northbound direction, speeds in the tunnel are expected to remain at approximately 44 to 45 mph in the AM peak hour in both the 2015 Program and the 2030 Program. In the PM peak hour, speeds are expected to remain at 44 mph in the 2015 Project and the 2015 Program. However, the speeds are expected to decrease from 41 mph in the 2030 Project to 36 mph in the 2030 Program. This projected decrease in northbound speeds could be due to increased volumes at the north portal, which are expected due to slightly more volume through the tunnel, less volume getting off at the Republican off-ramp, and more volume getting on at the Roy or Valley Street on-ramps. This is a result of both the improved waterfront connection (hence not as many opting to take Republican Street to Mercer Street) and the two-way Mercer Street, providing better access to SR 99.

In the south end of the project area from S. Spokane Street to the stadium off-ramp area, speeds on SR 99 in both directions with the 2015 Program are expected to be similar to the 2015 Project in the AM and PM peak hours, with the exception of a slight decrease in northbound speeds during the AM peak hour from 44 mph in the 2015 Project to 40 mph in the 2015 Program. With the 2030 Program, speeds during the AM peak hour are projected to remain similar in the southbound direction while decreasing in the northbound direction compared with the 2030 Project, from 41 mph to 34 mph. These northbound speeds are slower for the 2015 Program and 2030 Program because the off-ramp volumes are greater, causing some queue spillback from the ramp termini intersection that affects the mainline traffic. During the PM peak hour, 2030 Program travel speeds are expected to be similar to the speeds for the 2030 Project.

In the north end of the project area, speeds during both the AM and PM peak hours with the 2015 Program are expected to be similar to those in the 2015 Project in both directions. Speeds for the north end in the 2030 Program are anticipated to be similar to the speeds anticipated for 2030 Program.

7.1.4 Traffic Operations at Key Arterial Intersections

Key Findings

Average intersection delays and LOS for the 2015 Program and 2030 Program would generally be similar to the 2015 Project and 2030 Project.

In the south end, no substantial changes in channelization are anticipated for the 2015 Program and 2030 Program aside from enhanced transit service for the 2030

Program. Therefore, intersection operations would likely be similar to those for the 2015 Project and 2030 Project, respectively.

In the central sub-area, the Elliott/Western Connector to and from the Alaskan Way surface street is expected to draw greater north-south peak hour volumes to the waterfront area and away from Alaskan Way, north of Pike Street, Denny Way, west of Sixth Avenue and Mercer Street, and west of Fifth Avenue.

The Elliott/Western Connector would provide more direct access between the Alaskan Way surface street and the Elliott/Western one-way couplet and would allow north-south traffic to avoid the railroad conflicts in the north end of Alaskan Way near Elliott Avenue at Broad Street. Congestion levels along Alaskan Way, south of Madison Street, are projected to improve under the Program as a result of the additional lanes along Alaskan Way.

In the north end, the changes to Mercer Street with the Mercer West Project would not substantially affect intersection delays for the 2015 Program or the 2030 Program compared to the 2015 Project and the 2030 Project. However, the Elliott/Western Connector may draw some traffic away from the SR 99 and Mercer Street corridors, potentially reducing intersection delays at locations near or west of the SR 99 mainline.

Intersection operations in the 2030 Program are expected to remain similar to those in the 2030 Project.

South Sub-Area

Detailed results of the intersection analysis for the south sub-area are not provided in this section. However, a qualitative discussion of potential congestion hot spots and general comparisons of intersection operations in the 2015 Program and 2030 Program to the 2015 Project and 2030 Project are provided. Intersection performance for a selected number of study locations was evaluated using Synchro and VISSIM traffic analysis software.

2015 Program

In the 2015 Program, traffic patterns in the south end of the project area would be similar to those in the 2015 Project, reflecting the relocation of the SR 99 stadium area ramps and the introduction of newly created intersections on Alaskan Way and west of First Avenue S. The Elliott/Western Connector to the north is likely to draw additional traffic to Alaskan Way south of Pike Street and away from Alaskan Way, north of Pike Street, Denny Way, west of Sixth Avenue and Mercer Street, and west of Fifth Avenue. Improvements to the Alaskan Way corridor south of Pike Street are expected to accommodate the additional traffic. As for the 2015 Project, the intersections of First Avenue S. at S. Atlantic Street and First Avenue S. at Yesler Way are expected to operate under congested conditions

during the PM peak (LOS E conditions or worse). Congestion levels for the AM peak hour would be modest by comparison, with intersections in the south end likely operating at LOS D or better.

2030 Program

For the 2030 Program, the street network in the south end of the project area would be similar to that in the 2015 Program and the 2030 Project, which again includes the full range of planned improvements included in the 2015 Existing Viaduct (S. Holgate Street to S. King Street Viaduct Replacement Project and SR 519 Intermodal Access Project, Phase 2) as well as the replacement of the stadium area ramps and the introduction of several new intersections along the East Frontage Road. Also included as part of the 2030 Program are transit service enhancements and increases across the King Country Metro bus system.

With little to no change in the street network between the 2030 Project and the 2030 Program but with the proposed transit service enhancements incorporated, delays and LOS in the 2030 Program are expected to be similar to those in the 2030 Project, if not slightly improved.

Specific AM peak hour hot spots identified for the 2030 Project that would operate at high levels of congestion in the 2030 Program include E. Marginal Way S. (Terminal 46 driveway)/S. Atlantic Street, Colorado Avenue S./S. Atlantic Street, and East Frontage Road/S. Atlantic Street. For PM peak hour conditions, the intersection of First Avenue S. at S. Atlantic Street would likely operate at LOS F.

Central Sub-Area

As with the south end, no specific technical results or tables are provided in this discussion of intersection operations in the central sub-area. However, congestion levels at intersections in the 2030 Program are qualitatively compared to those described for the 2030 Project to highlight the similarities between the modeled conditions.

2015 Program

In the 2015 Program, removal of the downtown SR 99 on- and off-ramps would be identical to the network changes described for the 2015 Project. As previously discussed, the affected ramps would include the Columbia Street southbound on-ramp, the Seneca Street northbound off-ramp, the Western Avenue northbound off- and on-ramps, the Battery Street Tunnel off-ramp, and the Elliott Avenue on-ramp. Traffic would use the south end stadium area ramps or the north end interchange and take surface streets into downtown.

The Elliott/Western Connector would be introduced in the 2015 Program (versus the 2015 Project). This new connection is expected to draw additional traffic to Alaskan Way and Elliott and Western Avenues compared to conditions with the

2015 Project. Congestion levels along Alaskan Way, south of Madison Street, are projected to improve with the 2015 Program as a result of the additional lanes along Alaskan Way, proposed in the 2015 Program.

Some marginal reductions in delay may occur at some intersections in the central sub-area due to enhanced transit service and potential reductions in overall vehicular demand. However, such a mode shift to transit between the Project and the Program is not expected to affect overall intersection delays to a degree sufficient enough to influence peak hour LOS.

2030 Program

In the 2030 Program, the majority of intersections are anticipated to operate similarly to the 2030 Project in the central sub-area. During the AM peak hour, the only critical hot spot identified previously for the 2030 Project was Second Avenue at Marion Street. Similar delays could be expected at this location for the 2030 Program. For the PM peak hour, similar to the 2030 Project, the intersection of Western Avenue at Broad Street is anticipated to operate with the high levels of congestion for the 2030 Program.

Similar to the 2015 Program, congestion levels along Alaskan Way, south of Madison Street, are projected to improve with the 2030 Program as a result of the additional lanes along Alaskan Way, proposed in the 2030 Program.

The enhancements in transit service expected as part of the 2030 Program may help to reduce general-purpose vehicle demands on city streets and consequently result in an overall decrease in intersection delays. These effects may be more pronounced for the 2030 horizon compared to 2015 conditions due to higher overall traffic volumes and congestion levels, which may lead to greater potential for mode shift.

North Sub-Area

As discussed in Chapter 5, two options for Sixth Avenue N. and the southbound on-ramp are being considered in the north end, reflecting how Sixth Avenue N. is aligned between approximately Republican Street and Mercer Street. Detailed results of the intersection analysis for the north sub-area are not provided in this section; instead, a qualitative discussion is provided to draw comparisons and note similarities between the Project and Program scenarios for the 2015 and 2030 horizons.

2015 Program

For the 2015 Program, the network changes in the north end described for the 2015 Project would be retained for the 2015 Program. East-west arterials such as John, Thomas, and Harrison Streets would all intersect with a new north-south arterial (surface Aurora Avenue) with east-west through movements allowed,

and the northbound SR 99 off-ramp south of Mercer Street and the southbound on-ramp would both be located at Republican Street. Additional surface street changes would include closing Broad Street, extending Sixth Avenue N. to Mercer Street, and converting Sixth Avenue from one-way to two-way between Wall Street and Denny Way.

The major difference between the arterial networks in the 2015 Project and 2015 Program is the Mercer West Project, which would convert Mercer Street and Roy Street to two-way operations west of Fifth Avenue N. in the 2015 Program scenario. Mercer Street would continue as a two-way street to Elliott Avenue. Roy Street would be converted from one-way to two-way between Fifth Avenue N. and Queen Anne Avenue N. Roy Street is currently two-way west of Queen Anne Avenue N.

The Mercer West Project is not expected to affect traffic distributions or congestion levels substantially in the Uptown neighborhood. For the AM peak hour, similar intersection delays would be expected for the 2015 Program compared to the 2015 Project. Key congestion hot spots identified previously for the 2015 Project include Valley Street at Fairview Avenue N., W. Mercer Place at Elliott Avenue, Dexter Avenue N. at Mercer Street, and Fairview Avenue N. at Mercer Street. These intersections are expected to operate at LOS E or worse during the AM peak hour.

Similar to the 2015 Project, the intersections of Mercer Street at Fairview Avenue N., Mercer Street at Westlake Avenue N., and W. Mercer Place at Elliott Avenue are expected to experience delays and queuing during the PM peak hour in the 2015 Program. Similar to the 2015 Project, the intersection of Sixth Avenue and Battery Street is anticipated to experience long delays during the PM peak hour for the 2015 Program due to high northbound volumes.

The Curved Sixth Avenue option would include a modified Sixth Avenue N. alignment near Republican Street and the on-ramp to southbound SR 99. As described previously in Chapter 5, this option would align Sixth Avenue N. farther to the east between Republican Street and Mercer Street and restrict movements at the resulting intersection with Mercer Street. No westbound left-turns from Mercer Street or northbound left turns from Sixth Avenue N. would be allowed at the new intersection of Mercer Street and Sixth Avenue N. For the 2015 Program, intersection delays for affected intersections under the Curved Sixth Avenue option would not be expected to change noticeably compared to the Straight Sixth Avenue option despite some rerouting of trips accessing the southbound on-ramp to SR 99 at Republican Street.

The Elliott/Western Connector may draw some traffic volumes away from SR 99 into and out of the South Lake Union and Uptown neighborhoods due to a more

direct north-south route along the central waterfront. Trips originating from or destined to the Interbay and Ballard areas that may have used the SR 99 bored tunnel may shift to Elliott and Western Avenues, thereby reducing demands on east-west arterials such as Mercer Street. As a result, congestion levels at intersections in the north end may be slightly lower for locations near and/or west of the SR 99 corridor.

2030 Program

For the 2030 Program, most intersections in the north end are expected to operate at levels similar to the 2030 Project. During the AM peak hour, similar intersections are anticipated to operate under congested conditions as those expected to be congested in the 2030 Project, which includes key hot spots such as Denny Way at Dexter Avenue N., Valley Street at Fairview Avenue N., and the gateway intersection of Mercer Street at Fairview Avenue N./I-5 ramps.

During the PM peak hour for the 2030 Program, similar hot spots as those described above for AM peak hour conditions would occur. However, additional locations such as Denny Way at Aurora Avenue, Dexter Avenue N. at Mercer Street, Fifth Avenue N. at Mercer Street, Westlake Avenue N. at Mercer Street, Ninth Avenue N. at Mercer Street, and Denny Way at Aurora Avenue/Battery Street/Wall Street would also be included on the list of highly congested intersections during the PM peak hour. These intersections operate at similar levels of service in the 2030 Project.

Two elements that may result in slightly lower congestion levels for the 2030 Program compared to the 2030 Project are the Elliott/Western Connector and the enhanced transit service levels. The Elliott/Western Connector may draw some traffic volumes away from SR 99 into and out of the South Lake Union and Uptown neighborhoods due to a more direct routing of trips along the central waterfront, while increased transit service may capture some mode shift in the north end. Congestion levels at intersections in the north end may be slightly lower for locations near and/or west of the SR 99 corridor as a result.

7.1.5 Peak Hour Travel Times

Key Findings

With few exceptions, travel times for the specific paths and time periods examined are not expected to change substantially from the 2015 Project to the 2015 Program. Similar consistency could be expected for the comparison of selected travel times for the 2030 Project and 2030 Program. Only the Woodland Park to S. Spokane Street and Ballard to S. Spokane Street routes are discussed for the 2030 Program.

While the majority of travel time differences between the Project and the Program are within 5 to 10 percent, the northbound route from S. Spokane Street to Ballard (via SR 99, the Alaskan Way surface street, and Elliott Avenue/15th Avenue N.W.) would be approximately 3 minutes shorter in the 2015 Program compared to the 2015 Project (PM peak hour). This 15 to 20 percent reduction in travel time is likely attributable to the new Elliott/Western Connector.

For the Woodland Park to S. Spokane Street route, the Project and Program travel times would be similar in the southbound direction in both AM and PM peak hours. In the northbound direction, slight increases in travel time of 1 to 2 minutes would occur between the Project and the Program.

Travel times for both Ballard to S. Spokane Street routes (via Alaskan Way and via the bored tunnel) between the Project and the Program are generally similar. However, specific travel time changes of up to 3 minutes were noted for select cases.

For the Ballard to S. Spokane Street route via Alaskan Way, AM peak travel times are shown to generally increase in the southbound direction and decrease in the northbound direction between the Project and the Program. In the PM peak, travel times increase between the Project and the Program for all but one case (northbound between the 2030 Project and 2030 Program).

With the exception of one case, travel time differences for the Ballard to S. Spokane Street route via the bored tunnel between the Project and the Program were generally similar or greater by 1 to 2 minutes.

Peak hour travel times for the 2015 Existing Viaduct, 2015 Project, 2015 Program, 2030 Project, and 2030 Program are shown in Exhibit 7-25.

West Seattle to CBD

As described in Chapter 5, this route extends from the intersection of California Avenue and S.W. Alaska Street to the CBD (Fourth Avenue and Seneca Street) and is presented for the peak direction trip only (i.e., inbound in the AM and outbound in the PM peak period).

Travel times for this route during AM peak conditions (inbound) and PM peak conditions (outbound) would be similar for the 2015 Project and 2015 Program.

Woodland Park to CBD

This route is defined by the SR 99 corridor from N. 50th Street to downtown Seattle and is described for the peak direction trip only. Travel times for the 2015 Project and 2015 Program are generally similar for the AM and PM peak hours and for both directions.

Exhibit 7-25. Corridor Travel Times for the 2015 Existing Viaduct, 2015 Project, 2015 Program, 2030 Project, and 2030 Program

	AM Peak Hour					PM Peak Hour				
	2015 Existing Viaduct	2015 Project[1]	2015 Program	2030 Project[1]	2030 Program	2015 Existing Viaduct	2015 Project[1]	2015 Program	2030 Project[1]	2030 Program
West Seattle to CBD (Fourth Avenue and Seneca Street)										
Inbound	20	23/23	23	25/25	-	-	-	-	-	-
Outbound	-	-	-	-	-	25	21/21	21	27/27	-
Woodland Park to CBD (Fourth Avenue and Seneca Street)										
Inbound	19	18	18	22	-	-	-	-	-	-
Outbound	-	-	-	-	-	15	15	15	18	-
Woodland Park to S. Spokane Street										
Southbound	16	14	14	15	15	15	12	12	15	15
Northbound	16	12	12	12	13	18	14	15	16	17
Ballard to S. Spokane Street (via Alaskan Way, AWV)										
Southbound	15	15/15	16	15/15	16	17	17/17	18	18/18	20
Northbound	19	20/20	17	20/20	19	21	22/22	24	27/27	25
Ballard to S. Spokane Street (via Mercer Street, Bored Tunnel)										
Southbound	N/A	14	15	14	16	N/A	16	17	22	22
Northbound	N/A	19	18	21	20	N/A	21	22	23	24
Northgate to Boeing Access Road										
Southbound	28	28	28	30	-	32	32	32	38	-
Northbound	28	28	28	32	-	30	30	30	34	-
Mercer Street (I-5 to Elliott Avenue)										
Westbound	9	10	9	11	9	11	11	10	14	12
Eastbound	7	8	7	8	7	12	10	11	14	14

Note: Estimated travel times shown in minutes.
AWV = Alaskan Way Viaduct
CBD = Central Business District
N/A = not applicable
[1] Where two travel time values are given for the 2015 and 2030 Project, the first reflects the New Dearborn Intersection option and the second reflects the New Dearborn and Charles Intersections option.

Woodland Park to S. Spokane Street

Changes to the larger roadway network as part of the 2015 Program and 2030 Program, which include the Elliott/Western Connector, the Mercer West Project, and minor capacity enhancements to Alaskan Way, would not affect travel times substantially for this route. As a result, travel times for both directions and time periods are expected to be within 1 minute for the Project and the Program.

Ballard Bridge to S. Spokane Street (via Alaskan Way Viaduct and/or Alaskan Way)

This route is defined by a north end point of Ballard and a south end point near the Duwamish area at S. Spokane Street.

The main network changes influencing travel times along this route are the introduction of the Elliott/Western Connector, along with minor capacity enhancements on Alaskan Way in the 2015 Program and 2030 Program. This connector would provide more direct access between the Alaskan Way surface street and the Elliott/Western one-way couplet and would allow north-south traffic to avoid the railroad conflicts in the north end of Alaskan Way near Elliott Avenue at Broad Street. The other capacity enhancements would consist of additional lanes on Alaskan Way between S. King Street and Yesler Way.

These improvements would significantly improve connections between the Elliott/Western corridor and Alaskan Way and increase the capacity of these linked corridors in the Program relative to the Project. They would attract trips to the corridor, reducing congestion on other routes, particularly on Broad Street/Alaskan Way at the railroad crossing at the north waterfront. However, these improvements also would attract more traffic to the corridor (relative to conditions with the Project), and travel time results are therefore mixed. In some cases, travel times along this route even increase with the Program, although it should be noted that the increases are caused by the additional traffic accommodated by the improved route.

The findings show that AM peak hour travel times generally increase for the southbound direction and decrease for the northbound direction for the 2015 Program and 2030 Program compared to the 2015 Project and 2030 Project. The largest northbound decrease is shown for the 2015 Program compared to the 2015 Project and is likely due to the benefits of the Elliott/Western Connector, despite the higher volumes attracted to the Alaskan Way arterial. For the PM peak hour, southbound travel times for the Program compared to the Project generally increase by 1 minute as a result of greater volumes attracted to the Alaskan Way surface arterial. In the northbound direction, travel times also increase between the 2015 Project and 2015 Program. However, a travel decrease of 2 minutes was noted for the 2030 Program compared to the 2030 Project, again due most likely to the benefits of the Elliott/Western Connector.

Ballard Bridge to S. Spokane Street (via Mercer Street and Bored Tunnel)

This route is also defined by a north end point of Ballard and a south end point near the Duwamish area at S. Spokane Street, but it relies on the bored tunnel and Mercer Street for access through the Uptown area. The main network change influencing travel times along this route is the introduction of a two-way Mercer Street segment from Fifth Avenue N. to Elliott Avenue in the 2015 and 2030 Program.

The findings from the mainline analysis show that travel times in the AM peak hour are fairly similar between the 2015 Project and 2015 Program and between the 2030 Project and 2030 Program. Travel times are generally identical or within 1 to 2 minutes between the Project and Program (increase or decrease). For the PM peak hour, travel times are either identical or increase by 1 to 2 minutes between the Project and Program.

Northgate to Boeing Access Road (via I-5)

As mentioned in Chapter 5, travel times between Northgate and Boeing Access Road are generally the longest of any route investigated due to the distance covered along the I-5 corridor and the multiple merge/weave sections encountered between these two end points. The modeling results indicate that travel times for the 2015 Program would be nearly identical to those summarized for the 2015 Project. These similar travel times are expected because no major capacity enhancements are incorporated for the SR 99 corridor (outside of the Elliott/Western Connector) that would induce a shift to or away from the I-5 corridor.

Mercer Street (I-5 to Elliott Avenue)

This route focuses on travel between I-5 and Elliott Avenue via Mercer Street and reflects changes in the 2015 Program and 2030 Program compared to the 2015 Project and 2030 Project in terms of the configuration for Mercer Street. As with the Ballard to S. Spokane Street route (via Mercer Street), the main network change influencing travel times along this route is the conversion of Mercer Street to two-way operations from Fifth Avenue N. to Elliott Avenue in the 2015 Program and 2030 Program.

The analysis findings show lower travel times in the AM peak hour for the 2015 Program compared to the 2015 Project. Similarly, lower travel times are noted for the 2030 Program when compared to the 2030 Project. These slight reductions in travel time are likely due to the more direct access through Uptown along a contiguous segment of Mercer Street in the 2015 Program and 2030 Program, as well as the addition of the Elliott/Western Connector, which would draw some traffic away from Mercer Street, therefore improving travel conditions somewhat. For the PM peak hour, westbound travel times for the 2015 Program and 2030

Program are lower than for the 2015 Project and 2030 Project, respectively. However, travel times for the eastbound direction are similar or modestly higher for the 2015 Program and 2030 Program versus the 2015 Project and 2030 Project, respectively. Any increases, while minor, are most likely the result of greater turning movement friction from the opposing (westbound) traffic stream and the influences from a two-way system (versus a one-way street).

7.1.6 Roadway Connectivity and Access

Key Findings

The Program would create additional roadway connections and access opportunities that would offer more travel routes in the future.

The Elliott/Western Connector would improve access between the central waterfront and these corridors, and in conjunction with the Alaskan Way S. ramps and improvements to Alaskan Way, would provide an additional, high-quality route for trips from SR 99. It also would provide an improvement over the Alaskan Way route in the Project, in particular avoiding the conflicts with the at-grade rail crossing of Broad Street just east of Alaskan Way.

Mercer Street would become two-way from Fifth Avenue N. to Elliott Avenue W. Roy Street from Aurora Avenue to Queen Anne Avenue N. would also become two-way.

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

The improved roadway, coupled with the Elliott/Western Connector described below, would provide a key route for trips from SR 99 to the Elliott and Western Avenue corridor.

Elliott/Western Connector – Pike Street to Battery Street

The Elliott/Western Connector would improve connectivity between Alaskan Way on the central waterfront and the Elliott/Western corridor in the Belltown area. Since the Bored Tunnel Alternative would not provide an access point directly to Elliott and Western Avenues, this new route would be an alternative for traffic and trucks traveling to and from the Ballard/Interbay/Magnolia areas that formerly used those ramps. The Elliott/Western Connector would likely attract additional traffic to Alaskan Way.

Mercer West Project – Fifth Avenue N. to Elliott Avenue

The reconfiguration of the Mercer Street corridor to two-way operations between I-5 and Elliott Avenue W. would be completed with this project. The Mercer Street corridor would provide an improved east-west connection for trips in the north end of the study area and would provide access to Ballard/Interbay for freight, as well as general traffic traveling to Ballard and Magnolia. This corridor

would also help to reduce circuitous routing for freight vehicles that connect to I-5 at Mercer Street, as well as all westbound vehicles between South Lake Union and Uptown or points west.

7.1.7 Transit Services

Key Findings

The enhanced transit under the Program would result in higher transit ridership levels as compared to the 2015 Existing Viaduct and the 2015 Project.

Transit ridership for the 2015 Program would be about 1 percent higher than that for the 2015 Project (Exhibits 7-26 and 7-27).

Transit ridership for the 2030 Program would be about 1 percent higher than that for the 2030 Project (Exhibits 7-26 and 7-27).

Transit mode share is expected to be similar between the 2015 Project and 2015 Program, approximately 34 percent of trips. By 2030, this share would increase to 41 percent under both the Project and Program (Exhibit 7-28).

Along major transit corridors, travel times during most time periods for the 2015 Program would be similar or less than those for the 2015 Project (Exhibit 7-29).

Along two transit corridors, Ballard/downtown Seattle and Aurora Avenue/downtown Seattle, travel times for the 2030 Program would be similar or less than those for the 2030 Project (Exhibit 7-30).

Transit Vehicle Connections

Cumulative effects of the Program would occur in the 2015 Program as well as the 2030 Program. The 2015 Program would include the new Elliott/Western Connector and a widened Alaskan Way surface street.

In the 2015 Program Plus Enhanced Transit and the 2030 Program, enhanced transit, such as the Delridge RapidRide line, would be provided along with additional service hours on the West Seattle and Ballard RapidRide lines. Peak-hour express routes would be added to South Lake Union and Uptown, and local bus changes (such as realignments and a few additions) to several West Seattle and northwest Seattle routes would be provided. The First Avenue streetcar is currently planned to run between S. Jackson Street and Republican Street along First Avenue. In addition, there would be an extension of the South Lake Union streetcar to connect to the new First Avenue streetcar.

Transit operations would be enhanced through more extensive bus lanes. In the South Lake Union area, the bus lanes identified in the 2015 and 2030 Project would be extended across Denny Way to Third Avenue via Battery and Wall Streets.

The following sections discuss the estimated effects on transit services of the 2015 Program compared to the 2015 Project and the 2030 Program compared to the 2030 Project.

Modeled Transit Ridership

Exhibits 7-26 and 7-27 summarize projected daily and AM peak period transit ridership, respectively, at three screenlines: south, central, and north. For the daily and AM peak period, information is presented for the 2015 Existing Viaduct, Project, Program, and Program Plus Enhanced Transit and the 2030 Project and Program.

Exhibit 7-26. Model-Estimated Daily Transit Ridership (Person-Trips) at Selected Screenlines

Screenline	2015				2030	
	Existing Viaduct	Project	Program	Program + Transit[1]	Project	Program
South (South of S. King Street)	99,200	97,000	97,600	98,700	163,700	165,900
Central (North of Seneca Street)	126,900	124,800	125,600	126,900	179,200	181,300
North (North of Thomas Street)	118,700	118,800	118,500	119,600	169,900	172,500

[1] Program Plus Enhanced Transit

Exhibit 7-27. Model-Estimated AM Peak Transit Ridership (Person-Trips) at Selected Screenlines

Screenline	2015				2030	
	Existing Viaduct	Project	Program	Program + Transit[1]	Project	Program
South (South of S. King Street)	31,320	30,780	30,950	31,340	54,520	55,270
Central (North of Seneca Street)	36,690	36,380	36,470	36,670	53,810	53,290
North (North of Thomas Street)	36,410	36,510	36,430	36,870	52,780	53,700

[1] Program Plus Enhanced Transit

Daily ridership levels for the 2015 Project and 2015 Program would be comparable at each screenline. For the 2015 Existing Viaduct and the 2015 Program Plus Enhanced Transit, there would be about a 2 percent increase in ridership at the south screenline compared to the 2015 Project and the 2015 Program. For the 2030 Program, total daily transit ridership in the study area is forecasted to increase substantially, by about 45 percent over 2015 levels for the central and north screenlines, and by 70 percent for the south screenline. Ridership levels at each screenline would be higher for the 2030 Program compared to the 2030 Project, but the variation is small, about 1 percent.

Projected AM peak hour transit demand with the 2015 Existing Viaduct, the 2015 Program, and the 2015 Program Plus Enhanced Transit indicates somewhat higher rider demand for the 2015 Program Plus Transit. Peak hour ridership levels would also be higher for the 2030 Program (which includes transit enhancements) as compared to the 2030 Project.

Transit mode shares are identified in Exhibit 7-28. The transit share of home-based work trips would be 34 percent for the 2015 Existing Viaduct, Project, Program, and Program Plus Enhanced Transit. By 2030, this share would increase to 41 percent under both the Project and Program. The transit share of non-work trips in 2015 is estimated to be 9 percent for the 2015 Existing Viaduct, Project, Program, and Program Plus Enhanced Transit. By 2030, the transit share for non-work trips would increase to about 10 percent for the Project and Program.

Exhibit 7-28. Model-Estimated Daily Transit Mode Shares: To, From, and Within Seattle's Center City

Screenline	2015				2030	
	Existing Viaduct	Project	Program	Program + Enhanced Transit[1]	Project	Program
Home-based work	34.2%	34.2%	34.3%	34.4%	40.5%	40.9%
Non-work	8.9%	8.8%	8.9%	8.8%	10.1%	10.2%

[1] Program Plus Enhanced Transit

Peak Hour Travel Times – 2015

The cumulative effects in 2015 are presented in the following sections for the major transit corridors that access downtown Seattle. Exhibit 7-29 describes the 2015 travel times for the Project and Program for three major travel corridors.

Exhibit 7-29. 2015 Travel Times Along Major Transit Travel Corridors

	2015 Project[1]	2015 Program	Change	2015 Project[1]	2015 Program	Change
	AM Peak Hour			PM Peak Hour		
Ballard to Denny Way (from the south side of the Ballard Bridge)						
Inbound	8	8	0	8	8	0
Outbound	8	8	0	8	8	0
Aurora Avenue (Woodland Park to CBD)						
Inbound	18	18	0	16	16	0
Outbound	12	12	0	15	15	0
West Seattle to CBD						
Inbound	23/24	23	0/-1	17/17	17	0/0
Outbound	16/16	15	-1/-1	22/22	20	-2/-2

Notes: Travel times are in minutes for general-purpose traffic.
CBD location is Fourth Avenue and Seneca Street.
CBD = Central Business District

[1] Where two travel time values are given, the first reflects the New Dearborn Intersection option and the second reflects the New Dearborn and Charles Intersections option.

Peak Hour Travel Times – Ballard/Downtown Seattle

Peak hour travel times for the Ballard/downtown Seattle (Denny Way) corridor would be generally the same for the 2015 Project and Program, with no noticeable increase for any time period or direction. For buses in the 2015 Project and the 2015 Program, the travel times would likely be less due to the presence of the bus lane on Elliott Avenue.

Peak Hour Travel Times – Aurora Avenue Corridor

General traffic conditions on the Aurora Avenue corridor under the 2015 Program would generally be comparable to the 2015 Project. Features of the 2015 Program would not likely affect travel times for general-purpose traffic or transit along this corridor.

Peak Hour Travel Times – West Seattle/Downtown Seattle Corridor

The estimated travel times for the 2015 Project and Program along the West Seattle/downtown Seattle corridor would be generally similar. With the 2015 Project, access to downtown Seattle via Columbia and Seneca Streets would no longer be available. General traffic conditions between West Seattle and downtown Seattle in the 2015 Program would be comparable to the 2015 Project. The greatest change for this corridor occurs in the outbound direction during the PM peak hour, where travel time decreases by 2 minutes in the 2015 Program as compared to the 2015 Project. This decrease is in the peak direction and therefore improves the travel time for a larger number of transit riders than in the off-peak direction.

PM Peak Hour Travel Times – South King County/Downtown Seattle Corridor

The travel conditions for the Burien/downtown Seattle travel corridor would be affected by traffic characteristics in the south end of downtown, particularly the area between S. Spokane Street and S. King Street. Accordingly, the travel times noted above for West Seattle/downtown Seattle would apply to the Burien/ downtown Seattle corridor.

Peak Hour Travel Times – 2030

The cumulative effects in 2030 are presented in the following sections for two major transit travel corridors that provide access to downtown Seattle: Ballard to Denny Way and Aurora Avenue. Exhibit 7-30 describes travel times for the 2030 Project and Program for major transit travel corridors.

Exhibit 7-30. 2030 Travel Times Along Major Transit Travel Corridors

	2030 Project	2030 Program	Change	2030 Project	2030 Program	Change
	AM Peak Hour			PM Peak Hour		
Ballard to Denny Way (From the South Side of the Ballard Bridge)						
Inbound	8	8	0	8	8	0
Outbound	8	8	0	10	9	-1
Aurora Avenue (Aurora Bridge to South Lake Union)						
Inbound	3	3	0	3	2	-1
Outbound	3	3	0	4	4	0

Note: Travel times are in minutes for general-purpose traffic.

Peak Hour Travel Times – Ballard/Downtown Seattle

Peak hour travel times for the Ballard/downtown Seattle corridor would be generally the same for the 2030 Project and Program. A 1-minute decrease in travel time would occur under the 2030 Program for outbound trips in the PM peak hour.

Peak Hour Travel Times – Aurora Avenue Corridor

Peak hour travel times for the Aurora Avenue corridor between North Seattle (Aurora Bridge) and South Lake Union would be almost the same for the 2030 Project and Program.

7.1.8 Truck Traffic and Freight

Key Findings

The Elliott/Western Connector would greatly improve access and travel time performance for freight traffic traveling along the central waterfront (Alaskan Way). This connection would also improve freight travel time by eliminating train conflicts experienced at Broad Street and Alaskan Way.

Converting Mercer Street to two-way between I-5 and Elliott Avenue W. would provide improved east-west access for freight traffic, particularly for trucks headed toward the Ballard/Interbay/Magnolia areas.

Increases in transit services in corridors feeding SR 99 would not directly affect freight operations, although mode shift caused by the transit service expansion would likely reduce vehicle volumes on designated Center City freight routes.

2015 Program and 2030 Program

The combined strategies of the Bored Tunnel Alternative and other Program elements should improve freight operations through the study area.

In the central waterfront area, the Elliott/Western Connector would enhance access for freight traffic from the Magnolia, Interbay, and Ballard areas. This connector would provide two lanes in each direction, beginning at Alaskan Way and Pike Street to Elliott and Western Avenues at about Blanchard Street. A new bridge over the BNSF railroad tracks at Virginia Street would help eliminate conflicts between freight vehicles and train traffic. In the AM peak hour, travel time for freight trips traveling from Ballard to S. Spokane Street via Alaskan Way are about the same for the 2030 Project and 2030 Program (about 15 minutes). In the reverse direction, travel time is slightly longer for the Project and Program (20 minutes). In the PM peak hour travel times for southbound freight trips destined for Ballard from S. Spokane Street (via Alaskan Way) are lower in the 2030 Program compared to the 2030 Project (14 and 18 minutes, respectively). Travel times for the reverse trip are about the same for both the 2030 Program and the 2030 Project (27 minutes).

Alaskan Way would feature 11-foot-wide travel lanes with on-street parking, bicycle lanes or a cycle track, and wide sidewalks. Separation of pedestrians and freight vehicles would likely enhance safety in this area.

The First Avenue streetcar would likely not have a substantial effect on freight operations because most freight traffic would use Alaskan Way and Elliott and Western Avenues along the central waterfront.

In the north section of the study area, the enhanced Mercer Street corridor would improve access for freight traffic, particularly freight trips to Magnolia, Interbay, and Ballard from SR 99 and I-5. In the Program, Mercer Street would become two-way from Fifth Avenue N. on the east all the way to Elliott Avenue W. This may encourage the diversion of some freight traffic from the Nickerson Street/ Westlake Avenue N. freight street. For the Mercer Street corridor (I-5 to Elliott Avenue W.), travel time would be slightly less in the 2030 Program in comparison to the 2030 Project for the PM peak hour (12 compared to 14 minutes for the westbound direction). In the eastbound direction, the travel times are about the same for 2030 Program and the 2030 Project.

Finally, enhanced transit services in key corridors would not likely affect freight operations. In the Program, additional service hours would be assigned to the Ballard and West Seattle RapidRide lines. The investments in more transit service beyond currently planned levels would likely increase transit ridership and reduce automobile traffic in theses corridors, possibly improving performance for freight vehicles. A new RapidRide line, the Delridge line, would be introduced to King County Metro's suite of RapidRide services. This service would help improve transit ridership and reduce automobile traffic demand for communities in the Delridge Avenue S.W./White Center corridor.

7.1.9 Parking

Key Findings

Several Program elements would affect parking along the waterfront, Belltown, and Uptown areas.

The Alaskan Way surface street improvements could affect about 580 on-street parking spaces along Alaskan Way and under the viaduct, although some would be replaced.

A number of parking mitigation strategies could be implemented to address the cumulative effects of parking disruption, including informational and pricing strategies and an increased supply of short-term visitor and customer parking.

Program Elements That Could Affect Parking

This parking section is slightly different from the quantitative approach in Section 5.1. This discussion of cumulative effects of the Program is supported by general magnitudes of parking spaces, where data are available. The Program elements that could affect parking are described below. No parking removals are assumed for the First Avenue Streetcar Evaluation or the Transit Enhancements.

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

Rebuilding the Alaskan Way surface street would affect parking spaces currently on Alaskan Way and under the viaduct. There are approximately 580 on-street parking spaces on the Alaskan Way surface street and under the viaduct from S. King to Pike Streets. An additional 260 off-street parking spaces nearby could be affected by a street reconfiguration. This totals almost 1,000 parking spaces along the central waterfront that could be affected by the Alaskan Way surface street improvements. A number of these spaces would be replaced, with the number, location, and type of spaces to be determined by the City of Seattle.

Elliott/Western Connector – Pike Street to Battery Street

This project would provide would affect the existing parking spaces in this area. This project would affect approximately 280 parking spaces, split equally between on- and off-street parking spaces. Initial estimates indicate that approximately 120 of the 140 on-street parking spaces could be replaced, depending on the final design of the streets.

Mercer West Project – Fifth Avenue N. to Elliott Avenue

Improvements to Mercer Street from Fifth Avenue N. to Elliott Avenue and improvements to Roy Street from Fifth Avenue N. to Queen Anne Avenue N. could affect on-street parking. There are currently about 250 on-street parking spaces on these sections of Mercer and Roy Streets.

Parking Mitigation

Potential mitigation measures during construction are discussed in Section 7.3.4. Although the mitigation measures would be most needed during construction, many of them could be retained and provide benefits over the longer term. City of Seattle parking mitigation strategies focus on providing better information and reducing commuter parking in favor of short-term customer parking. These include the following measures:

- Encourage privately held parking lots to institute measures that reward short-term parking.
- Provide for short-term parking (off-street), especially serving retail and commercial areas.
- Partner with private and public parking facilities to implement e-Park, an electronic guidance system displaying real-time parking availability on right-of-way signs, facility signs, and the Seattle Parking Map website. Dynamic message signs would be located at key access points to the downtown, Pioneer Square, and the central waterfront.
- Encourage businesses to use parking vouchers that they could give to customers to park in designated parking lots.

7.1.10 Pedestrians

Key Findings

Pedestrian mobility and access would be improved in the south portal area as a result of the Port Side Pedestrian/Bike Trail and the City Side Trail.

Program elements would improve the pedestrian environment along the waterfront.

Pedestrian mobility and access would be greatly improved in the north portal area by three new crossings of SR 99 at John, Thomas, and Harrison Streets, as well as the improved pedestrian streetscape and pedestrian path on Mercer Street.

2015 Program and 2030 Program

As stated in Chapter 5, pedestrian mobility and overall pedestrian experience would be improved considerably due to the addition of the Port Side Pedestrian/Bike Trail and the City Side Trail in the south portal area.

The Program elements in the central waterfront area would enhance the pedestrian environment with a more pedestrian-focused waterfront that would include a substantial increase in pedestrian space with the proposed promenade along a redesigned Alaskan Way. The new expanded 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 space is expected to be approximately 70 to 80 feet wide.

Pedestrian mobility would be enhanced through the connection of John, Thomas, and Harrison Streets over SR 99 and the provision of the pedestrian path on the north side of Mercer Street, which is a key connection for the Lake to Bay Trail crossing of SR 99.

7.1.11 Bicycles

Key Findings

Bicycle mobility and access will be improved in the south portal area by the construction of the Port Side Pedestrian/Bike Trail and the City Side Trail.

The bicycle environment would be enhanced by the waterfront promenade and the in-street bicycle lanes on Alaskan Way and the bicycle lanes and sharrows proposed for the new Elliott/Western Connector.

Mobility and access would be improved for bicyclists in the north portal area due to improved bicycle connections facilitated by the Mercer East Project.

2015 Program and 2030 Program

As noted in Chapter 5, bicycle access and mobility will be improved in the south portal area by the construction of the Port Side Pedestrian/Bike Trail and the City Side Trail.

The Program elements in the waterfront area would enhance the bicycle environment through the reconfiguration of a large portion of the Alaskan Way right-of-way to focus on nonmotorized transportation, with bicyclists able to use the promenade and the in-street bicycle lanes on Alaskan Way and sharrows on the new Elliott/Western Connector.

Bicyclists would experience improved access and mobility in the north portal area as a result of the new connections across SR 99 and John, Thomas, and Harrison Streets and the modifications to Mercer Street completed by the Program and the Mercer West Project. Mercer West Project improvements also include a bicycle lane on Roy Street. The bicycle facilities on the north side of Mercer Street are part of the Lake to Bay Trail that connects bicycle facilities in South Lake Union with the Elliott Bay Trail and attractions west of SR 99.

7.1.12 Ferries

Key Findings

Ferry passengers on foot would benefit from the enhanced pedestrian environment along the waterfront.

Some of the vehicular traffic to and from the Seattle Ferry Terminal at Colman Dock would have slightly better access due to the new roadway configuration along Alaskan Way and Elliott and Western Avenues.

2015 Program and 2030 Program

For walk-on passengers who access the Seattle Ferry Terminal on foot, the Program elements along the waterfront would enhance the pedestrian environment through the construction of a more pedestrian-focused waterfront.

For ferry passengers in vehicles, the cumulative effect of the Program elements would be limited for most users. The new roadway configuration on Alaskan Way should slightly improve access to the Seattle Ferry Terminal, but the overall surface street network in downtown Seattle would remain substantially the same. An exception is that traffic exiting the terminal and destined for points north would benefit from the new connection between Alaskan Way and the Elliott/Western corridors.

7.1.13 Safety

Key Findings

The safety benefits of the Program would be similar to those of the Bored Tunnel Alternative.

2015 Program and 2030 Program

For the 2015 Program and 2030 Program, the safety benefits would be similar to those of the 2015 Project and 2030 Project. However, several elements of the Program could affect the potential for conflicts between vehicles, pedestrians, or bicycles. The construction of the Elliott/Western Connector would result in increased traffic along Alaskan Way, increasing the potential for conflicts between vehicles, pedestrians, and bicycles on those roadways. However, these potential effects are expected to be mitigated by roadway design features that moderate travel speeds and provide accommodations for all travelers of the corridor—drivers, cyclists, and pedestrians. Facility design associated with pedestrian and cyclist mobility includes a large pedestrian promenade along the proposed Alaskan Way surface street, appropriately located and well marked crosswalks, as well as bicycle lanes or a cycle track on Alaskan Way and sharrows on the Elliott/Western Connector.

The Elliott/Western Connector would likely reduce traffic volumes along the north waterfront, shifting some of this traffic from Alaskan Way to Elliott Avenue and Western Avenue. Traffic volumes on Elliott and Western Avenues would be higher than volumes in the 2015 Project and 2030 Project but reduced from the 2015 Existing Viaduct.

The Mercer West Project would convert Mercer and Roy Streets to two-way. Crossing the street may be somewhat more difficult for pedestrians at unsignalized intersections because traffic would be traveling in both directions, rather than a single direction.

7.1.14 Event Traffic

Key Findings

No substantial changes in the south portal area are expected beyond those attributed to the Bored Tunnel Alternative.

The two-way Mercer Street configuration would allow more direct access to the Seattle Center parking garages north of Mercer Street from the east. However, in terms of egress capacity after events at Seattle Center, the two-way system may result in slightly longer travel times and greater delays. More direct access to SR 99 from the Mercer Garage (eastbound) would be possible, however, due to the two-way configuration for Roy Street.

The new Elliott/Western Connector would greatly improve access for events and would likely shift some event traffic away from the bored tunnel to surface streets.

South Portal Area

In the 2030 Program, no substantial changes in the south end beyond those identified for the 2030 Project would occur in terms of roadway network components and connections to and from regional facilities. Therefore, no major differences for event traffic in terms of detour routing, congestion levels, or requirements for traffic management would result.

North Portal Area

No substantial roadway changes in the north end are expected between the 2030 Project and the 2030 Program, with the exception of two elements: (1) the Mercer West Project and (2) the new Elliott/Western Connector. The Mercer West Project would complete the two-way conversion of the Mercer Street corridor initiated by the Mercer East Project and the Alaskan Way Viaduct Replacement Project phases.

With regard to event traffic, the two-way Mercer Street configuration would allow more direct access to the Seattle Center parking garage north of Mercer Street from the east (e.g., I-5) by eliminating the need to use the one-way couplet system of Roy and Mercer Streets. However, in terms of egress capacity after events at Seattle Center, the two-way system may result in slightly longer travel times and greater delays compared to a traditional one-way system due to the need to serve a larger number of movements at nearby intersections/signals from

Queen Anne Avenue N. to Fifth Avenue N. More direct access to SR 99 from the Mercer Garage after events (due to a two-way Roy Street) may result in improved travel times specifically for event patrons using SR 99 to the south.

The Elliott/Western Connector would greatly improve access for events and would likely shift some event traffic way from the bored tunnel to surface streets. Diversion to local streets may increase congestion levels slightly on Broad Street and cross streets such as First Avenue N. compared to the project. However, use of Elliott and Western Avenues and Broad Street for the Program would be similar to the 2015 Existing Viaduct.

7.2 Cumulative Effects of the Project, Other Program Elements, and Other Actions

The focus of the cumulative effects analysis is on the combined effect of the Bored Tunnel Alternative, other Program elements, and other past, present, and reasonably foreseeable future projects that are anticipated to add to transportation effects in the study area. This entire section is approached qualitatively. The following projects are considered for potential activities that could have cumulative effects:

A. Roadway Elements

- Alaskan Way Surface Street Improvements – S. King Street to Pike Street
- Elliott/Western Connector – Pike Street to Battery Street
- Mercer West Project – conversion of Mercer Street to two-way from Fifth Avenue N. to Elliott Avenue and conversion of Roy Street to two-way from Fifth Avenue N. to Queen Anne Avenue N.

B. Non-Roadway Elements

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

C. Projects Under Construction

- Transportation Improvements to Minimize Traffic Effects During Construction

D. 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)

E. Seattle Planned Urban Development

- Gull Industries on First Avenue S.
- North Parking Lot Development at Qwest Field
- Seattle Center Master Plan (EIS) (Century 21 Master Plan)
- Bill and Melinda Gates Foundation Campus Master Plan
- South Lake Union Redevelopment
- U.S. Coast Guard Integrated Support Command
- Seattle Aquarium and Waterfront Park
- Seattle Combined Sewer System Upgrades

F. Local Roadway Improvements

- Bridging the Gap Projects
- SR 99/East Marginal Way Grade Separation

G. Regional Roadway Improvements

- I-5 Improvements
- SR 520 Bridge Replacement and HOV Program
- I-405 Corridor Program
- I-90 Two-Way Transit and HOV Operations, Stages 1 and 2

H. Transit Improvements

- First Hill Streetcar
- Sound Transit University Link Light Rail Project
- RapidRide
- Sound Transit North Link Light Rail Project
- Sound Transit East Link Light Rail Project
- Washington State Ferries Seattle Terminal Improvements

I. Transportation Network Assumptions

- HOV Definition Changes to 3+ Throughout the Puget Sound Region
- Sound Transit Phases 1 and 2
- Other Transit Improvements

J. Completed but Relevant Projects

- SR 519 Intermodal Access Project, Phase 2
- Sound Transit Central Link Light Rail Project
- South Lake Union Streetcar

Several projects, such as the S. Holgate Street to S. King Street Viaduct Replacement, Fourth Avenue S. Loop Ramp, Mercer East Project (two-way Mercer Street from Fairview Avenue N. to Dexter Avenue N.), and S. Spokane Street Viaduct Widening, are included in the 2015 Existing Viaduct, so they are not considered in this section for cumulative effects.

Key Findings

- Cumulative effects of the Bored Tunnel Alternative, other Program elements, and other past, present, and future projects are generally similar to the effects of the Bored Tunnel Alternative and the other Program elements.
- Overall, increased transit service, whether it is provided by bus, light rail, or commuter rail, would help in reducing single-occupant vehicle (SOV) demand to the Center City and reduce the growth rate of demand on SR 99, I-5, and local arterials for years to come.
- Other regional transportation improvements, such as the Link light rail expansion and the improvements to I-5, will help the system meet the growing demand.
- Intersection congestion levels under the 2030 Program, with the combined effects of regional projects, would likely be similar to or lower than those for the 2030 Program in terms of average vehicle delays and LOS.

7.2.1 Regional Context and Travel Patterns

Most of the projects considered for cumulative effects would not have a substantial effect on the larger region or regional travel patterns. However, the transit improvements are worth noting. A longer Link light rail system connecting the Eastside and extending at least to Lynnwood in the north and a more complete King County Metro RapidRide system, coupled with additional transit service hours, would increase the person-carrying capacity across the Center City screenlines. Overall, increased transit service, whether provided by bus, light rail, or commuter rail, would help in reducing SOV demand to the Center City and reduce the growth rate of demand on SR 99, I-5, and local arterials for years to come.

7.2.2 Traffic Operations on SR 99

The improvements related to the Bored Tunnel Alternative, Program, and other area projects would have a substantial effect on traffic operations on SR 99. As discussed previously, the Bored Tunnel Alternative is expected to result in operations that are similar to or better than the 2015 Existing Viaduct conditions between South Lake Union and the stadium area.

As other major regional transportation improvements are completed, traffic operations on SR 99 are expected to improve. For example, reconstruction of I-5 is expected to include restriping, which would provide higher capacity through downtown Seattle. In addition, the extension of Link light rail north to Lynnwood and south to Federal Way would provide additional person-carrying capacity. The additional capacity on these other facilities would help relieve demand on SR 99.

7.2.3 Traffic Operations at Key Arterial Intersections

Intersection congestion levels under the 2030 Program, with the combined effects of regional projects, would likely be similar or improved relative to the 2030 Program (described previously in Section 7.1) in terms of average vehicle delays and LOS. Traffic demand and peak hour volumes along the SR 99 corridor and at intersections within the three sub-areas investigated under the Program would either remain consistent with 2030 Program levels or decrease slightly once the regional projects are completed.

As discussed in Section 7.1, the transit enhancements proposed for the 2030 Program alone may induce some shift to non-automobile-based modes such as light rail or bus, though in general, these changes would likely not reduce traffic volumes or congestion on most arterials and highway facilities.

With additional transit resources and services included as part of the comprehensive regional transportation system, however, including completion of the Sound Transit streetcar program in the downtown area, Link light rail extensions to the north and east, implementation of Metro's RapidRide system, and completion of the HOV system, the mode shift to transit services should be more pronounced than under the 2030 Program. In principle, the ubiquity of transit services may increase overall ridership and potentially encourage a sizable portion of regional trips to shift away from conventional automobile-based alternatives (SOV, HOV, etc.). In the event that major transit patronage is realized with the long-range systems in place for the Program, traffic volumes in the downtown core and on regional facilities such as SR 99 could conceivably decrease from 2030 Program levels. Consequently, intersection delays and sub-area congestion could be reduced due to lower peak hour demands on local streets and arterials.

Benefits due to improvements to regional highway corridors such as I-405, SR 520, and I-90 may also serve as a means for reducing traffic volumes along I-5 and possibly SR 99. With greater options for regional travel in terms of high-capacity corridors and alternative modes, the probability of reduced demand on the SR 99 corridor would likely increase. Again, such decreases in traffic volume for affected intersections within the sub-areas evaluated would translate to reduced levels of delay, decreased congestion, and improvements in point-to-point travel times.

7.2.4 Roadway Connectivity and Access

The combined effects of the Alaskan Way Viaduct Replacement Project and other roadway, transit, and non-roadway improvements would further enhance accessibility and connectivity in the region, and in some cases directly benefit access to or from the SR 99 corridor. Projects such as the Bridging the Gap Projects, the S. Spokane Street Viaduct Widening, the SR 99/East Marginal Way Grade Separation, the Mercer West Project, and the SR 519 Intermodal Access Project, Phase 2, will improve access to the corridor and local circulation in neighboring areas as well.

7.2.5 Transit Services

Indirect and cumulative effects involving transit include future development of regional high-capacity transit facilities and service. With voter approval of the ST2 Plan in November 2008, Link light rail serving downtown Seattle will be extended to Lynnwood in the north, Redmond (Overlake) in the east, and Federal Way in the south. Also, additional trips and system capacity will be provided on Sounder commuter rail service operating between Lakewood and downtown Seattle.

Potential new passenger-only ferry connections to downtown Seattle may be provided by the King County Ferry District. These connections would be based on the results of a feasibility study of potential expanded passenger-only ferry service within King County. Potential new routes include Ballard (Shilshole) to downtown Seattle (Pier 50) and Des Moines to downtown Seattle.

7.2.6 Truck Traffic and Freight

The combined strategies of the Bored Tunnel Alternative and other Program elements should improve freight operations through the study area, as described previously. Other projects in the vicinity would further improve conditions.

Although the SR 99/East Marginal Way Grade Separation project is included in the 2015 Existing Viaduct, it is worth noting. This project is located on Duwamish Avenue between S. Spokane Street and E. Marginal Way S., and it will improve freight access among the Port of Seattle terminals, UPRR and BNSF railyards, and

local manufacturers' and distribution warehouses. The lead track will be grade-separated and connect 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 will also support industrial users in West Seattle and on Harbor Island. The project will improve safety by eliminating rail/highway conflicts at the existing at-grade crossing, reduce vehicle delay at railroad tracks by grade separation, and facilitate greater efficiencies in an area of substantial intermodal and multimodal activity.

7.2.7 Parking

Cumulative effects related to parking would largely be experienced during construction if parking is disrupted. Effects on parking during construction are discussed in Section 7.3.4. Beyond the effects on parking related to the Program elements, none of the projects considered for cumulative effects is anticipated to have a substantial effect on parking.

7.2.8 Pedestrians

The addition of the new roadway connections across existing pedestrian barriers such as SR 99 in the northern portion of the study area, improvements to pedestrian facilities and amenities, and greater consideration of the pedestrian experience in the project area may enhance overall nonmotorized and transit travel within and to the downtown Seattle area, contributing to the achievement of the region's goal of reduced automobile travel, decreased traffic congestion, and improvements in other overall quality of life measures, such as air quality.

7.2.9 Bicycles

The addition of new bicycle facilities in the southern portion of the study area and a substantial increase in the connectivity of the street grid to SR 99 and to other major bicycle facilities in the north portal area may increase nonmotorized travel and transit travel in the greater Seattle area, contributing to an overall decrease in dependence on automobiles and improvements in congestion, air quality, and other quality of life measures.

7.2.10 Ferries

For walk-on ferry passengers who access the Seattle Ferry Terminal on foot, the elimination of the Alaskan Way Viaduct, enhancements to the pedestrian environment adjacent to and through the Alaskan Way surface street, along with the other transit enhancements in the city such as the Link light rail system and the Third Avenue transit corridor, should improve daily conditions and encourage continued increases in nonmotorized travel.

For ferry passengers in vehicles, the cumulative effect of all the projects expected to be in place when the Bored Tunnel Alternative is completed would be limited.

7.2.11 Safety

The overall cumulative effects related to safety would be similar to those for the Program. Several of the projects considered for cumulative effects should improve safety. For example, the SR 99/East Marginal Way Grade Separation project would eliminate rail/highway conflicts at the existing at-grade crossing. The SR 519 Intermodal Access Project, Phase 2, improvements have separated automobile, freight, pedestrian, and rail traffic, helping to improve mobility, increase pedestrian safety, and reduce the risk of collisions.

7.2.12 Event Traffic

South Portal Area

Cumulative effects on event traffic in the stadium area would be mainly driven by changes in land use and transit modes. With the initiation of Link light rail service in mid-2009, the continuing improvements to Sounder commuter rail trains on weekends, and potential future bus service enhancements, it is anticipated that more event-goers will begin to gravitate toward non-automobile transportation options as their preferred alternative for going to and from the stadiums. This transition would not be immediate; it would occur over several years.

Land use changes such as the potential development of the Qwest Field north lot could also influence traffic demands, rebalancing origins and destinations for trip activity and possibly encouraging alternative modes, such as transit and walking.

North Portal Area

Similar to the south end, event traffic impacts due to cumulative effects in the north end would be influenced primarily by changes in land use and transit modes. Future streetcar service between downtown and Seattle Center as well as expanded RapidRide BRT service may be provided by the time the Program is completed. Such changes in the transportation system accompanied by increased densification of land uses near Seattle Center may influence a shift to non-automobile travel modes and help to offset future (and inevitable) increases in background traffic demands during major events.

7.3 Cumulative Effects During Construction

<u>Key Findings</u>

One of the benefits of the Bored Tunnel Alternative is that it minimizes construction effects (both project-specific and cumulative) by allowing the

existing Alaskan Way Viaduct to stay in operation until the bored tunnel is completed.

A number of other major transportation projects would occur in the vicinity during the Bored Tunnel Alternative's construction period.

Disruptions due to the Bored Tunnel Alternative would primarily occur at or near the tunnel portals.

Traffic patterns in the project area are complex, and schedule adjustments made during the construction of any of the overlapping projects have the potential to affect other projects and traffic patterns.

This section qualitatively describes any notable cumulative effects that could occur during construction, considering the entire Program and other projects in the general vicinity. Numerous projects underway in the Puget Sound region have the potential to affect a portion of trips on the Alaskan Way Viaduct (e.g., the SR 520 Bridge Replacement Project). However, this section of the Transportation Discipline Report discusses only projects that are located relatively close to the Alaskan Way Viaduct Replacement Project and also would occur during the construction period of the Bored Tunnel Alternative.

The following projects are discussed for their potential to affect the Bored Tunnel Alternative:

- Major components of the Program that are not included in the Bored Tunnel Alternative and would overlap with respect to construction timing and proximity, including the following:
  - Alaskan Way Surface Street Improvements – S. King to Pike Streets
  - Elliott/Western Connector – Pike Street to Battery Street
  - Mercer West Project – Fifth Avenue N. to Elliott Avenue
  - Elliott Bay Seawall Project
  - Alaskan Way Promenade/Public Space
  - S. Holgate Street to S. King Street Viaduct Replacement
- City of Seattle projects
  - Bridging the Gap Projects
  - S. Spokane Street Viaduct Widening Project
  - Mercer Street Corridor Improvements Project

The use of tunnel boring technology instead of a cut-and-cover method eliminates many of the construction effects in the center of the project area. Therefore, the cumulative effects due to construction of the bored tunnel and other nearby concurrent projects are best described in the following locations:

- At the south and north portal areas where connections need to be made to the tunnel and the tunnel boring machine would enter and exit the ground
- At the Elliott/Western Connector.
- In the area of the seawall replacement
- For the viaduct demolition activities

7.3.1 South Portal Area

Two projects have the potential to generate cumulative construction-related effects in the vicinity of the south portal of the tunnel: S. Spokane Street Viaduct Widening Project and the S. Holgate Street to S. King Street Viaduct Replacement Project.

Although the S. Spokane Street Viaduct Widening Project is not adjacent to the south portal of the bored tunnel and is farther away than the other two projects (about 1 mile south), it does have the potential to affect users of the SR 99 corridor and indirectly the bored tunnel. In particular, the closure of the southbound to westbound ramp from Fourth Avenue S. has the potential to divert some traffic that is current using Fourth Avenue S. for access to West Seattle to drive through the construction area on First Avenue S. The completion of a ramp from the eastbound lanes of the S. Spokane Street Viaduct to Fourth Avenue S. (in particular the northbound movement) could benefit traffic during construction of the Bored Tunnel Alternative by providing a more efficient connection to Fourth Avenue S. and additional incentive for drivers to avoid the construction zone on First Avenue S.

Construction activities on the S. Holgate Street to S. King Street Viaduct Replacement Project would overlap with the construction of the Bored Tunnel Alternative from about 2011 through 2014. In particular, the current schedules require lane closures on First Avenue S. between Railroad Way S. and S. King Street near the time that the S. Holgate Street to S. King Street Viaduct Replacement Project would be closing Alaskan Way S. from S. King Street to S. Atlantic Street. Although construction activities are not currently scheduled to overlap, if schedule adjustments during construction force the closure of Alaskan Way S. to occur when First Avenue S. is reduced to one lane, there would be a substantial effect on north-south traffic in the south portal area.

As part of the S. Holgate Street to S. King Street Viaduct Replacement Project, S. Royal Brougham Way would be closed east of Alaskan Way S. throughout the construction period, and it would remain closed thereafter. A portion of the roadway west of First Avenue S. would remain open to provide access to adjacent businesses and the temporary on-ramp to northbound SR 99. In this way, business access would not be directly affected. Users who normally use S. Royal Brougham Way to travel east-west between Alaskan Way S. and the stadium area, SR 519, or First Avenue S. would instead use S. King Street to the north or S. Atlantic Street one block to the south.

7.3.2 Central Area

In the central waterfront area between S. Washington Street and Pike Street, the Bored Tunnel Alternative would require detours along sections of Alaskan Way over a 3-year period between 2012 and 2015. Construction of the seawall and the associated effects on Alaskan Way are planned to be complete prior to the demolition of the Alaskan Way Viaduct. However, construction of the seawall would run concurrently with the Bored Tunnel Alternative construction, and there would likely be both lane closures and detours or realignments of Alaskan Way between S. Washington Street and Pike Street that occur during construction of the Bored Tunnel Alternative.

Along with affecting general-purpose traffic, project construction is anticipated to affect freight operations along Alaskan Way. WSDOT, the City, and the Port of Seattle will be working collectively to develop construction staging plans for the Elliott Bay Seawall Project.

7.3.3 North Portal Area

The primary project that requires discussion in the north portal area is the Mercer Street Corridor Improvements Project. For this Program, the City of Seattle would be widening and modifying Mercer Street from its current one-way configuration to a two-way operation.

The Two-Way Mercer Corridor Project consists of several major components. The section of Mercer Street between I-5 and Dexter Avenue N. would be constructed first. It is likely that construction on Mercer Street between Elliott Avenue W. and Fifth Avenue N. would be coordinated with construction on Mercer Street between Fifth Avenue N. and Dexter Avenue N. so that both projects would be complete at the same time.

7.3.4 Parking

Parking under and adjacent to the existing viaduct along the central waterfront would be affected by both the Bored Tunnel Alternative and other elements of the Program. The Program is expected to have a more substantial effect on parking than the Bored Tunnel Alternative alone. A number of parking mitigation strategies could be implemented to address parking disruption due to construction activities. Cumulative effects and potential mitigation strategies are discussed below.

Cumulative Effects on Parking During Construction

Elliott Bay Seawall Project

The Elliott Bay Seawall Project is not anticipated to permanently affect parking. However, there may be substantial effects on parking during construction, depending on a number of factors, such as whether parking on the Alaskan Way surface street would be removed, whether parking under the viaduct would need to

be removed to accommodate additional travel lanes under the viaduct, and the length of construction segments. It is likely that seawall construction would occur in segments, so parking would be affected only in the segment of construction, not the entire length of the Elliott Bay Seawall Project. The project limits for the seawall replacement extend from S. Washington Street in the south to Broad Street in the north. There are approximately 50 on-street parking spaces on the Alaskan Way surface street and 540 on-street parking spaces under the viaduct from S. King Street to Pike Street. Parking along the central waterfront also may be affected at times when utilities are relocated for seawall replacement.

In addition to the parking on Alaskan Way and under the viaduct, access to parking on the piers also could be temporarily affected during seawall construction activities. There are about 80 parking spaces on Piers 53, 54, 56, and 57, in addition to loading zones on many of the piers. Most of these parking spaces are employee and visitor spaces for businesses on the piers.

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

Rebuilding the Alaskan Way surface street between S. King Street and Pike Street would affect parking spaces currently on Alaskan Way and under the viaduct. Directly following viaduct demolition and removal, the City of Seattle expects to begin work on the waterfront promenade and the new Alaskan Way surface street. Construction of these projects will likely affect parking availability until they are completed (in approximately 2018). There are approximately 590 on-street parking spaces on the Alaskan Way surface street and under the viaduct from S. King Street to Pike Street. There are an additional 260 off-street parking spaces nearby that could be affected by street reconfiguration. This totals about 850 parking spaces along the central waterfront that could be affected by the Alaskan Way surface street improvements. A number of these spaces would likely be replaced, with the number, location, and type of spaces to be determined by the City of Seattle. While design is not finalized, the concept for Alaskan Way is to include parallel parking on both sides of the street. The effects to parking during viaduct demolition were discussed in more detail in Section 6.1.9.

Other Projects

Construction activity related to private development may occur concurrently with Bored Tunnel Alternative or Program construction and could affect the supply of parking, particularly in off-street (pay) parking lots. In particular, there are several developments in the stadium area that could affect parking within the timeframe of the Program.

The Qwest Field north lot redevelopment could affect 1,100 spaces during construction, but preliminary information on the redevelopment indicates that about 950 spaces would be included in the new development. However, the

number of these 950 spaces that would be available to the public is not known at this time. If the north lot redevelopment removes parking spaces at the same time that the Program affects parking spaces along the waterfront and in Pioneer Square, there could be a noticeable reduction in parking in Pioneer Square.

The redevelopment of Home Plate Parking at S. Atlantic Street and First Avenue S. could affect 300 off-street parking spaces during construction. About 610 spaces are proposed for the new development, although not all of these would be available to the public. The main effect of this redevelopment on parking would be felt during construction, when 300 spaces are removed.

In the north portal area, redevelopment of the Mercer Garage at Seattle Center and construction of a new underground garage at Memorial Stadium could affect up to 1,500 off-street parking spaces during north portal construction.

Parking Mitigation During Construction

Potential Management Strategies

A number of parking management strategies could be implemented to address the cumulative effects of parking disruption due to construction activities. Strategies would need to be coordinated between WSDOT and the City of Seattle, with input from surrounding businesses. City of Seattle parking mitigation strategies focus on providing better information and reducing commuter parking in favor of short-term customer parking. Potential parking mitigation strategies under consideration include the following:

- Encourage a shift from long-term parking to short-term parking. This could involve encouraging privately held parking lots to institute measures that reward short-term parking.
- Provide for short-term parking (off-street), especially serving retail and commercial areas.
- Partner with private and public parking facilities to implement e-Park, an electronic guidance system displaying real-time parking availability on right-of-way signs, facility signs, and the Seattle Parking Map website. Dynamic message signs would be located at key access points to the downtown, Pioneer Square, and the central waterfront.
- Launch the Seattle Parking Map, featuring on-street parking regulations and off-street parking locations, hours of operations, and short-term parking rates.
- Evaluate curb space designations and priorities to maximize and balance access needs for multiple curb space users, including commercial and delivery vehicles, taxis, and customers.

- Develop a Center City parking marketing program, which could include the following measures:
  - Provide improved access to parking option information through e-Park and Seattle Parking Map websites for businesses to share with customers and vendors.
  - Use existing and new social media and blog outlets to provide frequent parking impact information to create a "no surprise" environment.
  - Encourage businesses to adopt the use of parking vouchers that they could give to customers to park in designated parking lots.

Create a parking brokerage that would allow a site entitled to parking to sell that entitlement to someone else in the plan area. This would help locate parking where it is needed/valued and create a market for parking rights.

Center City Parking Program

The Center City Parking Program is SDOT's approach for addressing changes and growing demand for short-term parking in Seattle's Center City area over the next several years. Marketing, way-finding, and technology measures aim to improve access to off-street short-term parking beginning in 2012. The approach is designed to keep the Center City area moving as more jobs and people come to Seattle and throughout the construction of the Alaskan Way Viaduct Replacement Project.

One innovative component of the Center City Parking Program is e-Park, an electronic parking guidance system that uses signs to provide motorists with information about real-time parking space availability and directs them from primary downtown access points to parking garages. This new technology would make it easy for shoppers and visitors to find parking and reduce traffic congestion and pollution by reducing the time spent circling for vacant on-street parking. In fall 2010, the e-Park project will begin as a pilot project focused on the retail and Pike Place Market areas to test the technology and concept. In 2011-2012, e-Park will expand to other downtown destination areas, including Pioneer Square and the central waterfront.

To support the launch of the Electronic Parking Guidance System in spring 2010, SDOT is developing a marketing strategy and program name and branding to be used on message signs, a parking locator website, printed maps, and marketing programs for participating garages, properties, and other organizations in the Center City area.

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ATTACHMENT A

Surface and Transit Scenario Year 2030 Analysis Results

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ACRONYMS AND ABBREVIATIONS

EIS	Environmental Impact Statement
I-5	Interstate 5
LOS	level of service
mph	miles per hour
project	Alaskan Way Viaduct Replacement Project
SDOT	Seattle Department of Transportation
SODO	South of Downtown
SR	State Route
ST scenario	I-5, Surface, and Transit Hybrid Scenario
UMP	Urban Mobility Plan
VHD	vehicle hours of delay
VHT	vehicle hours of travel
VMT	vehicle miles of travel
WSDOT	Washington State Department of Transportation

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Chapter 1 INTRODUCTION AND SUMMARY

1.1 Introduction

This attachment discusses the Interstate 5 (I-5), Surface, and Transit Hybrid Scenario (hereafter referred to as the ST scenario) that was developed for the replacement of the Alaskan Way Viaduct during the Partnership Process of 2008. During the Partnership Process, all transportation modeling was for the year 2015, when a replacement facility could be opened. The normal practice for environmental review is to consider a design year in addition to the opening year. For the Alaskan Way Viaduct Replacement Project (project), the design year is 2030. This attachment provides information for the ST scenario in 2030 and discusses the following topics:

- Background information on the creation of the ST scenario.
- Traffic analysis of the 2030 ST scenario.
- Comparison of travel demand modeling and traffic analysis results for the 2030 ST scenario and the 2030 Project

The information provided in this attachment is referred to in the discussion in Chapter 3, Alternatives Development, of the Supplemental Draft Environmental Impact Statement (EIS).

1.2 Background Information

1.2.1 Previous Environmental Impact Statements

In early 2002, 76 viaduct replacement concepts and 7 seawall concepts were screened and packaged into five alternatives and several options that were evaluated in the 2004 Draft EIS (WSDOT et al. 2004).

The 2004 Draft EIS 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.

1.2.2 Partnership Process

After the March 2007 election, Governor Gregoire, King County Executive Sims, and Seattle Mayor Nickels committed to a collaborative process to find a solution to replace the viaduct along Seattle's central waterfront. This collaborative effort, referred to as the Partnership Process, was created to resolve the longstanding needs of the Alaskan Way Viaduct, seawall, and related projects in a manner that could be broadly supported and implemented. The three parties formalized this effort in a Memorandum of Understanding in December 2007.

The Partnership Process looked at how improvements to the broader transportation system could work with different ways to replace the function of the viaduct. Three of the initial transportation system scenarios and one of the final hybrid scenarios developed by the Partnership Process relied on improvements to surface streets, the transit system, and I-5 to replace the capacity currently provided by the viaduct. These scenarios are described in Section 1.3.

The process was advised by a 29-member Stakeholder Advisory Committee, which included representatives from business and economic stakeholders, neighborhoods, and public interest groups. The Partnership Process is described in more detail in Appendix S, 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.

1.2.3 Seattle Urban Mobility Plan

In response to Seattle City Council Ordinance 122406 adopted in May 2007, the Seattle Department of Transportation (SDOT) began developing the Urban Mobility Plan (UMP). Although the UMP originated before the Partnership Process, it included similar goals. The intent of the UMP was to replace the Alaskan Way Viaduct through the use of a systems approach, including enhanced transit service and road improvements to provide the following:

- Better mobility and access to and through Seattle's Center City area, which is roughly bounded by S. Royal Brougham Way in the south, just north of Mercer Street in the north, Broadway to the east, and Elliott Bay to the west.
- Surface improvements to the central waterfront portion of the Alaskan Way corridor.

The UMP was to be focused on the movement of people and goods to and through downtown rather than maintaining the vehicle capacity of the State Route (SR) 99 corridor. The UMP was designed to meet the goals of the *City of Seattle Comprehensive Plan*, the Seattle Shoreline Master Program, and other city policies. The goals of the UMP were achieved through the Partnership Process.

1.3 Surface and Transit Scenarios Developed During the Partnership Process

During the Partnership Process, eight scenarios, or comprehensive solutions, were developed for replacing the viaduct's central waterfront section. The scenarios were created to test the performance of various combinations of SR 99, I-5, surface street, transit, and transportation demand management building blocks. Three of these scenarios consisted of combinations of building blocks that excluded a limited-access roadway element as a replacement for SR 99; they were referred to as the *surface and transit scenarios*. All eight scenarios contained many improvements to surface streets, transit service and facilities, transportation demand management, and I-5 that are not described in this attachment. They are explained in detail in Appendix S, Project History Report.

The Partnership Process evaluated the original eight scenarios and developed hybrid scenarios by assembling the best-performing combinations from the original eight scenarios based on the findings of the evaluation. Section 1.3.2 describes the three surface and transit scenarios (Scenarios A, B, and C) and one of the hybrid scenarios (the ST scenario).

1.3.1 Scenario A: Demand Management and Low Capital

Scenario A combined lower-cost investments in new roads and transit service with a maximum effort to manage transportation systems and demand. This scenario included the most aggressive program of actions to manage roadway demand and was the only scenario that tested tolling. Scenario A would replace SR 99 with an improved Alaskan Way surface boulevard that would be two lanes in each direction north of Yesler Way, with bicycle lanes, parking, and signalized intersections on the waterfront and a connection to the Battery Street Tunnel.

1.3.2 Scenario B: Surface Boulevard and Transit

Scenario B was similar to Scenario A, but it had more capital investments and more aggressive transit improvements and only a moderate level of transportation demand and system management elements.

1.3.3 Scenario C: Alaskan Way and Western Avenue One-Way Couplet

Scenario C would replace SR 99 with a pair of north- and southbound one-way streets, a couplet, along the waterfront.

1.3.4 Scenario L: I-5, Surface, and Transit Hybrid Scenario

The ST scenario was based on the surface couplet included in Scenario C. Western Avenue would become a one-way northbound street with three lanes and a bicycle

lane. Alaskan Way would become a one-way southbound street with three lanes and a bicycle lane and a connection to the Battery Street Tunnel. Northbound Western Avenue would start near Yesler Way and include an underpass near Pike Place Market to minimize interference with market activities. The couplet was viewed as a compromise that would provide better transportation performance for through-trips and the smallest possible Alaskan Way roadway cross section, while also altering the character of Western Avenue. The components of Scenario L are shown in Exhibit 1.

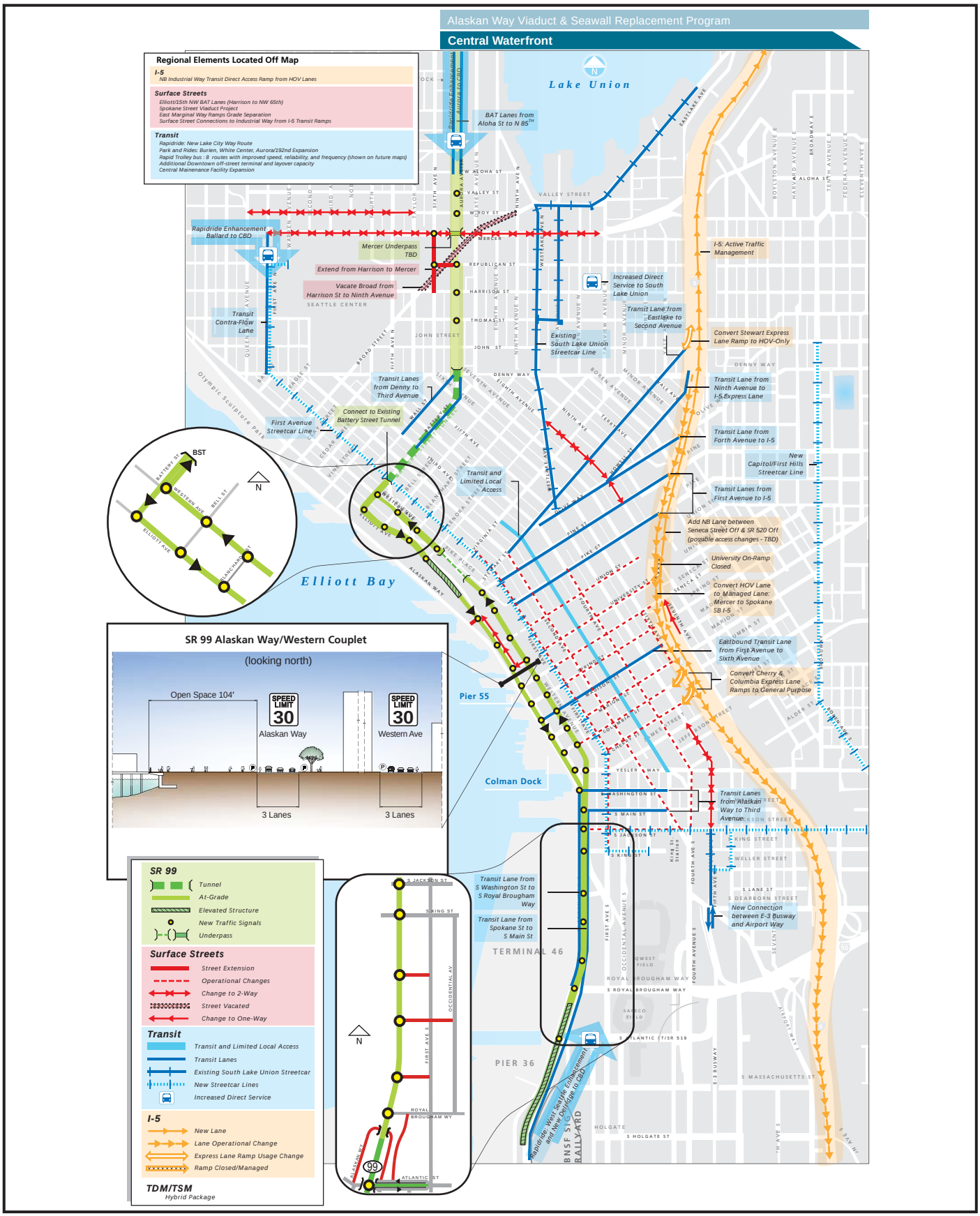

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Exhibit 1
Scenario L Map

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Chapter 2 ST SCENARIO 2030 TRANSPORTATION ANALYSIS

This section presents the findings of the travel demand modeling and transportation analysis of the 2030 ST scenario as compared to the 2030 Project.

2.1 Regional/Center City Context and Travel Patterns

2.1.1 Vehicle Miles Traveled

Exhibit 2 shows vehicle miles of travel (VMT) for the AM peak hour, the PM peak hour, and daily for the 2030 ST scenario and the 2030 Project. VMT is defined as the total number of miles traveled in either the four-county Puget Sound region or Seattle's Center City area for a given time period. As shown in Exhibit 2, peak period and daily VMT values for the 2030 ST scenario are generally lower than peak period and daily VMT values for the 2030 Project. This may be due to the fact that travel through downtown becomes more difficult under the ST scenario, and some trips redistribute themselves to different, and perhaps closer, destinations to avoid the added congestion.

2.1.2 Vehicle Hours of Travel

Exhibit 2 also shows vehicle hours of travel (VHT) for the three study periods for each scenario. VHT for the 2030 Project is higher than VHT for the 2030 ST scenario, primarily because the trips that are conveyed through the bored tunnel under the 2030 Project are shifted to signalized arterials under the 2030 ST scenario, resulting in higher VHT.

2.1.3 Vehicle Hours of Delay

Exhibit 2 also shows vehicle hours of delay (VHD) for the three study periods for each scenario. VHD is defined as the calculated total number of hours of delay incurred (i.e., travel time above that incurred during free-flow operations) by traffic on roadways in either the four-county Puget Sound region or Seattle's Center City area for a given time period. This measure is often used as an indicator of overall traffic congestion. VHD for the 2030 ST scenario is generally higher than VHD for the 2030 Project because of a shift of volumes from the bored tunnel to signalized arterials.

Exhibit 2. Vehicle Miles of Travel, Vehicle Hours of Travel, and Vehicle Hours of Delay for Center City and Region

Performance Measure		Time Period	2030 ST Scenario	2030 Project
Seattle's Center City	VMT	AM	423,900	443,800
		PM	530,600	557,400
		Daily	2,417,000	2,533,900
	VHT	AM	19,300	18,700
		PM	31,400	30,700
		Daily	103,600	101,400
	VHD	AM	7,400	6,700
		PM	16,200	15,200
		Daily	36,700	33,300
Four-County Region	VMT	AM	20,246,600	20,292,700
		PM	23,943,200	24,008,900
		Daily	109,444,700	109,718,600
	VHT	AM	1,105,400	1,104,500
		PM	1,231,100	1,232,700
		Daily	4,425,600	4,428,000
	VHD	AM	534,800	533,100
		PM	549,400	549,900
		Daily	1,377,200	1,374,900

VHD = vehicle hours of delay
VHT = vehicles hours of travel
VMT = vehicle miles of travel

2.1.4 Vehicle Volumes at Screenlines

Exhibit 3 shows AM peak period, PM peak period, and daily model-estimated vehicle volumes at three selected screenlines for the 2030 ST scenario and the 2030 Project. At all three screenlines, volumes for the 2030 ST scenario are lower than those for the 2030 Project. Since the screenlines include facilities from the waterfront to I-5, lower screenline volumes in the 2030 ST scenario may be an indication of the redistribution of trips away from downtown in general or the reassignment of trips to routes east of I-5.

Exhibit 3. Model-Estimated Vehicle Volumes at Selected Screenlines

Screenline Location	Time Period	2030 ST Scenario	2030 Project
South (south of S. King Street)	AM	35,110	37,540
	PM	39,380	43,640
	Daily	520,400	561,400
Central (north of Seneca Street)	AM	31,770	33,970
	PM	35,190	37,810
	Daily	471,600	496,600
North (north of Thomas Street)	AM	37,190	40,440
	PM	42,190	46,070
	Daily	525,000	582,300

2.1.5 Person Throughput

Exhibit 4 shows AM peak hour, PM peak hour, and daily model-estimated person throughput at three selected screenlines for the 2030 ST scenario and the 2030 Project. The higher vehicle volumes for the 2030 Project also result in higher person throughput for the 2030 Project compared to the 2030 ST scenario, and they indicate that the mode shift to transit is not sufficient to offset the difference resulting from the change in vehicle volumes. Similar to the vehicle volumes at the screenlines, the lower person throughput under the 2030 ST scenario may be an indication of the redistribution of trips away from downtown or the reassignment of trips to routes east of I-5.

Exhibit 4. Model-Estimated Person Throughput at Selected Screenlines

Screenline Location	Time Period	2030 ST Scenario	2030 Project
South (south of S. King Street)	AM	63,080	65,420
	PM	74,000	79,080
	Daily	836,400	883,500
Central (north of Seneca Street)	AM	57,320	60,560
	PM	65,230	70,070
	Daily	768,100	805,300
North (north of Thomas Street)	AM	64,970	67,550
	PM	76,170	80,400
	Daily	836,900	902,800

2.1.6 Traffic Volumes on SR 99

Exhibit 5 shows the estimates of AM and PM peak hour traffic volumes on the SR 99 mainline and ramps for the 2030 ST scenario. South of the Battery Street Tunnel, southbound SR 99 traffic continues on Elliott Avenue to Alaskan Way. North of Atlantic Street, northbound SR 99 traffic continues on Alaskan Way and Western Avenue before reaching the Battery Street Tunnel. The Alaskan Way and Western Avenue arterial couplet is assumed to be designated as SR 99.

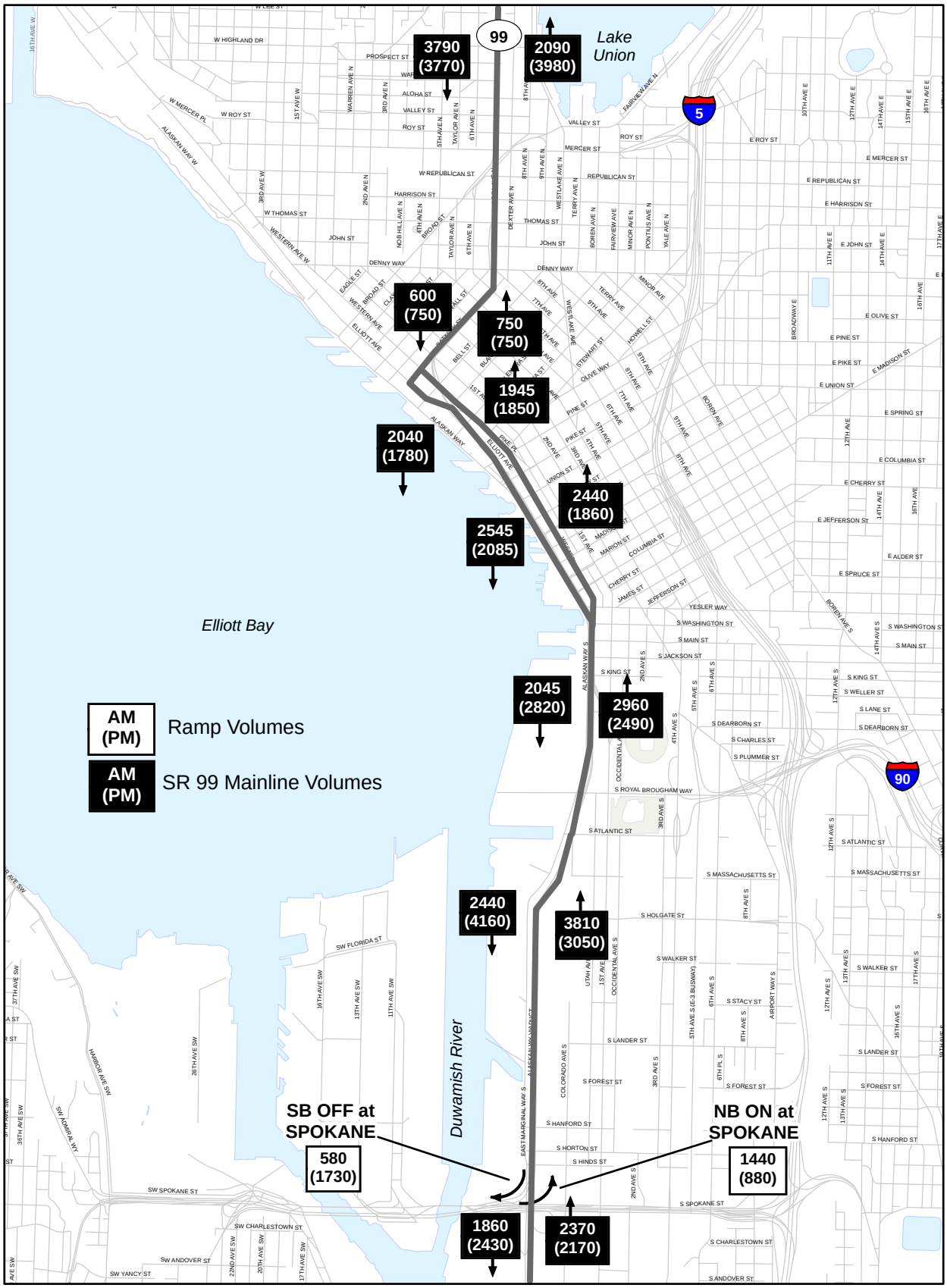
The AM peak hour traffic volumes on SR 99 are fairly directional, with heavier volumes inbound to the central downtown area from all directions. The PM peak hour traffic volumes along SR 99 are also directional (though generally not as pronounced as the AM peak hour volumes), with heavier volumes leaving the central downtown area.

Exhibit 6 shows the estimates of AM and PM peak hour traffic volumes on the SR 99 mainline and ramps for the 2030 Project. The pattern of directionality is similar to that shown for the 2030 ST scenario, but the overall volumes on SR 99 are considerably higher for the 2030 Project.

Exhibit 7 compares the AM and PM peak hour volumes for the 2030 ST scenario and the 2030 Project at selected locations along the SR 99 roadway and relevant ramps. In general, under the 2030 ST scenario, SR 99 conveys lower volumes due to its lower capacity compared to the 2030 Project in both the northbound and southbound directions.

2.1.7 Speeds

SR 99 traffic operations were assessed for the AM and PM peak hours using a traffic simulation model developed in the VISSIM modeling environment (version 5.1). The VISSIM model includes SR 99 segments (including segments on Alaskan Way and Western Avenue), ramps, and ramp termini intersections. The model replicates traffic flow by simulating discrete vehicle movements. Exhibits 8 and 9 show average peak hour travel speeds for southbound and the northbound corridor segments under the 2030 ST scenario and the 2030 Project.

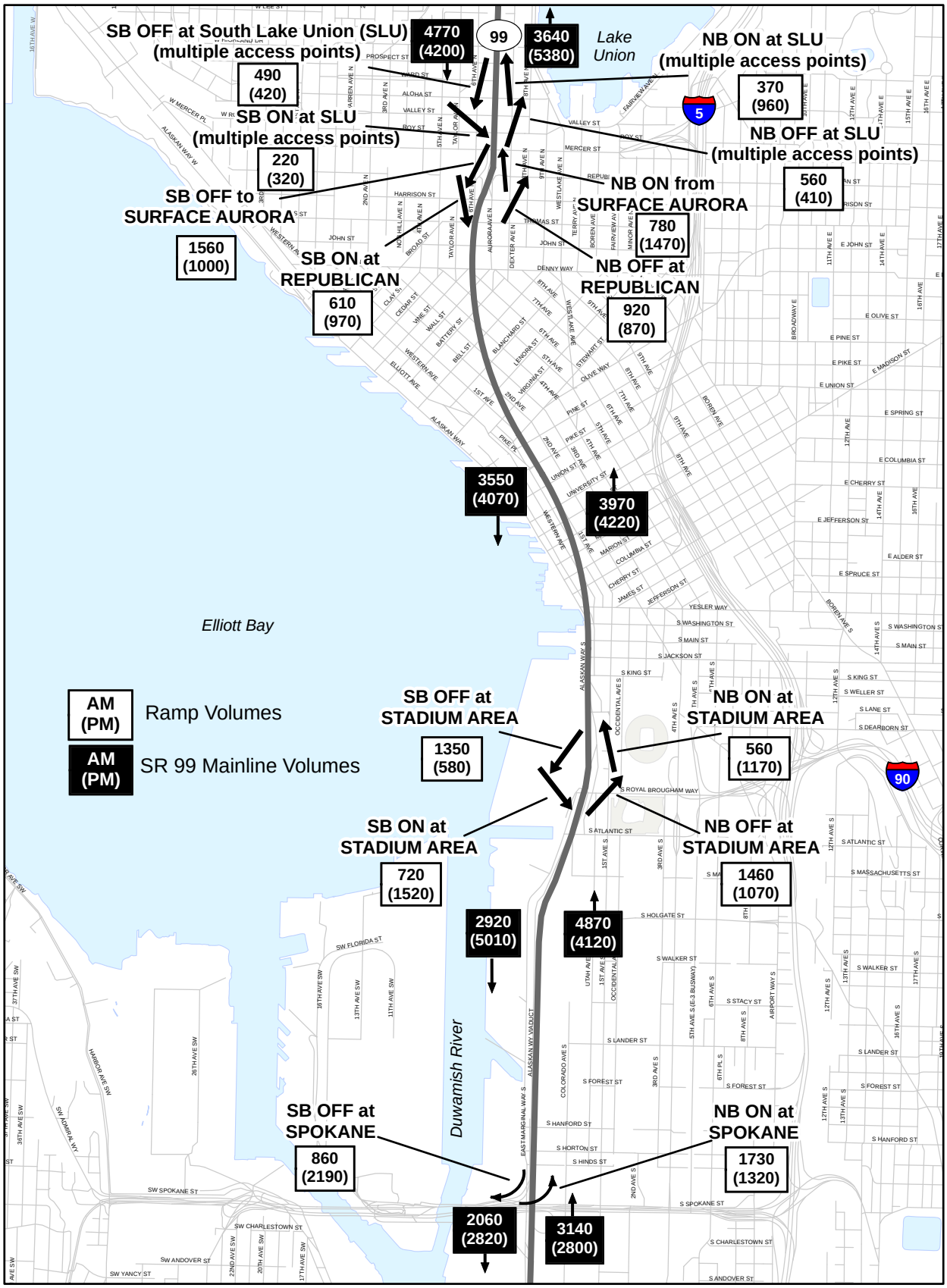


N

0 2,500

Feet

Exhibit 5
AM and PM Peak Hour
Mainline and Ramp Volumes
2030 Surface and Transit



N

0 2,500

Feet

Exhibit 6
AM and PM Peak Hour
Mainline and Ramp Volumes
2030 Project

Exhibit 7. Comparison of Vehicle Volumes for 2030 ST Scenario and 2030 Project

Mainline/Ramp Location	Time Period	2030 ST Scenario	2030 Project
Northbound Direction			
On-ramp from West Seattle	AM	1,440	1,730
	PM	880	1,320
North of Spokane Street	AM	3,810	4,870
	PM	3,050	4,120
North of Seneca Street	AM	2,440	3,970
	PM	1,860	4,220
North of Aloha	AM	2,090	3,640
	PM	3,980	5,380
Southbound Direction			
North of Aloha	AM	3,790	4,770
	PM	3,770	4,200
North of Seneca Street	AM	2,545	3,550
	PM	2,085	4,070
North of Spokane Street	AM	2,440	2,920
	PM	4,160	5,010
Off-ramp to West Seattle	AM	580	860
	PM	1,730	2,190

In the southbound direction, travel speeds north of the Battery Street Tunnel are governed by the proposed signalized intersections along Aurora Avenue, particularly those with Valley, Roy, and Republican Streets. These congested intersections result in substantially lower AM and PM peak hour speeds north of the Battery Street Tunnel for the 2030 ST scenario at 11 miles per hour (mph) and 7 mph, respectively, compared to 34 mph and 36 mph north of the bored tunnel for 2030 Project. Because of the overall higher volumes in the PM peak hour, these intersections are expected to operate poorly in the PM peak hour (i.e., LOS F); hence average speeds north of the Battery Street Tunnel are expected to be slower during the PM peak hour than the AM peak hour. Through the Battery Street Tunnel and through the central waterfront section, average speeds for the 2030 ST scenario are expected to be 14 to 18 mph (compared to 43 to 45 mph in the bored tunnel for the 2030 Project) as traffic is projected to back up from the signalized intersections north of the Battery Street Tunnel. At the south end of the study area, the differences in speeds for the 2030 ST scenario (between S. Royal Brougham Way and S. Spokane Street) and the 2030 Project (between the stadium on-ramp and S. Spokane Street)

are comparatively smaller (see Exhibit 8). The reason for the smaller differences is that once southbound traffic has traveled beyond the final signalized intersection at S. Atlantic Street, the capacity of the facility expands dramatically and free-flow speeds can be reached. Because this segment also includes the delay at the S. Atlantic Street intersection, the speeds for the 2030 ST scenario during the AM peak hour are about 10 mph slower than those under the 2030 Project but during the PM peak hour (see Exhibit 9), they about 6 mph faster (because the bored tunnel conveys much more traffic and experiences some slowdowns south of the stadium ramps during the PM peak hour).

In the northbound direction, under the 2030 ST scenario, AM and PM peak hour travel speeds between S. Spokane Street and S. Royal Brougham Way are expected to be much slower than those for the 2030 Project (i.e., 8 and 19 mph versus 41 and 47 mph) due to the projected poor operations at the SR 99/S. Atlantic Street intersection, and to a lesser degree, the SR 99/S. Royal Brougham Way intersection. Traffic is expected to spill back from these intersections, affecting the long stretches of SR 99 leading up to them. North of S. Royal Brougham Way and through the Battery Street Tunnel, AM and PM peak hour speeds for the 2030 ST scenario are significantly slower than speeds in the bored tunnel under the 2030 Project. However, the speeds of northbound traffic north of the Battery Street Tunnel and the bored tunnel for the 2030 ST scenario and the 2030 Project are expected to be similar, with a difference of approximately 4 to 5 mph.

Exhibit 8. Comparison of Southbound SR 99 Peak Hour Speeds (Miles per Hour)

Southbound – AM	2030 ST Scenario		2030 Project	
	AM	PM	AM	PM
South Corridor				
SR 99 - stadium on-ramp to S. Spokane Street	NA	NA	48	30
SR 99 - S. Royal Brougham Way to S. Spokane Street	38	36	NA	NA
Midtown				
Bored tunnel	NA	NA	45	43
Elliott Avenue/Alaskan Way – Battery Street to S. Royal Brougham Way	14	15	NA	NA
Battery Street Tunnel	17	18	NA	NA
North Corridor				
North of Battery Street Tunnel	11	7	NA	NA
North of bored tunnel	NA	NA	34	36

NA = not applicable

Exhibit 9. Comparison of Northbound SR 99 Peak Hour Speeds (Miles per Hour)

Northbound – AM	2030 ST Scenario		2030 Project	
	AM	PM	AM	PM
South Corridor				
SR 99 - S. Spokane Street to stadium off-ramp	NA	NA	41	47
SR 99 - S. Spokane Street to S. Royal Brougham Way	8	19	NA	NA
Midtown				
Bored Tunnel	NA	NA	44	41
Alaskan Way/Western Avenue – S. Royal Brougham Way to Battery Street	16	19	NA	NA
Battery Street Tunnel	28	26	NA	NA
North Corridor				
North of Battery Street Tunnel	28	22	NA	NA
North of bored tunnel	NA	NA	32	27

NA = not applicable

2.1.8 Traffic Operations at Key Arterial Intersections

Intersection operations under the 2030 ST scenario and the 2030 Project were evaluated at selected locations. The primary performance measure used for this analysis is LOS, which is a commonly used measure of operational effectiveness for transportation facilities. LOS is used to assess a variety of transportation facilities ranging from arterials to freeway segments. For the evaluation of signalized intersections, LOS is specifically based on the average vehicle delay calculated for a given intersection. LOS is represented by a letter grade ranging from "A" (low delays and free-flow traffic conditions) to "F" (very congested or break-down conditions). The intersection analysis results are summarized for the south, central, and north sub-areas. Intersections that are projected to operate at LOS E or F are those most likely to experience higher levels of congestion during the peak hour. Intersections that are projected to operate at LOS A through D would experience little to moderate congestion during the peak hour and generally are not of concern. While traffic congestion is a common occurrence in the urban environment, determining the intersections that would operate at LOS E or F identifies those areas that warrant consideration of how congestion may affect major travel movements and specific travel modes such as transit or freight. Also of interest is whether congestion may result in concentrations of air pollutants that approach the thresholds of concern.

South Sub-area

Exhibit 10 shows the projected LOS at signalized intersections in the south sub-area for the 2030 ST scenario and the 2030 Project. Of the 31 intersections evaluated in the south sub-area for the 2030 ST scenario, 9 are expected to operate at LOS E or F during the AM peak hour, and 7 are expected to operate at LOS E or F during the PM peak hour. The intersections that are expected to operate under congested conditions are generally located around S. Atlantic Street and S. Royal Brougham Way, as SR 99 enters the south sub-area and transitions from a limited-access facility to an urban arterial with signalized intersections. The congested conditions at intersections along S. Atlantic Street and S. Royal Brougham Way are expected to create a bottleneck. Because of this congestions and the redistribution of traffic outside the downtown area by the travel demand model, traffic volumes at intersections north of these bottleneck intersections yield reasonable LOS conditions. The LOS at intersections north of Royal Brougham Way is D or better, suggesting that southbound and northbound transit lanes on Alaskan Way do not substantially degrade their performance. The extent of the impact of the southbound and northbound transit lanes at the S. Royal Brougham Way intersection and of the northbound transit lane at the S. Atlantic Street intersection is unknown because this analysis was not included in the scope of this work.

LOS for the 2030 ST scenario and the 2030 Project could be compared for only 20 intersections out of the 31 intersections evaluated in the south sub-area. Of these 20 intersections, under the 2030 Project, only 3 intersections are expected to operate at LOS E or F during the AM peak hour and 4 are expected to operate at LOS E or F during the PM peak hour. Under the 2030 ST scenario, all of these intersections are also expected to also operate at LOS E or F, except for First Avenue/Yesler Way in the PM peak hour which is projected to operate at LOS C under the 2030 ST scenario (compared to LOS F under the 2030 Project. The primary difference in these results, however, is that for the 2030 ST scenario, it was assumed that parking would be restricted on First Avenue during the PM peak period and that the parking lane would be used as a travel lane, providing two lanes in each direction. For the 2030 Project, it was assumed that on-street parking would be allowed along First Avenue through Pioneer Square, thereby limiting travel to only one lane in each direction. Hence, LOS for the 2030 Project is worse than that for the 2030 ST scenario at intersections along First Avenue through Pioneer Square.

Exhibit 10. Comparison of Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), South

Street	Cross Street	2030 ST Scenario				2030 Project			
		AM		PM		AM		PM	
Alaskan Way S.	S. Atlantic Street	F	137	E	66	NA	NA	NA	NA
Alaskan Way S.	S. Royal Brougham Way	E	63	D	41	NA	NA	NA	NA
Alaskan Way S.	S. Charles Street	D	37	C	21	NA	NA	NA	NA
Alaskan Way S.	S. Dearborn Street	C	21	A	6	D	44	C	23
Alaskan Way S.	S. King Street	D	35	B	12	B	19	C	22
Alaskan Way S.	S. Jackson Street	B	11	B	13	A	5	A	5
Alaskan Way S.	S. Main Street	A	7	B	11	A	9	A	8
E. Frontage Road	S. Atlantic Street	D	41	B	13	E	56	C	28
E. Frontage Road	S. Royal Brougham Way	C	29	E	75	C	34	D	47
E. Frontage Road	S. Charles Street	C	32	F	95	NA	NA	NA	NA
E. Frontage Road	S. Dearborn Street	C	21	C	33	NA	NA	NA	NA
Western Avenue	Yesler Way	A	8	A	8	NA	NA	NA	NA
Alaskan Way	Yesler Way	B	17	C	26	C	34	B	19
E. Marginal Way S.	h-shaped overcrossing	B	11	A	10	NA	NA	NA	NA
E. Marginal Way S./Terminal 46	S. Atlantic Street	E	77	D	51	F	80	D	47
Colorado Avenue	S. Atlantic Street	E	57	C	25	E	59	E	56
First Avenue S.	S. Atlantic Street	F	132	F	161	C	33	F	97
First Avenue S.	S. Royal Brougham Way	B	11	C	34	C	25	D	36
First Avenue S.	S. Charles Street	D	41	D	43	NA	NA	NA	NA
First Avenue S.	S. Dearborn Street	C	24	D	43	B	19	C	26
First Avenue S.	S. King Street	C	24	D	38	NA	NA	NA	NA
First Avenue S.	S. Jackson Street	A	7	D	53	B	17	C	26
First Avenue	Yesler Way	E	62	C	21	D	40	F	110
Fourth Avenue S.	S. Atlantic Street	B	14	A	10	NA	NA	NA	NA
Fourth Avenue S.	S. Royal Brougham Way	D	37	F	145	D	38	D	54
Fourth Avenue S.	Airport Way S.	F	347	F	156	NA	NA	NA	NA
Fourth Avenue S.	S. Jackson Street	F	72	D	54	D	41	D	51
Fourth Avenue S.	S. Main Street	B	11	A	9	A	8	A	6
Second Avenue S.	S. Jackson Street	F	89	F	95	D	45	F	103
Second Avenue S.	S. Main Street	C	21	D	47	C	31	C	33
Second Avenue S.	Yesler Way	B	17	B	19	B	14	B	16

NA = not applicable

Central Sub-area

Exhibit 11 shows the projected LOS at signalized intersections in the central sub-area for 2030 ST scenario and the 2030 Project. Of the 55 intersections evaluated in the central sub-area for the 2030 ST scenario, 4 are expected to operate at LOS E or F during the AM peak hour, and 2 are expected to operate at LOS E or F during the PM peak hour. As discussed previously, the expected traffic demand would not be fully served by intersections at the south and north ends of the project area; effectively metering traffic that reaches the central intersections in the Central Business District (CBD). Because of this, and the redistribution of traffic outside the downtown area by the travel demand model, traffic volumes forecasted within the central CBD area yield reasonable LOS conditions at most intersections.

LOS for the 2030 ST scenario and the 29030 Project could be compared for only 42 out of the 55 intersections evaluated in the central sub-area. Of these 42 intersections, under the 2030 Project, only 5 intersections are expected to operate at LOS E or F during the AM and the PM peak hours. Three of these intersections are also expected to operate at LOS E or F under the 2030 ST scenario.

Exhibit 11. Comparison of Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), Central

Street	Cross Street	2030 ST Scenario				2030 Project			
		AM		PM		AM		PM	
Alaskan Way	Columbia Street	C	28	C	25	B	15	A	10
Alaskan Way	Marion Street	B	19	B	19	A	10	B	17
Alaskan Way	Madison Street	A	3	A	3	A	6	B	14
Elliott Avenue	Bell Street	A	10	A	5	A	2	A	3
Elliott Avenue	Wall Street	A	9	B	12	B	13	B	11
Elliott Avenue	Broad Street	C	29	C	20	C	25	D	38
Western Avenue	Columbia Street	B	12	C	28	NA	NA	NA	NA
Western Avenue	Marion Street	B	13	B	16	C	21	B	12
Western Avenue	Madison Street	A	9	A	10	B	18	B	20
Western Avenue	Spring Street	A	8	A	6	B	17	B	11
Western Avenue	Lenora Street	C	25	F	113	NA	NA	NA	NA
Western Avenue	Blanchard Street	A	2	A	4	NA	NA	NA	NA
Western Avenue	Battery Street/SR 99 off-ramp	E	67	D	42	A	1	A	3
Western Avenue	Wall Street	B	15	B	11	D	40	C	28
Western Avenue	Broad Street	B	17	E	79	B	17	F	96
First Avenue	Columbia Street	C	31	B	12	A	8	B	15
First Avenue	Marion Street	F	107	C	21	B	18	B	16
First Avenue	Madison Street	A	8	B	11	A	8	A	9

Exhibit 11. Comparison of Signalized Intersection Level of Service and Average Vehicle Delay (seconds), Central (continued)

Street	Cross Street	2030 ST Scenario				2030 Project			
First Avenue	Spring Street	B	17	B	14	D	41	C	30
First Avenue	Seneca Street	B	20	B	20	B	19	B	14
Second Avenue	James Street	B	16	C	21	NA	NA	NA	NA
Second Avenue	Cherry Street	B	16	B	13	B	11	B	13
Second Avenue	Columbia Street	B	17	B	12	A	6	A	9
Second Avenue	Marion Street	F	86	D	51	E	68	D	48
Second Avenue	Madison Street	D	40	C	26	C	32	C	25
Second Avenue	Spring Street	B	11	C	27	D	39	B	14
Second Avenue	Seneca Street	B	16	C	31	B	18	B	11
Second Avenue	University Street	A	4	C	24	B	12	C	21
Second Avenue	Union Street	A	7	B	18	B	15	B	17
Second Avenue	Pike Street	A	4	A	8	A	7	B	10
Second Avenue	Pine Street	B	16	B	14	B	11	B	18
		AM		PM		AM		PM	
Second Avenue	Stewart Street	B	15	A	7	NA	NA	NA	NA
Second Avenue	Virginia Street	A	8	C	27	NA	NA	NA	NA
Second Avenue	Lenora Street	A	9	B	11	NA	NA	NA	NA
Second Avenue	Blanchard Street	B	13	A	4	NA	NA	NA	NA
Second Avenue	Bell Street	A	9	B	13	A	6	A	10
Second Avenue	Battery Street	B	15	A	9	A	6	A	8
Second Avenue	Wall Street	C	20	C	21	B	17	B	17
Fourth Avenue	James Street	B	17	C	25	NA	NA	NA	NA
Fourth Avenue	Cherry Street	B	17	A	10	B	16	B	11
Fourth Avenue	Columbia Street	F	140	A	9	E	79	D	42
Fourth Avenue	Marion Street	D	36	B	17	C	20	D	46
Fourth Avenue	Madison Street	D	52	C	27	E	66	E	64
Fourth Avenue	Spring Street	C	25	C	33	D	39	D	36
Fourth Avenue	Seneca Street	D	52	D	50	B	15	E	62
Fourth Avenue	University Street	A	9	B	14	A	8	D	50
Fourth Avenue	Union Street	B	16	B	13	B	12	B	15
Fourth Avenue	Pike Street	D	40	D	43	B	18	C	33
Fourth Avenue	Pine Street	C	24	B	10	C	22	C	27
Fourth Avenue	Stewart Street	A	5	A	9	NA	NA	NA	NA
Fourth Avenue	Virginia Street	A	5	B	12	NA	NA	NA	NA
Fourth Avenue	Lenora Street	A	9	A	4	NA	NA	NA	NA
Fourth Avenue	Blanchard Street	B	10	A	6	A	8	A	8
Fourth Avenue	Bell Street	B	11	A	8	A	7	A	10
Fourth Avenue	Battery Street	A	9	B	14	NA	NA	NA	NA

NA = not applicable

North Sub-area

Exhibit 12 shows the projected LOS at signalized intersections in the north sub-area for 2030 ST scenario and the 2030 Project. Of the 16 intersections evaluated in the north sub-area for the 2030 ST scenario, 7 are expected to operate at LOS E or F during the AM peak hour, and 6 are expected to operate at LOS E or F during the PM peak hour. Similar to the south sub-area, intersections at the north of this sub-area, such as Aurora Avenue at Valley and Roy Streets, are expected to operate under highly congested conditions, creating a bottleneck. More reasonable LOS projections are predicted for many intersections south of these bottleneck intersections.

LOS could be compared for only 11 out of the 16 intersections evaluated in the north sub-area. Of the 11 intersections, under the 2030 Project, only 1 intersection is expected to operate at LOS E or F during the AM peak hour, and 6 are expected to operate at LOS E or F during the PM peak hour.

Exhibit 12. Comparison of Signalized Intersection Level of Service and Average Vehicle Delay (Seconds), North

Street	Cross Street	2030 ST Scenario				2030 Project			
		AM				PM			
Western Avenue W.	Elliott Avenue W.	A	10	C	30	B	15	C	21
W. Mercer Place	Elliott Avenue W.	E	79	E	65	E	74	F	86
Fifth Avenue N.	Mercer Street	D	46	D	45	D	43	E	72
Sixth Avenue	Battery Street	B	13	B	18	B	13	F	87
Sixth Avenue	Denny Way	B	18	B	17	B	19	B	15
Sixth Avenue N.	Mercer Street	F	82	C	33	B	15	C	30
Dexter Avenue N.	Mercer Street	E	64	E	79	D	42	F	94
Ninth Avenue N.	Mercer Street	F	100	F	111	D	41	E	66
Westlake Avenue N.	Mercer Street	F	95	D	54	D	43	F	163
Aurora Avenue SB	Denny Way	C	30	C	21	NA	NA	NA	NA
Aurora Avenue NB	Denny Way	B	15	B	11	NA	NA	NA	NA
Aurora Avenue	Thomas Street	B	20	D	40	B	12	C	24
Aurora Avenue	Harrison Street	B	17	B	18	C	22	B	17
Aurora Avenue	Republican Street	B	14	F	99	NA	NA	NA	NA
Aurora Avenue	Roy Street	E	71	F	186	NA	NA	NA	NA
Aurora Avenue	Valley Street	E	80	F	136	NA	NA	NA	NA

NA = not applicable
NB = northbound
SB = southbound

AM and PM Peak Hour Travel Times

Exhibit 13 shows corridor travel times between selected locations during the AM and PM peak hours for the 2030 ST scenario and the 2030 Project.

Exhibit 13. Comparison of Corridor Travel Times (Minutes)

	2030 ST Scenario		2030 Project	
	AM	PM	AM	PM
West Seattle to CBD (Fourth Avenue and Seneca Street)				
Inbound	37	NA	25	NA
Outbound	NA	24	NA	27
Woodland Park to S. Spokane Street				
Southbound	25	27	15	15
Northbound	30	25	12	16
Ballard to S. Spokane Street (via Alaskan Way, AWV)				
Southbound	19	18	15	18
Northbound	32	32	20	27
Second Avenue (Wall Street to S. Jackson Street)				
Southbound	11	12	12	12
Fourth Avenue (S. Jackson Street to Battery Street)				
Northbound	12	8	9	11

AWV = Alaskan Way Viaduct
CBD = Central Business District
NA = not applicable

West Seattle to CBD

This route represents trips between West Seattle (specifically the intersection of California Avenue and SW Alaska Street) and the CBD (specifically at Fourth Avenue and Seneca Street) and is presented for the peak traffic flow direction only (i.e., inbound in the AM and outbound in the PM peak period). The the AM inbound travel time is expected to be longer under the 2030 ST scenario (37 minutes) than the travel time under the 2030 Project (25 minutes). The longer travel time for the 2030 ST scenario is due to the increased travel time along SR 99 between the Spokane Street on-ramp and S. Royal Brougham Way. This segment has signals at Royal Brougham Way and Atlantic Street that are not present in the 2030 Project.

In the PM outbound direction, travel times are relatively close: approximately 24 and 27 minutes for the 2030 ST scenario and the 2030 Project, respectively.

Woodland Park to S. Spokane Street

For this route, the travel times for the 2030 ST scenario are dramatically longer than those for the 2030 Project because the traffic flows through the highly congested arterials between Denny Way and Atlantic Street unlike under the 2030 Project in

which traffic uses the bored tunnel in the core CBD section for this segment. The difference in travel times between the 2030 ST scenario and the 2030 Project ranges from 10 to 18 minutes and is greatest for the northbound direction during the AM peak hour.

Ballard to S. Spokane Street

For this route, the travel times in the northbound direction for the 2030 ST scenario are significantly longer than those for the 2030 Project. The AM peak hour travel times for the northbound direction are 32 and 20 minutes for the 2030 ST scenario and the 2030 Project, respectively. The PM peak travel times for the northbound direction are 32 and 27 minutes for the 2030 ST scenario and the 2030 Project, respectively. This difference primarily results from the queues on SR 99 south of Atlantic Street. In the southbound direction, the difference in terms of AM peak hour travel times is relatively minor; the travel time is approximately 4 minutes longer for the 2030 ST scenario. PM peak hour travel times are expected to be the same for in the southbound direction.

Second Avenue (Wall Street to S. Jackson Street)

For this route, the differences in travel times are relatively minor for the southbound direction during both the AM and PM peak hours (up to 1 minute).

Fourth Avenue (S. Jackson Street to Battery Street)

For this route, the differences in travel times are minor for the northbound direction during both the AM and PM peak hours (approximately 3 minutes).

2.2 Transit Services

2.2.1 Modeled Transit Ridership (Person Trips)

Exhibit 14 shows model-estimated AM peak hour and daily transit ridership at the selected screenlines for the 2030 ST scenario and the 2030 Project. Ridership levels are expected to be similar across all three screenlines. During the AM peak hour, transit ridership is expected to be highest across the south screenline. However, daily ridership is expected to be highest across the central screenline. In general, transit ridership for the 2030 ST scenario is higher than that for the 2030 Project, except for ridership in the central screenline where ridership for the 2030 ST scenario is lower compared to the 2030 Project.

Exhibit 14. Comparison of Model-Estimated Transit Ridership at Selected Screenlines (Person Trips)

Screenline Location	2030 ST Scenario		2030 Project	
	AM	Daily	AM	Daily
South (south of S. King Street)	55,890	169,300	54,520	163,700
Central (north of Seneca Street)	52,400	176,500	53,810	179,160
North (north of Thomas Street)	54,810	174,800	52,780	169,940

2.2.2 Transit Mode Share

Exhibit 15 shows the model-estimated transit mode share for travel to and from Seattle's Center City for home-based work trips ("commute") and non-work trips. Similar to most urban environments, under the 2030 ST scenario, a higher percentage of home-based work trips (41.5 percent) are expected to arrive in the Center City via transit compared with non-work trips (slightly more than 10 percent). These percentages for home-based work trips and non-work trips are slightly higher than those for the 2030 Project (40.5 and 10.1 percent, respectively); however, the difference may not be statistically significant.

Exhibit 15. Comparison of Model-Estimated Daily Transit Mode Shares To and From Seattle's Center City

	2030 ST Scenario	2030 Project
Home-based work	41.5%	40.5%
Non-work	10.4%	10.1%

2.2.3 Truck Traffic and Freight

Under the 2030 ST scenario, freight traffic to and from port facilities in the South of Downtown (SODO) area is expected to be adversely affected by poor LOS at key intersections in the south sub-area, including intersections along S. Atlantic Street at E. Marginal Way S., Alaskan Way S., Colorado Avenue S., and First Avenue S., as well as along Alaskan Way S. and S. Royal Brougham Way. Freight connections between SR 99 and streets in the SODO area, including the stadium area ramps and E. Marginal Way, would be improved under the Bored Tunnel Alternative and reflected by the truck and freight traffic conditions under the 2030 Project

Direct freight connections to the Interbay and Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) areas would no longer be provided on SR 99 at the north end of the central waterfront (Elliott/Western ramps area)

under the 2030 Project or 2030 ST scenario. Under both, freight traffic from Elliott and Western Avenues would connect to Alaskan Way via Broad Street. These trucks would incur potentially longer delays at Broad Street due to increased traffic as well as regular train crossings.

Under the 2030 Project, hazardous and flammable cargo and over-height loads would be prohibited in the bored tunnel all day; they would have to be transported through downtown on either Alaskan Way or I-5. Under the 2030 ST scenario, hazardous and flammable cargo and over-height loads would also have to be transported on either Alaskan Way or I-5. This change would affect freight from the Ballard/Interbay areas. Currently, hazardous and flammable materials are prohibited only during the peak periods on the Alaskan Way Viaduct and all day in the Battery Street Tunnel.

2.2.4 Parking

Under the 2030 ST scenario, substantial quantities of existing on-street parking would be removed or restricted during peak and off-peak periods. The net loss of on-street parking spaces is expected to be more than 1,000 spaces during the off-peak periods and more than 1,200 spaces during the PM peak period. The net loss of off-street parking spaces would be more than 400 spaces, which is less than 1 percent of the existing supply in the study area.

Changes in on-street parking and loading availability would occur for several reasons. Along the central waterfront, the reconfigured street design would likely result in less space for parking than the area currently provided under the viaduct. A number of surface street and transit improvements would provide additional travel lanes or transit lanes at the expense of parking.

Although some on-street parking would be affected permanently, several hundred additional parking spaces would be affected during peak periods of traffic. During the PM peak period, for example, it is likely that parking on some streets would be removed to provide increased roadway capacity or transit lanes. Reductions in on-street parking would not be distributed evenly across the Center City. The waterfront, Pioneer Square, and Uptown would likely experience the greatest changes in on-street parking supply. The Office Core, Retail Core, International District, Denny Triangle, and South Lake Union would experience relatively little change in parking supply.

In comparison, under the 2030 Project, approximately 320 on-street parking spaces and 210 off-street parking spaces would be removed, resulting in a net loss of 570 parking spaces compared to the net loss of more than 1,600 spaces under the 2030 ST scenario. Similar to the 2030 ST scenario, reductions in on-street parking are not distributed evenly across the City Center. The waterfront, Pioneer Square, and

Uptown would likely experience the greatest changes in on-street parking supply. The Office Core, Retail Core, International District, Denny Triangle, and South Lake Union would experience relatively little change in parking supply.

2.2.5 Pedestrians and Bicycles

Under the 2030 ST scenario, pedestrian and bicycle traffic are expected to be adversely affected by high traffic volumes and congested operating conditions at the outer intersections of the south and north sub-areas. However, because the traffic volumes projected by the travel demand model within the central sub-area are expected to be at reasonable levels, conditions for pedestrian and bicycle traffic are not expected to be too adversely affected.

In comparison, traffic congestion at the outer intersections of the south and north sub-area under the 2030 Project is expected to be less than that of the 2030 ST scenario. Therefore, pedestrian and bicycle traffic are also not expected to be adversely affected under the 2030 Project.

2.2.6 Ferries

Under the 2030 ST scenario, Traffic conditions at intersections near Colman Dock are projected to operate at LOS C or better in the AM and PM peak hours. Thus, access for ferry traffic to and from the immediate area around the terminal is not expected to be adversely affected by the 2030 ST scenario. However, ferry traffic attempting to access the ferry terminal from outside the downtown area, particularly via southbound Aurora Avenue would experience delays as it encounters signalized intersections along SR 99 entering the downtown area. Northbound ferry traffic on SR 99 would continue to experience delays as it encounters signalized intersections.

Under the 2030 Project, traffic conditions at intersections near Colman Dock are projected to operate at LOS D or better in the AM and PM peak hours, similar to current conditions. Ferry traffic attempting to access the ferry terminal from the north, outside the downtown area, is expected to experience fewer delays under the 2030 Project, compared to the 2030 ST scenario, as there are fewer signalized intersections along Alaskan Way entering the downtown area.

2.2.7 Safety

High traffic volumes and congested traffic conditions in the north and south sub-areas could result in a relatively high potential for accidents, although the severity of the accidents would be reduced because of slower speeds. In contrast, safety issues are not expected to be as significant a concern in the central sub-area, with lower volumes and more favorable operating conditions expected at most intersections.

The improvements proposed in the north area of the 2030 Project could potentially decrease collision rates on SR 99 between Denny Way and Mercer Street. Additionally, the decommissioning of the Battery Street Tunnel and the associated northbound on-ramp and southbound off-ramp (the Battery Street Tunnel ramps), as well as the Elliott/Western ramps, would eliminate areas with higher than average collision rates at the ramps and within the Battery Street Tunnel. The replacement of the current midtown ramps at Seneca and Columbia Streets with new ramps in the stadium area connecting to Alaskan Way would eliminate the current diverging, merging, and weaving movements associated with the Seneca and Columbia Street ramps that lead to queuing and collisions on the mainline. Also, the 2030 Project would eliminate the identified northbound collision analysis location at the south end of the viaduct, roughly between S. Massachusetts Street and S. Royal Brougham Way, through improved design of the replacement roadway facility. Finally, the 2030 Project is expected to increase the total volume of traffic on Alaskan Way surface street, which could increase the number of conflicts between vehicles, pedestrians, and cyclists, similar to the 2030 ST scenario.

2.2.8 Event Traffic

High levels of congestion projected at some intersections near the stadiums, including First Avenue S./S. Atlantic Street and SR 99/S. Atlantic Street, could adversely affect access to large events at the stadiums. Similarly, congested conditions in the north sub-area could make access to events at Seattle Center difficult. In both cases, access to these areas from outside of downtown via Aurora Avenue and SR 99 would be the most severely affected. However, access from within the downtown area would not be as severely affected, as traffic volumes and congestion levels are expected to be lower due to the inability of traffic to enter the downtown system.

Overall levels of traffic congestion are expected to be similar during events in the stadium area. Improved access to and from SR 99 near the north portal and added network redundancy across SR 99 for the 2030 Project would likely result in reduced congestion before and after Seattle Center events, compared to the 2030 ST scenario.

Chapter 3 REFERENCES

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ATTACHMENT B

Analysis of 2030 Viaduct Closed (No Build Alternative)

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ACRONYMS AND ABBREVIATIONS

I-5	Interstate 5
PSRC	Puget Sound Regional Council
SODO	South of Downtown
SR	State Route
ST2	Sound Transit Phase 2 program
TDR	Transportation Discipline Report
V/C	volume-to-capacity
VHD	vehicle hours of delay
VHT	vehicle hours of travel
VMT	vehicle miles of travel

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INTRODUCTION

This memo describes the possible state of the transportation network and its operations under a 2030 Viaduct Closed (No Build Alternative) scenario. It supplements the analysis in the Transportation Discipline Report (TDR) for the Alaskan Way Viaduct Replacement Project (the project). The TDR describes changes in travel patterns and traffic volumes for the following:

- 2015 Existing Viaduct (with the Alaskan Way Viaduct)
- 2015 Viaduct Closed (No Build Alternative) scenario
- 2015 Project (Bored Tunnel Alternative)
- 2030 Project (Bored Tunnel Alternative)

During preparation of the TDR, the 2030 Viaduct Closed (No Build Alternative) was considered to be unrealistic, as it assumes that there would be no attempt to mitigate the reduction in north-south roadway capacity caused by the closure of the viaduct. Although a 2030 Viaduct Closed (No Build Alternative) scenario is unlikely, it was analyzed later to provide further comparison for the 2030 Project (Bored Tunnel Alternative). This memo also discusses the potential impact to land use under a 2030 Viaduct Closed (No Build Alternative) scenario.

Approach to Analyzing Transportation Effects

The approach to analyzing the operational characteristics of a 2030 Viaduct Closed (No Build Alternative) alternative uses data and analysis that was prepared for the 2015 Viaduct Closed (No Build Alternative) and supplements it with additional model runs. The travel forecasting model was run with the same 2030 land-use levels and distribution assumed in other analyses, consistent with forecasts developed by the Puget Sound Regional Council (PSRC), and with a transportation network very similar to the 2015 Viaduct Closed (No Build Alternative). Exceptions are listed below:

- The 2030 network assumes that the Sound Transit Phase 2 program (ST2) with light rail extensions east to Overlake via I-90 and north to Mountlake Terrace is completed and operational.
- Other projects with committed funding were also assumed to be in place by 2030. However, due to funding constraints limiting the number of projects with committed funding in 2030 and the distance of these projects from the AWV project area, it is unlikely that projects other than the ST2 program will impact the analysis of a 2030 Viaduct Closed (No Build Alternative).

Upon completion of the travel forecasting model runs, data was compared for the 2015 and 2030 Viaduct Closed (No Build Alternatives). The primary indicators used for comparison are listed below.

System-wide measures for selected areas:

- Vehicle hours of delay
- Vehicle miles traveled
- Vehicle hours traveled

Screenline-based measures for selected locations:

- Person throughput
- Vehicle volumes
- Transit ridership
- Mode share
- Vehicle Volume/Capacity ratios for the peak direction of the peak hour

In addition to the comparison between the 2015 and 2030 Viaduct Closed (No Build Alternative), an analysis of the difference in trip origins and destinations between the 2030 baseline network (with the existing facility) and the 2030 Viaduct Closed (No Build Alternative) was also performed. This sensitivity test provided additional insight into the way in which travel behavior may change as the result of the Alaskan Way Viaduct being removed from service.

Based on the data taken from the TDR and from new modeling results for the 2030 Viaduct Closed (No Build Alternative) the effects to other transportation topics discussed in the existing TDR are addressed. Specific topics include:

- Qualitative discussion of the impact of higher 2030 volumes on the modeled 2015 Viaduct Closed (No Build Alternative) travel time analysis
- Discussion of the ability of the existing north-south roadway network in the project area to absorb the increased demand associated with the background growth in population and employment contained in the 2030 Viaduct Closed (No Build Alternative)
- Qualitative discussion of the likely operational state of the study area intersections under the 2030 Viaduct Closed (No Build Alternative)

Analysis Summary

System-Wide Measures

Exhibits 1 through 4 present a comparison of aggregate measures of transportation system performance (Vehicle Miles of Travel [VMT], Vehicle Hours of Travel [VHT], and Vehicle Hours of Delay [VHD]). The transportation network associated with the 2030 Viaduct Closed (No Build) alternative results in approximately 160,000 less VMT on a daily basis than the 2030 Project (Bored Tunnel Alternative) (Exhibit 1).

When compared to 2030 Project, the lower VMT and person-trips associated with the 2030 Viaduct Closed (No Build Alternative) reflects the limited capacity of this condition. Congestion increases along with the growth to 2030 population and employment levels in an environment without the viaduct in the transportation network. Vehicle hours of travel and especially vehicle hours of delay increase over the 2030 or 2015 Project (Bored Tunnel) alternatives (see Exhibits 2 and 3).

Transit mode share increases by about 6 percent between the 2015 and 2030 scenarios (Exhibit 5). The 2030 No Viaduct Closed (No Build Alternative) exhibits only slightly lower mode share (about 1 percent) for home-based work trips than the 2030 build scenario. To make the alternatives comparable, transit service levels were assumed to remain constant between the 2030 no build and the 2030 build scenarios. The reason for the similarity between the build and no build mode share results stems from the bus routing done by local transit agencies. With the exception of buses using the Seneca/Columbia ramps, virtually all buses use a relatively few surface streets for their routes to, from, and through downtown. There are transit priority treatments in central downtown, but buses will experience traffic congestion at similar levels with other vehicles outside this area. The relative advantage for transit travel time does not change enough to result in a significant change in mode share.

Exhibit 1. Vehicle Miles of Travel

		2015			2030	
	Existing (2005)	Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	Viaduct Closed (No Build Alternative)	Project
Seattle's Center City						
AM	394,200	433,100	392,500	427,000	413,000	443,800
PM	484,500	537,500	490,700	530,600	521,400	557,400
Daily	2,170,000	2,432,700	2,239,500	2,406,700	2,371,400	2,533,900

Note: AM and PM peak periods are 6:00–9:00 a.m. and 4:00–6:00 p.m., respectively.

Exhibit 2. Vehicle Hours of Travel

		2015			2030	
	Existing (2005)	Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	Viaduct Closed (No Build Alternative)	Project
Seattle's Center City						
AM	13,700	16,800	18,200	17,200	20,300	18,700
PM	18,300	23,800	26,500	24,500	33,600	30,700
Daily	71,000	87,200	91,800	88,500	107,400	101,400

Notes: The VHT estimates do not include centroid connectors in the calculations.
AM and PM peak periods are 6:00–9:00 a.m. and 4:00–6:00 p.m., respectively.

Exhibit 3. Vehicle Hours of Delay

	Existing (2005)	2015			2030	
		Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	Viaduct Closed (No Build Alternative)	Project
Seattle's Center City						
AM	3,500	5,300	7,100	5,700	8,600	6,700
PM	5,300	9,100	12,400	9,900	18,500	15,200
Daily	14,400	22,700	30,000	24,300	41,300	33,300

Note: AM and PM peak periods are 6:00–9:00 a.m. and 4:00–6:00 p.m., respectively.

Exhibit 4. Model-Estimated Daily Person Throughput (Person-Trips)

	2005 Existing	2015			2030	
		Existing Viaduct	Viaduct Closed (No Build Alternative)	2015 Project	Viaduct Closed (No Build Alternative)	Project
South Screenline (South of S. King Street)						
AM	45,750	55,120	49,950	54,250	61,370	65,420
PM	55,270	67,860	61,110	66,800	73,480	79,080
Daily	645,100	788,880	718,300	777,400	821,900	883,500
Central Screenline (North of Seneca Street)						
AM	46,040	53,080	46,970	52,350	53,670	60,560
PM	54,420	62,430	54,900	61,550	61,920	70,070
Daily	630,500	734,400	658,600	725,300	727,800	805,300
North Screenline (North of Thomas Street)						
AM	53,130	59,330	55,440	58,790	63,020	67,550
PM	61,360	69,140	65,200	69,760	74,890	80,400
Daily	708,400	794,600	747,200	803,700	840,100	902,800

Notes: AM and PM data is for the peak hour.
Screen lines include all facilities from Elliott Bay through I-5.

Exhibit 5. Model-Estimated Daily Transit Mode Shares: To, From, and Within Seattle's Center City

	Existing (2005)	2015			2030	
		Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	Viaduct Closed (No Build Alternative)	2030 Project
Home-Based Work	31.0%	34.2%	34.0%	34.2%	39.6%	40.5%
Non-Work	8.1%	8.9%	8.7%	8.8%	9.8%	10.1%

Screenline-Based Measures

At the screenline level, the 2030 Viaduct Closed (No Build Alternative) shows a little less than 10 percent lower vehicle throughput than the 2030 project alternative. This reflects the reduction in transportation network capacity. From a person-throughput perspective, the

results are similar. The 2030 Viaduct Closed (No Build Alternative) provides roughly 60,000 fewer daily person trips than the 2030 Project (Bored Tunnel Alternative) (Exhibit 4).

Exhibit 6. Model-Estimated Vehicle Volumes at Screenlines

		2015			2030	
	2005 Existing	Existing Viaduct	Viaduct Closed (No Build Alternative)	Project	Viaduct Closed (No Build Alternative)	Project
Spokane Screenline (North of S. Spokane Street)						
AM	31,110	33,340	30,320	33,040	32,020	34,680
PM	33,650	37,270	33,680	36,770	35,800	38,590
Daily	423,100	473,700	435,200	469,000	464,200	497,300
South Screenline (South of S. King Street)						
AM	33,500	36,670	32,440	36,150	34,090	37,540
PM	37,670	42,730	37,640	42,110	39,430	43,640
Daily	470,800	543,300	490,200	536,500	515,900	561,400
Central Screenline (North of Seneca Street)						
AM	30,970	33,250	28,420	32,790	29,720	33,970
PM	34,550	37,270	31,790	36,710	33,060	37,810
Daily	435,500	483,100	428,000	477,700	447,500	496,600
North Screenline (North of Thomas Street)						
AM	36,720	39,500	35,910	39,050	37,370	40,440
PM	39,810	43,130	39,920	43,460	42,290	46,070
Daily	503,000	544,700	505,600	550,200	535,500	582,300

Notes: AM and PM data is for the peak hour.
Screen lines include all facilities from Elliott Bay through I-5.

Volume-to-Capacity Relationships

Another way to gain insight into the performance of the transportation system under a 2030 Viaduct Closed (No Build Alternative) scenario is to look at travel-demand model generated volume-to-capacity (V/C) ratios at select locations in the study area. In general, V/C ratios nearing or exceeding 1.0 indicate very congested conditions on that facility or screenline. The most relevant elements of Exhibit 7 are the north-south arterial screenlines south of King Street and north of Seneca Street that become highly congested under a 2030 Viaduct Closed (No Build Alternative) scenario. Likewise, some of the individual facilities will experience high levels of congestion in 2015 and increase (sometimes dramatically in the case of Alaskan Way south of King Street) to a more congested state under a 2030 Viaduct Closed (No Build Alternative) scenario. I-5 operates slightly under capacity for a 2015 Existing Viaduct scenario, which assumes that the Alaskan Way Viaduct is in operation. It is forecast to exceed capacity under both a 2015 and 2030 Viaduct Closed (No Build Alternative) scenario.

Exhibit 7. PM Peak Hour, Peak Direction Volume-to-Capacity Ratios at Select Locations

	Existing (2005)	2015		2030
		Existing Viaduct	Viaduct Closed (No Build Alternative)	Viaduct Closed (No Build Alternative)
Individual Facilities				
SR 99, North of Spokane Street	0.86	0.99	0.33	0.35
SR 99, at Battery Street Tunnel	1.07	1.13	0.26	0.27
SR 99, North of Valley Street	0.84	0.97	0.92	0.98
I-5, South of I-90	0.93	0.97	1.03	1.05
I-5, at Seneca Street	0.91	0.95	1.02	1.03
I-5, South of SR 520	0.97	1.03	1.03	1.04
Alaskan Way, South of King Street	0.79	0.88	1.33	1.47
Alaskan Way, North of Seneca Street	0.29	0.54	0.84	0.94
Alaskan Way, North of Pine Street	0.30	0.45	0.83	0.93
Arterial Screenlines				
North-South Arterials, South of King Street	0.54	0.67	0.88	0.94
North-South Arterials West of I-5, at Seneca Street	0.68	0.79	0.92	0.99
North-South Arterials East of I-5, at Seneca Street	0.36	0.44	0.51	0.58
North-South Arterials West of SR 99, at Thomas Street	0.53	0.55	0.54	0.58
North-South Arterials East of SR 99, at Thomas Street	0.35	0.43	0.46	0.49

Note: Arterial screenlines exclude I-5, SR 99, Aurora Avenue, and Alaskan Way.

Travel-Time and Intersection-Level Measures

The system-level and screenline-based measures provide a clear picture of the likely state of the transportation system, under the 2030 Viaduct Closed (No Build Alternative). The downtown network of arterials and I-5 will be even more congested and over capacity than in the 2015 Viaduct Closed (No Build Alternative) scenario. Some facilities will be more affected than others, with the Alaskan Way surface street serving as an example of a roadway that has available capacity in 2005, becomes much more congested under 2015 Viaduct Closed (No Build Alternative) and much more congested still under 2030 Viaduct Closed (No Build Alternative).

Travel time changes can be inferred from the results of the screenline and system-wide analyses. Travel times increased by a factor of 3 (from 15 to 45 minutes for a trip between Woodland Park and Spokane Street) when the 2015 Viaduct Closed (No Build Alternative) is compared to the 2015 Project (Bored Tunnel Alternative). The additional travel demand and congestion levels associated with a 2030 Viaduct Closed (No Build Alternative) scenario would likely result in even greater travel times than the 2015 Viaduct Closed (No Build Alternative) for north-south trips on State Route (SR) 99 and other facilities such as Second and Fourth Avenues and Interstate 5 (I-5).

Similarly, intersection levels of service presented in the TDR for the 2015 Viaduct Closed (No Build Alternative) scenario would also degrade as the traffic demand levels increase to levels forecasted for this analysis.

Approach to Modeling Potential Land-Use Effects

In addition to modeling a 2030 Viaduct Closed (No Build Alternative) scenario, a sensitivity test was also conducted to identify potential effects to land-use and the distribution of jobs and households resulting from a scenario in 2030 where the viaduct had been closed for some time and no other transportation improvements were put in place. A sketch planning approach to modeling potential land-use impacts was utilized. A more in-depth process that was considered and rejected would have used the PSRC's land-use model that provides input to the travel demand model. The full PSRC land-use allocation process typically used for regional modeling first allocates land-use to large districts, which are then adjusted with input from multiple jurisdictions and distributed on the more refined zonal structure of the travel forecasting model. This process requires input from multiple municipalities and is out of the scope of this analysis. (A full description of the land-use modeling process used for this project is documented at PSRC's web site: http://psrc.org/data/models/dramempal/).

The sketch planning approach used to estimate and reallocate jobs and households resulting from a 2030 Viaduct Closed (No Build Alternative) scenario included the following general steps:

Step 1 – Identify the zones in primary market shed for through-trips on SR 99. This is a subset of total through-trips, but it represents the zones that are the most likely to exhibit noticeable land-use change as a result of a viaduct closure.

Step 2 – Run the travel forecasting model to compare the level of zone-to-zone trip interchange with and without a viaduct in 2030 using constant land-use assumptions.

Step 3 – Calculate the corresponding number of jobs and households that would be candidates for relocation based on the changes in patterns of trip interchange with and without the viaduct.

Step 4 – Modify the land-use in the market shed and input the new zonal land-use into the travel forecasting model.

Step 5 – Rerun the travel demand model with new land-use patterns and report the new transportation metrics.

Additional details of the sketch planning process include the following:

- Select link analyses were used to inform the selection of the primary market shed for through-trips on SR 99 in the project area. Ten districts (2, 3, 5, 6, 7, 10, 11, 12, 13, and 25) comprise the primary travel shed for through-trips on SR 99 (see Exhibit 8

for the location of districts). These districts represent the primary candidate locations for land-use reallocation.

- The process assumes that the total number of jobs and households remains the same in the market shed. Jobs and households were only redistributed.
- This sketch process assumed that the zones in the market shed could accommodate the redistribution of jobs and households within their existing zoning.
- The travel demand model was used to estimate the change in average weekday directional person trips between these districts in both directions for the 2030 baseline (with viaduct) and 2030 Viaduct Closed (No Build Alternative) scenarios.
- Directional trips were converted into jobs assuming two trips per job per day.
- Jobs per household for the districts included in the analysis were calculated based on PSRC land use forecasts used in the travel forecasting model. This factor was then used to calculate the number of households associated with the directional trips. Net impacted jobs and households that would be redistributed were estimated based on their location.
- Finally, it was assumed that the level of redistribution of jobs and households would happen equally (i.e., half of the impacted jobs would move and half of the impacted households would move).

Results of the Land-Use Sensitivity Analysis

Relatively small changes were observed using the land-use reallocation approach described above. Based on the methodology described above, trips to and from the downtown core did not change much with the removal of the viaduct, but through trips(i.e., trips between districts north and south of downtown in the primary travel shed) did change to some extent. Hence, land use in downtown was not changed, but some jobs and households were redistributed between districts north and south of downtown. Exhibits 9 through 12 show a comparison of selected metrics for the 2030 Viaduct Closed (No Build Alternative). Virtually all of the transportation metrics exhibit minimal changes resulting from the assumed land-use reallocation.

Exhibit 13 shows the base land-use used for the analysis. Districts 2, 3, 10, 11, 12, and 13 (Uptown, South Lake Union, Queen Anne, Magnolia, Ballard, and Fremont, respectively) represent the primary travel shed north of downtown. When combined, these districts represent about 4 to 5 percent of the households and employment in the region. District 5, 6, 7, and 25 (South of Downtown [SODO], West Seattle, Duwamish, and Burien, respectively) represent the primary travel shed south of downtown, about 6 to 8 percent of the regional households and employment. Under a 2030 Viaduct Closed (No Build Alternative) scenario, some of these businesses and households would redistribute themselves to the south or north

based on the change in accessibility associated with a transportation network that does not include the viaduct.

Based on the methodology described above, it was estimated that there would be a net redistribution of jobs between the north and south of fewer than 2,000 jobs. That is, after jobs reallocate themselves between the north and south districts based on travel patterns associated with a 2030 Viaduct Closed (No Build Alternative) scenario, the districts to the south would have a net increase in jobs. Similarly, it is expected that the redistribution of households associated with a 2030 Viaduct Closed (No Build Alternative) scenario would result in net increase in households in the southern districts of fewer than 1,000 people.

Exhibit 8. District Boundary Map

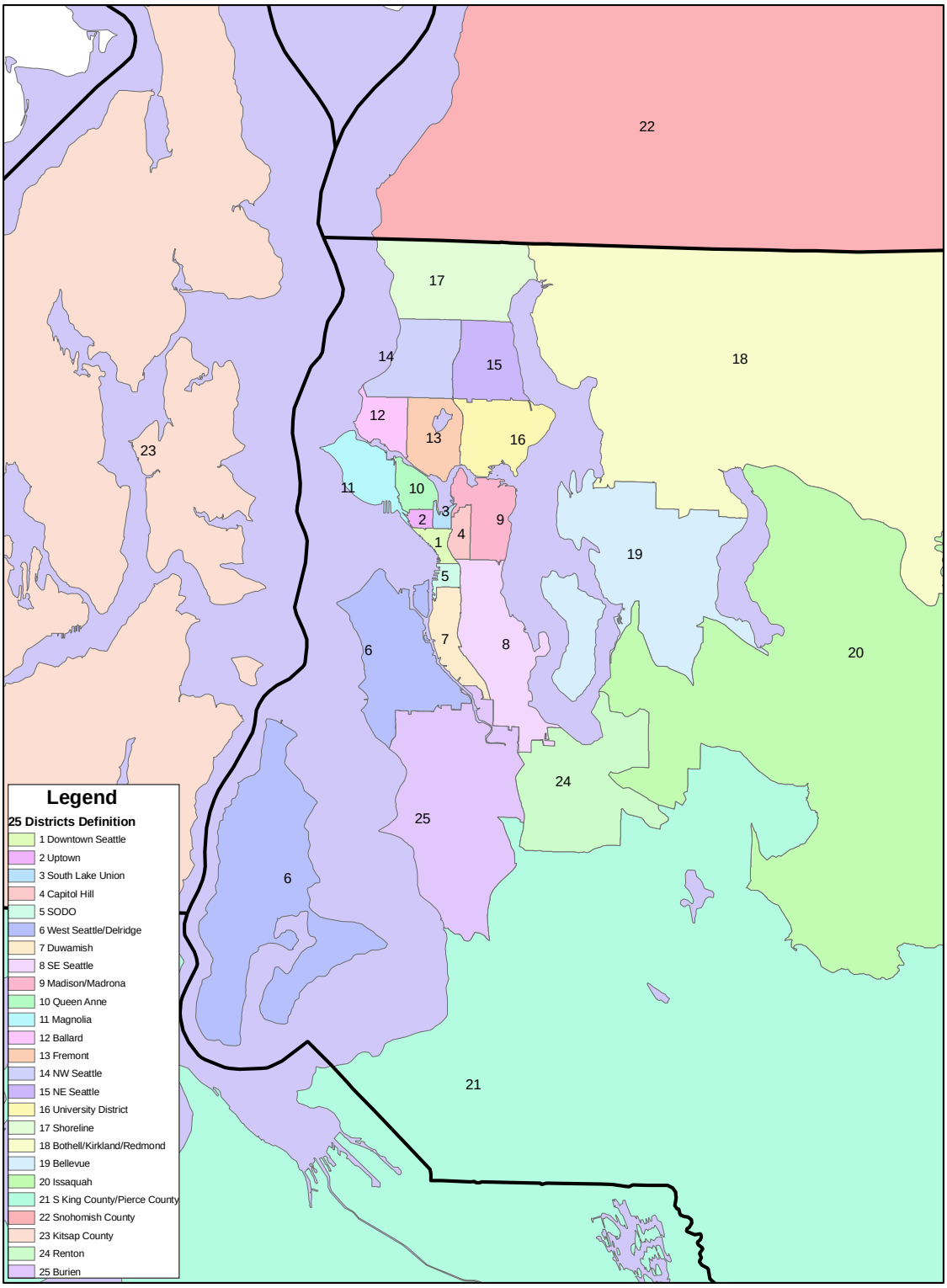

Exhibit 9. Model-Estimated Vehicle Volumes at Screenlines

	2030	
	Viaduct Closed (No Build Alternative) Planned Land-Use	Viaduct Closed (No Build Alternative) Adjusted Land-Use
Spokane Screenline (North of S. Spokane Street)		
AM	32,020	31,930
PM	35,800	35,780
Daily	464,200	463,700
South Screenline (South of S. King Street)		
AM	34,090	33,990
PM	39,430	39,390
Daily	515,900	515,200
Central Screenline (North of Seneca Street)		
AM	29,720	29,680
PM	33,060	33,000
Daily	447,500	446,800
North Screenline (North of Thomas Street)		
AM	37,370	37,280
PM	42,290	42,260
Daily	535,500	535,600

Notes: AM and PM data is for the peak hour.
Screen lines include all facilities from Elliott Bay through I-5.

Exhibit 10. Model-Estimated Daily Person Throughput (Person-Trips)

	2030	
	Viaduct Closed (No Build Alternative) Planned Land-Use	Viaduct Closed (No Build Alternative) Adjusted Land Use
South Screenline (South of S. King Street)		
AM	61,370	61,040
PM	73,480	73,190
Daily	821,900	820,000
Central Screenline (North of Seneca Street)		
AM	53,670	53,620
PM	61,920	61,840
Daily	727,800	726,600
North Screenline (North of Thomas Street)		
AM	63,020	63,160
PM	74,890	74,050
Daily	840,100	841,600

Note: Screen lines include all facilities from Elliott Bay through I-5.

Exhibit 11. Model-Estimated Daily Transit Mode Shares: To, From, and Within Seattle's Center City

	2030	
	Viaduct Closed (No Build Alternative) Planned Land Use	Viaduct Closed (No Build Alternative) Adjusted Land-Use
Home-Based Work	39.6%	39.5%
Non-Work	9.8%	9.9%

Exhibit 12. PM Peak Hour, Peak Direction Volume-to-Capacity Ratios at Select Locations

	2030	
	Viaduct Closed (No Build Alternative) Planned Land-Use	Viaduct Closed (No Build Alternative) Adjusted Land-Use
Individual Facilities		
SR 99, North of Spokane Street	0.35	0.35
SR 99, at Battery Street Tunnel	0.27	0.27
SR 99, North of Valley Street	0.98	0.98
I-5, South of I-90	1.05	1.05
I-5, at Seneca Street	1.03	1.03
I-5, South of SR 520	1.04	1.04
Alaskan Way, South of King Street	1.47	1.48
Alaskan Way, North of Seneca Street	0.94	0.93
Alaskan Way, North of Pine Street	0.93	0.92
Arterial Screenlines		
North-South Arterials, South of King Street	0.94	0.94
North-South Arterials West of I-5, at Seneca Street	0.99	0.99
North South Arterials East of I-5, at Seneca Street	0.58	0.57
North-South Arterials West of SR 99, at Thomas Street	0.58	0.58
North South Arterials East of SR 99, at Thomas Street	0.49	0.49

Note: Arterial screenlines exclude I-5, SR 99, Aurora Avenue, and Alaskan Way.

Exhibit 13. 2030 Land-Use Summary

District #	District Name	Total Households	Total Population	Total Employment
1	Downtown Seattle	27,900	46,200	229,200
2	Uptown	8,200	12,900	23,500
3	South Lake Union	9,900	5,200	42,000
4	Capitol Hill	26,100	39,800	43,500
5	SODO	3,100	3,800	26,700
6	West Seattle/Delridge	45,200	95,700	38,300
7	Duwamish	700	1,200	56,000
8	SE Seattle	40,600	103,400	45,000
9	Madison/Madrona	25,600	53,700	23,600
10	Queen Anne	14,200	30,800	14,600
11	Magnolia	11,300	22,300	15,400
12	Ballard	10,500	16,500	14,200
13	Fremont	18,700	37,100	21,900
14	NW Seattle	46,800	93,600	31,600
15	NE Seattle	37,000	75,100	31,400
16	University District	20,200	47,000	58,800
17	Shoreline	29,500	70,300	20,000
18	Bothell/Kirkland/Redmond	138,800	322,900	237,300
19	Bellevue	74,700	160,000	200,700
20	Issaquah	89,000	222,700	59,000
21	S King County/Pierce County	631,600	1,563,800	584,000
22	Snohomish County	391,600	966,900	349,100
23	Kitsap County	136,500	334,200	115,300
24	Renton	36,800	78,300	120,500
25	Burien	60,000	140,600	96,000
Regional Total		**1,934,600**	**4,544,200**	**2,497,700**

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