FINAL ENVIRONMENTAL IMPACT STATEMENT
AND FINAL SECTION 4(F) AND 6(f) EVALUATIONS
SR 520 BRIDGE REPLACEMENT AND HOV PROGRAM

MAY 2011

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

Final Transportation Discipline Report

Washington State Department of Transportation

U.S. Department of Transportation Federal Highway Administration

SR 520, I-5 to Medina:
Bridge Replacement and HOV Project
Final EIS and Final Section 4(f) and 6(f) Evaluations

Final Transportation Discipline Report

Prepared for

Washington State Department of Transportation
Federal Highway Administration

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Contents

List of Exhibits

Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
Arboretum	Washington Park Arboretum
AVO	average vehicle occupancy
CBD	central business district
CTR	Commute Trip Reduction
EB	eastbound
EIS	environmental impact statement
ESSB	Engrossed Substitute Senate Bill
ETL	express toll lane
FHWA	Federal Highway Administration
HCT	high-capacity transit
HCS	Highway Capacity Software
HOT	high-occupancy toll
HOV	high-occupancy vehicle
HSS	Highway of Statewide Significance
I-5	Interstate 5
ITS	Intelligent Transportation Systems
LOS	level of service
Metro	King County Metro
MOE	measure of effectiveness
MOHAI	Museum of History and Industry
mph	miles per hour
MPO	Metropolitan Planning Organization
mvmt	million vehicle miles traveled

NB	northbound
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
Non-HSS	Non-Highway of Statewide Significance
PSRC	Puget Sound Regional Council
RSSH	Regionally Significant State Highway
SB	southbound
SDEIS	Supplemental Draft Environmental Impact Statement
SDOT	Seattle Department of Transportation
SEPA	State Environmental Policy Act
Ship Canal Bridge	Lake Washington Ship Canal Bridge
SR	State Route
TDM	transportation demand management
TIC	Tolling Implementation Committee
TMP	Traffic Management Plan
TSMC	Traffic System Management Center
UW	University of Washington
V/C	volume-to-capacity (ratio)
vph	vehicles per hour
WB	westbound
WSDOT	Washington State Department of Transportation

Chapter 1—Background

Why is transportation considered in an environmental impact statement?

Transportation affects everyone. Whether we are working, delivering products, driving children to school, or taking a vacation, all of us depend on a safe, efficient, reliable transportation system. Many people depend on multiple modes of travel, such as driving alone; carpooling; taking a bus, train, or plane; walking; or biking. Good connections between these various travel modes are critical to the efficient movement of people, goods, and services throughout an area.

Understanding the effects of a proposed public project and its alternatives is an important part of any environmental impact statement (EIS) and is required by law. The National and State Environmental Policy Acts (NEPA and SEPA) require federal agencies to integrate environmental values into their decision-making processes.

Federal, state, and local agencies must consider the environmental effects of their proposed actions and reasonable alternatives to those actions. For example, how would each alternative affect traffic operations on the freeways and local streets? Would congestion improve or get worse? How would each alternative affect traffic volumes? How would moving high-occupancy vehicle (HOV) lanes from the outside lane to the inside lane affect traffic operations? Would the project change traffic patterns, causing people to take a different route to work and increasing traffic at one intersection while decreasing traffic at another? Does having a toll on the Evergreen Point Bridge shift traffic patterns? If so, how? Transportation is included in our EIS because of these questions.

What is this report about?

This Final Transportation Discipline Report—Appendix R to the State Route (SR) 520, Interstate 5 (I-5) to Medina: Bridge Replacement and HOV Project Final EIS—describes transportation conditions on the SR 520 corridor between I-5 to the west and 84th Avenue NE to the east. The report presents transportation information for SR 520 as it exists today and estimates transportation performance and operations for the

No Build Alternative and Preferred Alternative under evaluation for this project.

The Preferred Alternative is described below in this chapter. Chapter 1 is followed by:

- ***Chapter 2—Key Findings***. Summarizes the most important information and findings of the transportation analysis.
- ***Chapter 3—Travel Demand Modeling***. Describes how the project travel demand model was developed, updated during the project, and used to estimate future growth and changes in travel patterns for the No Build and Preferred Alternatives.
- ***Chapter 4—Transportation Forecasts and Operations Analysis Methodology***. Provides the methodology of the detailed project-level forecasts developed and the methodology for conducting the detailed traffic operational analysis.
- ***Chapter 5—Freeway Volumes and Operations***. Describes the existing freeway forecasts results and operating conditions for the project corridor. Compares the future No Build Alternative with the Preferred Alternative.
- ***Chapter 6—Local Volumes and Operations***. Describes the existing forecast results and operating conditions at local intersections. Compares the future No Build Alternative with the Preferred Alternative.
- ***Chapter 7—Nonmotorized Facilities***. Describes existing bicycle, pedestrian, and other nonmotorized transportation facilities as well as improvements proposed as part of the SR 520 Bridge Replacement and HOV Project.
- ***Chapter 8—Transit Operations***. Describes and quantifies how the project alternatives affect SR 520 corridor bus service and person-moving capacity.
- ***Chapter 9—Parking Supply***. Evaluates the existing parking supply, estimated demand, and estimated use and determines the effects of the Preferred Alternative design on parking supply.

Did you know?

The **SR 520 Bridge Replacement and HOV Program** will enhance safety by replacing the aging floating bridge and keep the region moving with vital transit and roadway improvements throughout the corridor. The 12.8-mile program area begins at I-5 in Seattle and extends to SR 202 in Redmond.

In 2006, WSDOT prepared a Draft EIS—published formally as **the SR 520 Bridge Replacement and HOV Project**—that addressed corridor construction from the I-5 interchange in Seattle to just west of I-405 in Bellevue. Growing transit demand on the Eastside and structure vulnerability in Seattle and Lake Washington, however, led WSDOT to identify new projects, each with a separate purpose and need that would provide benefit even if the others were not built. These four independent projects were identified after the Draft EIS was published in 2006, and these now fall under the umbrella of the entire **SR 520 Bridge Replacement and HOV Program**:

- **SR 520, I-5 to Medina: Bridge Replacement and HOV Project** replaces the SR 520 roadway, floating bridge approaches, and floating bridge between I-5 and the eastern shore of Lake Washington. This project spans 5.2 miles of the SR 520 corridor.
- **Medina to SR 202: Eastside Transit and HOV Project** completes and improves the transit and HOV system from Evergreen Point Road to the SR 202 interchange in Redmond. This project spans 8.6 miles of the SR 520 corridor.
- **SR 520 Pontoon Construction Project** involves constructing the pontoons needed to restore the Evergreen Point Bridge in the event of a catastrophic failure and storing those pontoons until needed.

- ***Chapter 10—Construction Effects***. Describes the effects of construction on traffic and parking for the Preferred Alternative and identifies temporary measures to mitigate the effect of construction on traffic.
- ***Chapter 11—Cumulative Transportation Effects***. Identifies the cumulative effects of the Preferred Alternative in combination with a regional package of additional transportation facility improvements and tolling/pricing strategies.
- ***Chapter 12—Traffic and Parking Improvement Guidelines***. Presents the approach and guidelines for determining the extent and timing of mitigation for freeway and local street operations and parking supply.
- ***Chapter 13—References***. Lists all of the documentation cited in this report.

What is the SR 520, I-5 to Medina: Bridge Replacement and HOV Project?

The SR 520, I-5 to Medina: Bridge Replacement and HOV Project would widen the SR 520 corridor to six lanes from I-5 in Seattle to Evergreen Point Road in Medina and would restripe and reconfigure the lanes in the corridor from Evergreen Point Road to 92nd Avenue Northeast in Yarrow Point. It would replace the vulnerable Evergreen Point Bridge (including the west and east approach structures) and Portage Bay Bridge as well as the existing local street bridges across SR 520. The project would complete the regional HOV lane system across SR 520, as called for in regional and local transportation plans. New stormwater facilities would be constructed for the project to provide stormwater treatment.

What is the Preferred Alternative?

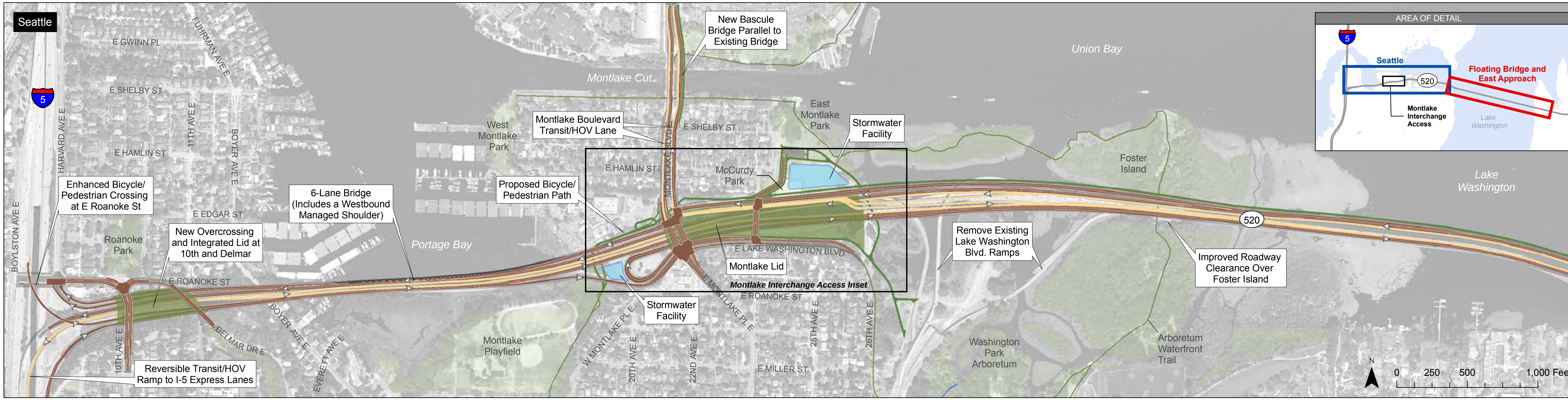
The SR 520, I-5 to Medina: Bridge Replacement and HOV Project Supplemental Draft Environmental Impact Statement (SDEIS), published in January 2010, evaluated a 6-Lane Alternative with three design options (Options A, K, and L) for the Seattle portion of the SR 520 corridor, and a No Build Alternative (WSDOT 2010a). Since the SDEIS was published, Washington State Department of Transportation (WSDOT) and the Federal Highway Administration (FHWA) announced a Preferred Alternative for the SR 520, I-5 to Medina project. All components of the Preferred Alternative were evaluated in the

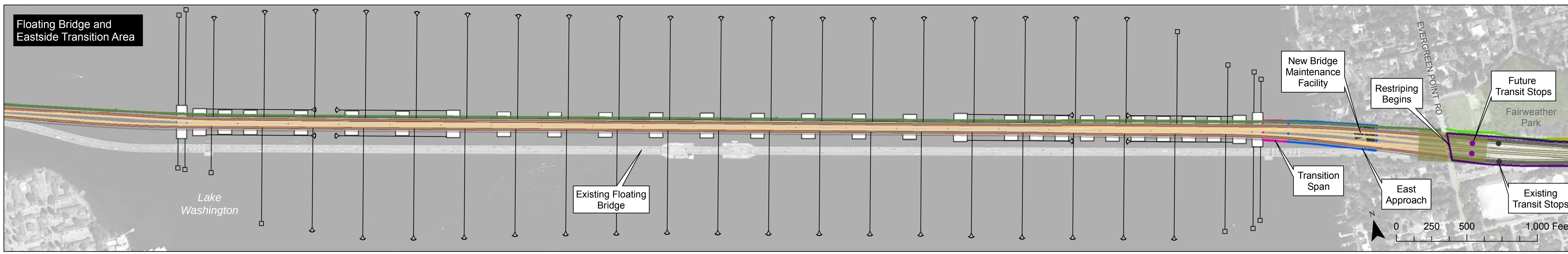
SDEIS, and the design of the SR 520 corridor has been further refined in response to comments received during public review of the SDEIS. The Preferred Alternative is summarized below. More information about the Preferred Alternative is provided in the Description of Alternatives Discipline Report Addendum (WSDOT 2011a).

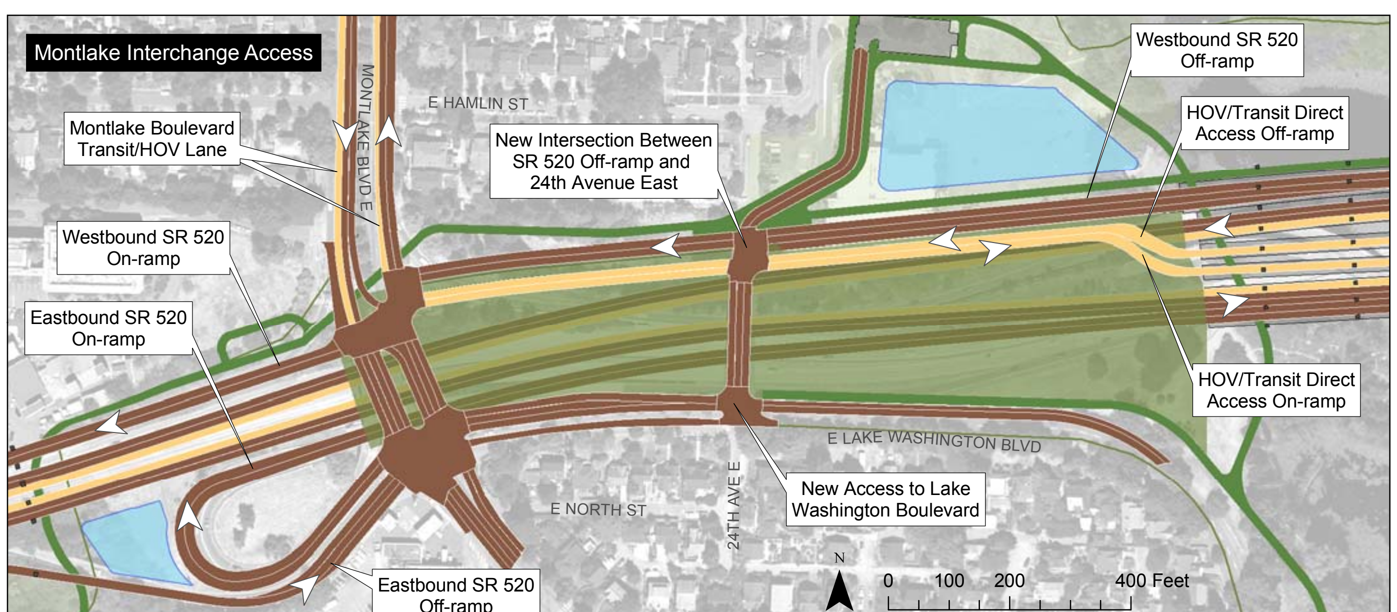
The new SR 520 corridor would be six lanes wide (two 11-foot-wide outer general-purpose lanes and one 12-foot-wide inside HOV lane in each direction), with 4-foot-wide inside shoulders and 10-foot-wide outside shoulders across the floating bridge. In response to community interests expressed during public review of the SDEIS, the SR 520 corridor between I-5 and the Montlake area would operate as a boulevard or parkway with a posted speed limit of 45 miles per hour (mph), and median planting across the Portage Bay Bridge. To support the boulevard concept, the width of the inside shoulders in this section of SR 520 would be narrowed from 4 feet to 2 feet, and the width of the outside shoulders would be reduced from 10 feet to 8 feet. Exhibit 1-1 highlights the major components of the SR 520, I-5 to Medina project Preferred Alternative.

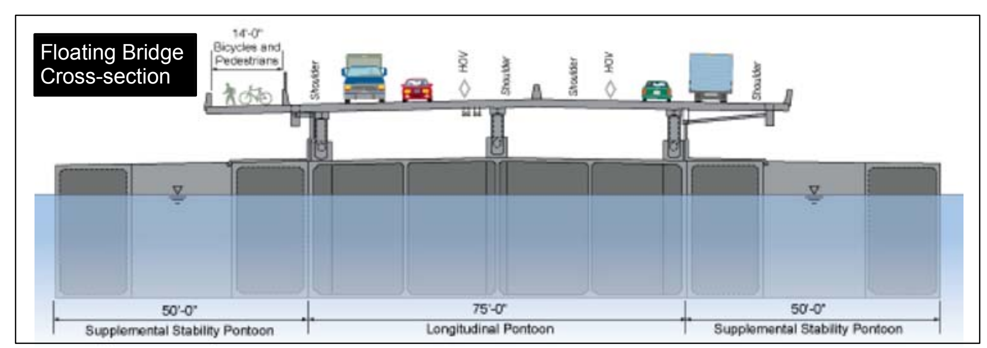
The Preferred Alternative would include design elements that would also provide noise reduction such as a reduced speed limit between I-5 and the Montlake area, 4-foot concrete traffic barriers, noise absorptive material on the inside of the traffic barriers and around the lid portals, and encapsulated bridge joints. The Preferred Alternative, like the SDEIS options, would also include quieter concrete pavement along the main line between I-5 and the floating bridge. Traffic noise modeling completed for the Final EIS resulted in fewer recommended noise walls for the Preferred Alternative than for the SDEIS options. Noise walls would meet all FHWA and WSDOT requirements for avoidance and minimization of negative noise effects. In areas where noise walls are warranted, they would only be constructed if approved by the affected communities.

The description and evaluation of the Preferred Alternative and the comparison of the Preferred Alternative to the design options presented in the SDEIS are organized by three areas along the project corridor: Seattle, Lake Washington, and the Eastside. Within these larger areas, project elements are described by geographic area, as identified in Exhibit 1-2. The project features for the Preferred Alternative are described under the geographic area headings so that the differences between the Preferred Alternative and the SDEIS options can be easily identified and compared.









Medina to SR 202 Project Elements

- General-Purpose Lane
- HOV Lane
- Bike Path
- Points Loop Trail
- Medina to SR 202 Project Lid

Source: King County (2006) Aerial Photo, King County (2008) GIS Data (Stream), CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

I-5 to Medina Project Elements

- Column
- Anchor and Cable
- Existing Regional Bicycle/Pedestrian Path
- General-Purpose Lane
- HOV, Direct Access, and/or Transit-Only Lane
- Westbound Managed Shoulder
- Proposed Bicycle/Pedestrian Path
- East Approach
- Transition Span
- Restriping Area
- Stormwater Treatment Facility
- Lid
- Pontoon

Exhibit 1-1. **Preferred Alternative Project Elements**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

Exhibit 1-2. **Preferred Alternative and Comparison to SDEIS Options**

Geographic Area	Preferred Alternative	Comparison to SDEIS Options A, K, and L
I-5/Roanoke Area	The SR 520 and I-5 interchange ramps would be reconstructed with generally the same ramp configuration as the ramps for the existing interchange. A new reversible transit/HOV ramp would connect with the I-5 express lanes.	Similar to all options presented in the SDEIS. Instead of a lid over I-5 at Roanoke Street, the Preferred Alternative would include an enhanced bicycle/pedestrian path adjacent to the existing Roanoke Street Bridge.
Portage Bay Area	The Portage Bay Bridge would be replaced with a wider and, in some locations, higher structure with six travel lanes and a westbound-managed shoulder.	Similar in width to Options K and L; similar in operation to Option A. Shoulders are narrower than described in the SDEIS, posted speed would be reduced to 45 mph, and median plantings would be provided to create a boulevard-like design.
Montlake Area	The Montlake interchange would remain in a similar location as today. A new bascule bridge would be constructed over the Montlake Cut. A 1,400-foot-long lid would be constructed between Montlake Boulevard and the Lake Washington shoreline, and would include direct access ramps. Access would be provided to Lake Washington Boulevard via a new intersection at 24th Avenue East.	Interchange location similar to Option A. Lid would be approximately 75 feet longer than previously described for Option A, and would be a complete lid over the top of the SR 520 main line, which would require ventilation. Transit connections would be provided on the lid to facilitate access between neighborhoods and the Eastside. Montlake Boulevard would be restriped for two general-purpose lanes and one HOV lane in each direction between SR 520 and the Montlake Cut.
West Approach Area	The west approach bridge would be replaced with wider and higher structures, maintaining a constant profile rising from the shoreline at Montlake out to the west transition span. Bridge structures would be compatible with potential future light rail through the corridor.	Bridge profile is most similar to Option L and slightly steeper; structure types similar to Options A and L. The gap between the eastbound and westbound structures would be wider than previously described to accommodate light rail in the future.
Floating Bridge Area	A new floating span would be located approximately 190 feet north of the existing bridge at the west end and 160 feet north of the existing bridge at the east end. The floating bridge would be 20 feet above the water surface at the midspan (about 10 feet higher than the existing bridge deck).	Similar to design described in the SDEIS. The roadway profile of the bridge would be approximately 10 feet lower than described in the SDEIS, and most of the roadway deck support would be constructed of steel trusses instead of concrete columns.
Eastside Transition Area	A new east approach to the floating bridge, and a new SR 520 roadway would be constructed between the floating bridge and Evergreen Point Road.	Same as described in the SDEIS.

The differences between the Preferred Alternative and the options presented in the SDEIS include:

- Reduced the lid over I-5 to a smaller bicycle/pedestrian overcrossing
- Designed the westbound shoulder on the Portage Bay Bridge to operate as a managed shoulder that would be used as an auxiliary lane during peak commute hours
- Reduced the posted speed to 45 mph in the Seattle portion of the corridor and reduced the overall footprint by narrowing the shoulders
- Reconfigured Montlake Boulevard between SR 520 and the Montlake Cut to include transit/HOV lanes
- Increased the overall size and length of the lid located in the Montlake area
- Reconfigured the west approach bridges (eastbound and westbound structures) to have a wider gap between them
- Lowered the roadway height on the floating bridge

Seattle

As described in the SDEIS, SR 520 would connect to I-5 in a configuration similar to the way it connects today. Improvements to the I-5/SR 520 interchange would include a new reversible HOV ramp connecting the new SR 520 HOV lanes to existing I-5 reversible express lanes. The project would include an enhanced bicycle/pedestrian crossing spanning I-5 near Roanoke Street, and landscaped lids across SR 520 at 10th Avenue East and Delmar Drive East, and in the Montlake area to help reconnect the communities on either side of the roadway.

The new Portage Bay Bridge design under the Preferred Alternative would have two general-purpose lanes and an HOV lane in each direction, plus a managed westbound shoulder. In response to community interest and public comment on the SDEIS, the width of the new Portage Bay Bridge at the midpoint has been reduced, and a planted median would separate the eastbound and westbound travel lanes. The Preferred Alternative design of the Portage Bay Bridge would operate traffic at 45 mph as a boulevard.

Under the Preferred Alternative, the SR 520 interchange with Montlake Boulevard would be similar to today's interchange, connecting to the University District via Montlake Boulevard and the Montlake bascule bridge. A new bascule bridge would be added to Montlake Boulevard NE parallel to the existing bridge. Montlake Boulevard would be restriped and reconfigured between SR 520 and the Montlake Cut to include two general-purpose lanes and one HOV lane for improved transit connectivity. A large new lid would be provided over SR 520 in the Montlake area, configured for transit and bicycle/pedestrian connectivity. The lid would function as a vehicle crossing for eastbound SR 520 traffic exiting to Montlake Boulevard and Lake Washington Boulevard. The lid would also serve as a pedestrian crossing, a landscaped area, and open space. The Lake Washington Boulevard ramps and the Montlake Freeway Transit Station would be removed.

The SR 520 roadway would maintain a constant slope profile rising from the east portal of the new Montlake lid, through Union Bay, across Foster Island, out to the west transition span of the Evergreen Point Bridge. This profile is most similar to the profile described in the SDEIS for Option L, but is slightly steeper for improved stormwater management.

Lake Washington

Floating Bridge

The alignment of the floating bridge is the same as evaluated in the SDEIS. The floating span would be located approximately 190 feet north of the existing bridge at the west end and 160 feet north at the east end.

The pontoon layout for the new 6-lane floating bridge is the same as evaluated in the SDEIS. The new floating bridge would be supported by 21 longitudinal pontoons, 2 cross pontoons, and 54 supplemental stability pontoons. As described in the SDEIS, the longitudinal pontoons would not be sized to carry future high-capacity transit (HCT), but would be equipped with connections for additional supplemental stability pontoons to support HCT in the future.

The new bridge would have two 11-foot-wide general-purpose lanes in each direction, one 12-foot-wide HOV lane in each direction, 4-foot-wide inside shoulders, and 10-foot-wide outside shoulders. As a result of comments on the SDEIS, the height of the bridge deck above the water has been lowered to reduce visual effects. At midspan, the floating bridge would now rise approximately 20 feet above the water, compared to approximately 30 feet for the design described in the Draft EIS and SDEIS. The roadway would be about 10 feet higher than the existing bridge deck. At each end of the floating bridge, the roadway would be supported by rows of concrete columns. The remainder of the roadway across the pontoons would be supported by steel trusses.

Bridge Maintenance Facility

The new bridge maintenance facility would be as described in the SDEIS. Routine access, maintenance, monitoring, inspections, and emergency response for the floating bridge would be based out of a new bridge maintenance facility located underneath SR 520 between the east shore of Lake Washington and Evergreen Point Road in Medina. This bridge maintenance facility would include a working dock, an approximately 7,200-square-foot maintenance building, and a parking area.

Eastside Transition Area

The SR 520, I-5 to Medina project and the SR 520, Medina to SR 202: Eastside Transit and HOV Project (SR 520, Medina to SR 202 project) overlap between Evergreen Point Road and 92nd Avenue NE in Yarrow Point. Work planned as part of the SR 520, I-5 to Medina project between Evergreen Point Road and 92nd Avenue NE would include moving the Evergreen Point Road transit stop west to the lid (part of the SR 520, Medina to SR 202 project) at Evergreen Point Road, adding new lane and ramp striping from the Evergreen Point lid to 92nd Avenue NE, and moving and realigning traffic barriers for the new lane striping. The restriping would transition the SR 520, I-5 to Medina project improvements into the improvements completed as part of the SR 520, Medina to SR 202 project.

When will the project be built?

Construction for the SR 520, I-5 to Medina project is planned to begin in 2012, after project permits and approvals are received. In order to maintain traffic flow in the corridor, the project would be built in stages. Major construction in the corridor is expected to be complete in 2018. The most vulnerable structures (east and west approaches and floating portion of the Evergreen Point Bridge and Portage Bay Bridge) would be built in the first stages of construction, followed by the

less vulnerable components (Montlake and I-5 interchanges).
Exhibit 1-3 provides an overview of the anticipated construction stages and durations identified for the SR 520, I-5 to Medina project.

A Phased Implementation scenario was discussed in the SDEIS as a possible delivery strategy to complete the SR 520, I-5 to Medina project in phases over an extended period of time. Since publication of the SDEIS, WSDOT has adopted a construction schedule to complete all major project improvements by 2018, and is developing a finance plan. This full corridor delivery strategy would complete all major construction in approximately the same amount of time as the delivery schedule outlined in the SDEIS. Therefore, the Final EIS will not address the Phased Implementation scenario as it is no longer applicable.

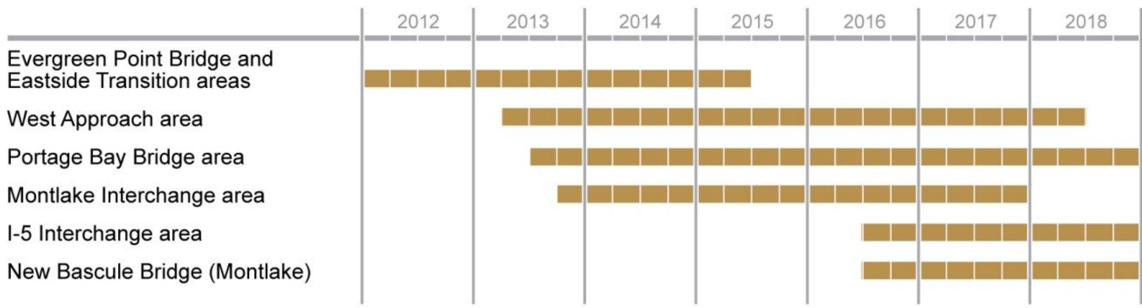


Exhibit 1-3. **Preferred Alternative Construction Stages and Durations**

Are pontoons being constructed as part of this project?

As described in the SDEIS, WSDOT is in the process of planning and permitting a facility that would build and store the 33 pontoons needed to replace the existing capacity of the floating portion of the Evergreen Point Bridge in the event of a catastrophic failure. If the bridge does not fail before its planned replacement, WSDOT would use the 33 pontoons constructed and stored as part of the SR 520 Pontoon Construction Project in the SR 520, I-5 to Medina project. An additional 44 pontoons would be needed to complete the new 6-lane floating bridge planned for the SR 520, I-5 to Medina project. The additional pontoons could be constructed at the Port of Tacoma and/or at the pontoon construction facility in Grays Harbor. Final pontoon construction locations will be identified at the discretion of the contractor. For additional information about project construction schedules and pontoon construction, launch, and transport, please see the Construction Techniques and Activities Discipline Report Addendum and Errata (WSDOT 2011b).

Chapter 2—Key Findings

What is in this chapter?

This chapter presents key findings of the transportation effects analysis for the SR 520, I-5 to Medina project. The analysis includes freeway operations, local roadway operations, nonmotorized facilities, transit, parking, construction effects, and cumulative effects. These topics are summarized below and described in detail in Chapters 5 through 12 of this Transportation Discipline Report.

What is traffic currently like on SR 520?

The existing configuration of SR 520 does not meet current WSDOT design guidelines, which affects the freeway's capacity to provide reliable and safe travel for buses and carpools (HOV) and general-purpose traffic. Roadway capacity in the SR 520 corridor is constrained by:

- Narrow shoulders and lanes on the corridor and across the bridge
- Short acceleration lane lengths at the SR 520/Montlake interchange and Lake Washington Boulevard on-ramps
- Limited sight distance at roadway curves, resulting in slower posted and operating speeds

These constraints, coupled with high traffic volumes on SR 520, result in regular congestion at the following locations:

- Westbound approaching the bridge (near the HOV lane termination in Medina)
- Westbound on the Portage Bay Bridge between I-5 and the SR 520/Montlake interchange
- Eastbound approaching the west approach span of the Evergreen Point Bridge

Several bottlenecks along the I-5 and I-405 corridors limit the amount of traffic that can access westbound SR 520. In Seattle, these areas include northbound I-5 through downtown Seattle and southbound I-5 across the Lake Washington Ship Canal Bridge (Ship Canal Bridge). The capacity of the I-405/SR 520 interchange and I-405 main line through downtown Bellevue also limits the amount of traffic that can enter or exit the SR 520 corridor westbound.

How would travel on SR 520 and I-5 change by the year 2030 with and without the project?

Between today and the year 2030, the population of the region is anticipated to grow by 1 million people, add over 640,000 new jobs, and need to accommodate close to 40 percent more traffic (PSRC 2006).

With the forecasted increases in population and employment, traffic volumes would also increase on major transportation facilities. Person demand at all cross-lake roadways would increase substantially more than vehicle demand, indicating a growth in HOV travel (carpools and buses) in year 2030 compared to today.

With the Preferred Alternative, daily vehicle demand on SR 520 would decrease by 5 percent compared to the No Build Alternative. Traffic volumes on alternative routes would increase slightly as a result of the SR 520 toll implementation. The two corridors most affected would be SR 522 and I-90. SR 522 traffic volumes would increase by about 2 percent, and I-90 traffic volumes would increase by about 1 percent compared to the No Build Alternative. Traffic demand on SR 520 would primarily decrease during the off-peak periods when the alternative routes are less congested, making drivers more likely to use those routes to avoid a toll.

In the year 2030 (No Build Alternative), peak-period traffic demand on SR 520 would increase compared to today by 11 percent in the morning and 9 percent in the evening. Without improvement in the corridor, congestion would continue to worsen. Total traffic demand volumes would be similar with the Preferred Alternative during peak periods. This traffic demand would occur even with a toll on the corridor because the congestion on SR 522 and I-90 would be severe enough to encourage drivers to pay the toll and cross SR 520, especially if it is the most direct route.

However, with the Preferred Alternative, the following changes in travel would occur:

- Congestion is present on the SR 520 corridor for 13 fewer hours during the morning and evening commute periods due to shoulder improvements and overall corridor geometry. For example, in the No Build Alternative, there are several key bottlenecks that result in substantial congestion during the commute periods. One of these is the westbound bridge approach where congestion is present for 4 hours during the morning commute and 4.5 hours during the evening commute; as a result, this section of roadway alone has congestion for 8.5 hours during the commute periods. With the Preferred Alternative, there is no congestion at this location during the commute periods; therefore, congestion is present for 8.5 fewer hours during the commute periods. Taking into account all such locations in the No Build Alternative and Preferred Alternative results in 13 fewer hours when congestion is present.
- More people would be traveling in higher occupancy modes, such as HOV (three or more passengers) lanes or transit (less general-purpose trips).
- With the Preferred Alternative, the number of people on the SR 520 corridor who would use HOV (carpools with three or more people and buses) would increase by approximately 19,000 (39 percent) compared to the No Build Alternative. General-purpose vehicle demand would decrease approximately 11,000 vehicles per day (10 percent) for the Preferred Alternative compared to the No Build Alternative. These changes would occur because of the corridor toll, improved HOV reliability, and reduced HOV travel times that would increase the incentive to carpool or take the bus.

As more people travel in higher vehicle-occupancy modes such as HOV and transit, the Preferred Alternative can have similar total vehicle trips while serving more persons than the No Build Alternative. The Preferred Alternative serves 15 to 17 percent more persons than the No Build Alternative in the morning and evening peak periods, respectively, as well as serving 5 to 10 percent more vehicles. This increase would occur because the Preferred Alternative includes additional HOV capacity from Medina to I-5; moreover, by providing an HOV lane, the general-purpose lanes also operate with less congestion.

By reducing congestion or bottlenecks on SR 520 with construction of the Preferred Alternative and improvement in throughput, I-5 would operate differently as follows:

- Today and in the year 2030 congestion on eastbound SR 520 adversely affects traffic flow on northbound I-5. By the year 2030, on northbound I-5 between I-90 and SR 520 congestion would be present for 3 hours of the morning commute period as a result of the eastbound SR 520 traffic volume with the No Build Alternative. Travel times from Seattle to Bellevue would be about 44 minutes. Completing the SR 520, I-5 to Medina project would alleviate congestion points on SR 520 and improve the Seattle-to-Bellevue travel time to 11 minutes.
- In the afternoon, I-5 southbound is congested through downtown Seattle from the SR 520 interchange area to the I-90 collector-distributor in the No Build Alternative. Travel time from Bellevue to Seattle is up to 41 minutes during the peak of the commute. With the congestion relief on SR 520 provided by the Preferred Alternative, up to 200 more vehicles per hour (vph) would be able to reach I-5 southbound during the peak hour. This 200-vph increase in traffic on I-5 would result in some increase in congestion on I-5 southbound. However, with the Preferred Alternative's improvements to the SR 520 corridor, the travel time between Bellevue and Seattle would still improve to 28 minutes during the peak of congestion. This is a 12-minute improvement compared to the No Build Alternative.

What are the safety benefits of this project?

Today, the highest number of vehicle crashes shown in the SR 520, I-5 to Medina project analysis occur between I-5 and the 24th Avenue East undercrossing (in both directions). This section of SR 520 had higher crash rates than the SR 520 corridor average of 1.11 crashes/million vehicle miles traveled (mvmt) in both the eastbound and westbound directions. This result is likely due to the congested conditions because 83 percent of the eastbound crashes and 86 percent of the westbound crashes are congestion-related (rear-end and side-swipe incidents) along this section.

This project would improve the ramp designs in the SR 520 study area to current design guidelines, which would help to resolve current safety issues.

The main safety benefits of this project are summarized below. The improved traffic flow and reduced congestion may have other minor benefits as well.

- A decrease in overall crash frequencies and crash rates as a result of widening the roadway and improving traffic operations
- A decrease in fixed-object crashes as a result of widened shoulders, which would provide increased recovery area for errant vehicles
- A decrease in some ramp crashes as a result of improved designs that more closely meet current design guidelines

What is traffic like at the Montlake Boulevard interchange area today?

The SR 520/Montlake Boulevard interchange area, which provides access to and from SR 520, is congested during the morning and afternoon peak hours. This congestion is partially related to traffic flow on SR 520 (which can affect traffic flow on the local street network), and traffic flow on the local street network (which can affect traffic flow on SR 520).

During the morning and afternoon commutes, traffic typically backs up on southbound Montlake Boulevard approaching the on-ramp to eastbound SR 520. Traffic congestion can extend across the Montlake Bridge to the Montlake Boulevard/NE Pacific Street intersection and as far back as 25th Avenue NE near University Village (approximately 1 mile). Congestion can also occur on NE Pacific Street eastbound, extending back through the NE Pacific Place intersection. The following factors contribute to the congestion in the SR 520/Montlake Boulevard interchange area:

- Freeway traffic operations on SR 520 are managed by using the eastbound on-ramp meter to control the flow of traffic entering SR 520. On-ramp traffic volumes at this location exceed the storage capacity on the ramp and queue onto Montlake Boulevard. At times, congestion on SR 520 exceeds a level that can be managed by the ramp meter, which means congestion from SR 520 spills back through the merge point and past the ramp meter.

- Traffic congestion associated with the eastbound SR 520 on-ramp can extend back across the Montlake Bridge. When traffic is backed up in the outside right lane, Montlake Boulevard southbound is constrained to one lane for drivers destined for areas to the south of SR 520.
- Drivers traveling northbound on Montlake Boulevard NE to access SR 520 westbound must make a U-turn at the Montlake Boulevard/East Hamlin Street intersection. These vehicles often spill out of the U-turn pocket. This congestion blocks the inside northbound lane on Montlake Boulevard, which constrains through traffic to a single lane. This, in turn, affects traffic exiting the eastbound off-ramp and other intersections to the south.
- Some drivers who use the SR 520 westbound off-ramp want to travel southbound on Montlake Boulevard or reach the Shelby/Hamlin neighborhood west of Montlake Boulevard. These drivers stop at the end of the westbound off-ramp to wait for a gap in traffic to aggressively merge across the two northbound through lanes and access the U-turn at the East Hamlin Street intersection. Accommodating this movement can worsen northbound congestion and create backup on the westbound off-ramp.
- Montlake Bridge openings can have long-lasting effects on traffic flow in this area. The bridge does not open during the morning and afternoon peak periods; however, if the bridge opens at the end of the midday period (3:30 p.m.), it can affect traffic operations throughout the afternoon commute. Bridge openings compound whatever congestion is present on the local street network and can cause congestion to spill back onto the SR 520 main line. When congestion reaches the SR 520 corridor, eastbound traffic can then become so congested that it affects traffic on I-5.
- An average of 10 bridge openings occurs during a typical summer weekday (fewer openings occur during other times of the year). Bridge openings typically last 4 to 5 minutes, but can extend up to 6 minutes on occasion (WSDOT 2008a).
- Montlake Bridge opening delays make it difficult for bus drivers to keep to their schedules, affecting bus travel times and reliability. Additional discussion on the effects on bus travel times is provided in Chapter 8—Transit Operations.

- Montlake Boulevard NE is an important transit corridor, serving both local and regional buses between the SR 520/Montlake interchange and the University District. Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE are considered Urban Village Transit Network corridors as identified in the Seattle Transit Plan (SDOT 2005). Today minimal transit priority is provided along the Montlake corridor. A transit or HOV ramp meter bypass lane is provided at the eastbound on-ramp. Queue jumps are also provided for northbound transit after the bus stop at Montlake Boulevard/East Shelby Street and from the HOV lane along NE Pacific Street turning southbound at the Montlake Boulevard/ NE Pacific Street intersection.
- The Montlake Boulevard/Lake Washington Boulevard/SR 520 eastbound ramps intersection operates at Level of Service (LOS) E during both the morning and afternoon peak hours, with legs of the intersection operating near or over capacity. LOS E represents moderate to high delay; LOS is further described in Chapter 4. Congestion from this signal spills back into the off-ramp deceleration lane, which affects SR 520 mainline operations as drivers slow approaching the off-ramp. Southbound queues at times extend back between East Hamlin Street and East Shelby Street limiting access to the westbound on-ramp. Northbound queues at times extend through the East Roanoke Street intersection.

What would traffic be like at the Montlake interchange in 2030 with and without the project?

Traffic volumes at the Montlake interchange area are forecasted to increase up to 15 and 23 percent in the morning and afternoon, respectively, by the year 2030 for either the No Build or Preferred Alternative. However, travel patterns within the interchange area would be different for the Preferred Alternative compared to the No Build Alternative. These changes are a result of the modified interchange configuration and highway access points for HOV and general-purpose traffic.

Changes in travel patterns as part of the Preferred Alternative include the following:

- More people from the University District area destined to I-5 would travel along Montlake Boulevard southbound and across Portage Bay westbound than under the No Build Alternative. This increased travel would occur because southbound travel along Montlake Boulevard would be improved due to reduced queuing from the westbound on-ramp.

- Access to SR 520 from the south would be relocated to the Montlake loop ramp (for general-purpose trips) and at 24th Avenue East (for HOV trips). Relocating this access point adds 640 vph to the Montlake Boulevard/Lake Washington Boulevard intersection during the evening peak hour. Fifty percent of these trips to and from SR 520 would divert to Montlake Boulevard rather than travel along Lake Washington Boulevard.

The Preferred Alternative also includes improvements in geometry and signal timing at key intersections. The Preferred Alternative would improve traffic operations at the following intersections compared with the No Build Alternative.

- Montlake Boulevard/Lake Washington Boulevard/SR 520 eastbound ramps would operate at 20 percent over capacity in the afternoon peak hour under the Preferred Alternative instead of 50 percent over capacity under the No Build Alternative. This improvement is associated with the addition of lanes at the intersection. However, in the morning the intersection would operate at LOS F and 10 percent over capacity with the Preferred Alternative compared to LOS E and 5 percent over capacity with the No Build Alternative. The additional capacity provided at the intersection was determined through the Engrossed Substitute Senate Bill (ESSB) 6392 process and constrained due to adjacent land use. Additional coordination between WSDOT and the City of Seattle may be needed to manage operations at the intersections.
- Montlake Boulevard/East Shelby Street would improve from an LOS F with the No Build Alternative to an LOS D in the afternoon peak hour for the Preferred Alternative. This improvement is the

result of additional capacity (the HOV lane) extending through the intersection.

- Montlake Boulevard/NE Pacific Street would improve from operating at 20 percent over capacity with the No Build Alternative to operating at 15 percent over capacity with the Preferred Alternative in the afternoon peak hour. This improvement is the result of better signal timing and coordination along the Montlake corridor.

How would travel through the Arboretum change in the year 2030 with and without the project?

During the morning and evening commutes today, traffic through the Washington Park Arboretum (Arboretum) is at a level of 1,590 and 1,400 vph, respectively. Based on projected land use growth estimates from the Puget Sound Regional Council (PSRC) model, year 2030 No Build traffic volumes are estimated to reach levels of 1,950 and 1,730 vph in the morning and evening commutes, respectively. The Preferred Alternative would remove the Lake Washington Boulevard ramps from their current configuration and provide more restrictive access at the 24th Avenue East crossing of SR 520. This change in interchange configuration would result in levels of traffic at 1,330 and 1,410 vph during the morning and evening commutes, respectively. This shows that there would be less traffic in the Arboretum in the year 2030 with the Preferred Alternative than there is today.

What are the key findings for nonmotorized travel?

The new Evergreen Point Bridge would include a 14-foot-wide dedicated right-of-way bicycle/pedestrian path across the bridge to Montlake Boulevard NE. The SR 520 regional bicycle path would connect to regional and local bicycle and pedestrian facilities on both sides of the lake. Nonmotorized travel times could improve because bicyclists and pedestrians would no longer have to wait for buses to cross the lake. Bicyclists and pedestrians would continue to reach the SR 520 corridor in Seattle via a combination of trails and on-street bicycle lanes.

The project would improve the nonmotorized travel experience by providing two landscaped lids at:

- Montlake Boulevard and 24th Avenue East
- 10th Avenue East and Delmar Drive East

These lids would help reconnect the communities on either side of the SR 520 corridor.

In the Montlake interchange area, the Preferred Alternative would also improve connectivity for bicyclists and pedestrians to other modes of transportation via the Montlake Multimodal Center and University Link light rail station by expanding the pedestrian and bicycle facilities across the Montlake Cut. In addition to providing a new connection on the lid along 24th Avenue East, improved crossings of the freeway would be provided via a widened sidewalk across the new bascule bridge on the Montlake Cut, a new path along Lake Washington under SR 520 connecting to the Arboretum, and a grade-separated connection under Montlake Boulevard to the Bill Dawson Trail.

At the I-5/Roanoke Street bridge crossing, a new path on the south side of Roanoke Street and new crosswalks at the Harvard Avenue East/Roanoke Street intersection would improve safety in an area where bicyclists typically share the roads with vehicular traffic.

The goals for nonmotorized travel in the project vicinity are to provide access across Lake Washington between Seattle and the Eastside communities, as well as to improve bicycle/pedestrian connections between the neighborhoods of North Capitol Hill, Roanoke/Portage Bay/Montlake and the University District. The proposed project would fulfill these goals by constructing a bicycle/pedestrian path on the new Evergreen Point Bridge, as well as bicycle/pedestrian path connections under SR 520 and across the new lids that would increase nonmotorized travel across SR 520. These features are part of a larger, comprehensive transportation system, including connections to the City of Seattle Bicycle Master Plan routes.

What are the key findings for transit?

Transit reliability and travel times in the SR 520 corridor would improve with the Preferred Alternative due to changes and improvements in transit infrastructure. The project's transit infrastructure changes and improvements are as follows:

- Completion of inside HOV lanes in both directions across the Evergreen Point Bridge to I-5.
- Addition of an HOV lane (transit and carpools with three or more passengers) as a direct connection to I-5 express lanes that would operate westbound-to-southbound in the morning and northbound-to-eastbound in the afternoon.
- Addition of a transit and HOV direct access ramp connection between 24th Avenue East and SR 520 to and from the east.
- Removal of the Montlake Freeway Transit Station.
- Addition of eastbound and westbound transit stops on the Montlake lid. During the off-peak periods, these stops can accommodate buses that currently use the Montlake Freeway Transit Station stop.
- Addition of new equipment for traffic signal control compatible with transit signal priority at five intersections:
    1. Direct access ramp/24th Avenue East
    2. Direct access ramp/Montlake Boulevard NE
    3. East Shelby Street/Montlake Boulevard NE (southbound)
    4. East Hamlin Street/Montlake Boulevard NE (northbound)
    5. NE Pacific Street/Montlake Boulevard NE (eastbound)
- Addition of an inside HOV lane on Montlake Boulevard northbound from SR 520 across the Montlake Bridge
- Addition of an outside HOV lane on Montlake Boulevard southbound from NE Pacific Street to across the Montlake Bridge

Between now and the year 2030, transit service within the greater Seattle area and across SR 520 would change. Transit agencies have indicated that transit service with the Preferred Alternative would be the same as for the No Build Alternative and would include the following elements:

- Central Link light rail between South 200th Street and Lynnwood
- East Link light rail across I-90 between downtown Seattle and downtown Redmond
- Consolidation of SR 520 bus routes to serve East Link and eliminate low ridership routes, resulting in 14 instead of 23 SR 520 bus routes. Eight routes would provide service between Eastside cities and downtown Seattle and six routes between Eastside cities and the University District/north Seattle
- All-day transit service would continue to be provided by King County Metro (Metro) Routes 255 and 271 and Sound Transit Routes 540 and 545
- Improvements in route headways for remaining SR 520 bus service to maintain levels of service, providing approximately 645 bus trips across SR 520 between 6:00 a.m. and 6:15 p.m. (compared to 575 today); on average, a bus would cross SR 520 every 1 to 2 minutes during the peak periods and every 3 to 4 minutes during midday
- Pedestrian and bicycle infrastructure improvements at the Montlake Triangle to accommodate the addition of 23,000 passenger boardings and alightings per day at the University of Washington (UW) light rail station

Site Restoration and Station Facility Plan for Sound Transit University Link Station

The intersection of this transit service with the Preferred Alternative's transit infrastructure changes and improvements would result in the following changes and improvements to transit service in the SR 520 corridor between I-5 and Medina:

- Transit travel times and reliability would improve. The HOV lanes would operate at or near free-flow conditions throughout the day, including during the peak periods. HOV travel times would be 14 to 15 minutes between I-5 and SR 202, even during the peak hour of the peak period.

- Travel times for eastbound buses would improve by 12 minutes during the evening commute (compared to the No Build Alternative between I-5 and SR 202). Completing the eastbound HOV lanes would allow transit to reliably bypass congestion associated with I-405 that is forecasted to extend back onto SR 520 eastbound by the year 2030.

- Daily transit person trips would increase about 33 percent, from 9,900 in the No Build Alternative to 13,200 person trips. Transit person trip demand would increase 11 percent during the morning commute and 14 percent during the afternoon commute. These increases are due to the HOV lane completion and a toll on general-purpose traffic.

- The function of the Montlake Freeway Transit Station would be replaced in part by westbound and eastbound bus stops on the new Montlake lid, which would allow 430 bus trips to access the Montlake interchange area compared to 645 in the No Build Alternative (between 6:00 a.m. and 6:15 p.m. on weekdays).

- Eastside/University District bus routes would serve the Montlake lid bus stops all day, providing approximately 305 bus trips. Eastside/downtown Seattle bus routes would serve these stops at midday, providing approximately 120 additional bus trips (between approximately 6:00 a.m. and 6:15 p.m. with bus service continuing until approximately 12:00 a.m.). Eastside/downtown Seattle bus routes would also serve these stops during evenings and weekends.

- During peak periods, when Eastside/downtown Seattle buses would not serve the Montlake lid stops, riders would be expected to make the following changes:

    - Some Eastside westbound riders would be required to transfer between Eastside/downtown Seattle and Eastside/University District bus routes at the Evergreen Point Freeway Transit Station. An Eastside/University District bus would arrive every 3 to 4 minutes and most riders would be able to board any University District route.

    - Some Montlake or University District residents traveling to and from downtown Seattle would be required to change their transit route from SR 520 buses to light rail or other local bus routes.

    - Some eastbound riders coming from the University District would also be required to transfer at the Evergreen Point Freeway Transit Station from a University District route to a route to their final destination, such as Route 311 or 424. If riders do not consult bus schedules, they could wait up to 45 minutes for their specific route.

- Connections between SR 520 bus service and local bus service in the Montlake interchange area would be similar to the No Build Alternative. The Montlake Boulevard northbound bus stop at the SR 520 westbound off-ramp would be relocated 100 feet to the south on the Montlake overpass. The Montlake Boulevard southbound bus stop at the SR 520 eastbound on-ramp would be relocated 270 feet to the south to near East Roanoke Street. Because the Montlake lid stops would be at-grade with these stops, the walk distance between SR 520 bus service and the northbound stop would be approximately 150 feet less than in the No Build Alternative while the walk distance to the southbound stop would be approximately 250 feet less from the westbound stop but approximately 330 feet more from the eastbound stop.

- The Preferred Alternative includes an inside HOV lane on Montlake Boulevard northbound across the Montlake Bridge and an outside HOV lane on Montlake Boulevard southbound from NE Pacific Street across the Montlake Bridge. The addition of HOV lanes on Montlake Boulevard NE between SR 520 and the Montlake Bridge, and other transit/HOV priority treatments, would improve local bus travel times compared to the No Build Alternative.

What are the key findings for parking?

The Preferred Alternative would require removal of 172 parking spaces. Most of the affected parking is in the Montlake area, with the exception of the lot at Bagley Viewpoint near I-5.

Exhibit 2-1 lists the existing parking supply, the number of spaces expected to remain after the Preferred Alternative is constructed, and the number of spaces removed at each location.

Exhibit 2-1. **Estimated Effects on Parking Supply in the Study Area**

Location	Existing/No Build Parking Supply	Preferred Alternative Parking Supply	Spaces Affected by the Preferred Alternative
Lot at Bagley Viewpoint	10	0	10
NOAA Northwest Fisheries Science Center	132[a]	94	38
MOHAI and East Montlake Park	150	26	124

[a] Parking supply includes 38 spaces located on WSDOT right-of-way under the existing Evergreen Point Bridge.

The affected parking spaces would include removal of the existing lot in Bagley Viewpoint Park due to construction of the 10th and Delmar lid. WSDOT is considering replacement of part or all of this parking. At the National Oceanic and Atmospheric Administration (NOAA) property, only the portion of the facility parking lot located on WSDOT right-of-way under the Evergreen Point Bridge structure would be removed. Most of the affected parking spaces are located at the Museum of History and Industry (MOHAI), which would be relocated under the Preferred Alternative. Some parking spaces at the existing MOHAI site would be replaced, supporting access to East Montlake Park.

What are the key findings for construction effects?

The following sections describe construction effects on local streets, the regional freeways, transit, nonmotorized modes of travel (i.e., bicycles and pedestrians), and parking.

Construction of the project, including demolition of structures and use of some areas for contractor staging, would require adjustments to the existing lanes and intersections on roadways. Construction activities would occupy a portion of the transportation right-of-way. During off-peak traffic periods, haul truck traffic would be present on the roadways, and some travelers would encounter lane closures. Some local street delays can be expected during reconstruction of the Montlake Boulevard East bridge, but during most of construction, congestion is expected to remain similar to existing conditions.

The most substantial construction effects are related to closure of the Lake Washington Boulevard ramps to and from SR 520. When the ramps are closed, more traffic would travel through the Montlake/SR 520 interchange during periods of construction, until new portions of the project are complete. There is limited transportation right-of-way available in the Montlake interchange area to accommodate construction activities; moreover, existing transportation conditions are congested. WSDOT would make improvements along Montlake Boulevard during construction to accommodate the temporarily increased activity and traffic.

Local Street Traffic Operations

Traffic on most local streets in the project vicinity would continue to flow during construction as it does today.

Throughout construction of the Preferred Alternative, there would be intermittent, short-term local ramp and road closures that would only be allowed during times of off-peak traffic. There would be one long-term, temporary road closure of the 24th Avenue NE bridge over SR 520. The bridge closure on 24th Avenue NE would not initially affect traffic operations, but it would improve intersection operations on Montlake Boulevard when reconstructed with the new westbound SR 520 off-ramp. During construction of the Preferred Alternative, the Lake Washington Boulevard ramps to and from SR 520 would be closed and traffic would use the Montlake interchange instead.

Because of the temporary roadway changes that would be needed, traffic volumes would increase on some roadway segments and decrease on others periodically as the stages of construction progress, particularly on local streets in the Montlake interchange area. Other locations in the project vicinity would not be substantially affected.

Traffic operations on local streets are expected to remain similar to existing conditions during most of the construction period. The temporary improvements along Montlake Boulevard would accommodate traffic volume changes and prevent substantial increases in congestion. Delay would increase at three locations during a portion of the construction timeline:

- SR 520 westbound ramps/Montlake Boulevard East, during years 3 and 4 in the AM and PM peak hours—change from LOS B to C
- Lake Washington Boulevard/eastbound SR 520 ramps/Montlake Boulevard East, during year 6 in the AM peak hour—change from LOS E to F

- East Shelby Street/Montlake Boulevard East, during year 7 in the AM peak hour—change from LOS B to C

Freeway Traffic Operations

Traffic conditions on the freeways would remain similar to existing conditions during the most congested times of the day. Intermittent delays can be expected due to isolated construction events, but activities that reduce freeway capacity would not be allowed during the daytime. When the Lake Washington Boulevard ramps are closed and other ramps are shifted temporarily, the locations of existing congestion on SR 520 would change while overall delay would remain much as it is today. Congestion due to the Lake Washington Boulevard ramps would no longer be present, but some increased congestion at the Montlake Boulevard ramps can be expected. This change would not be substantial for the westbound off-ramp. At the eastbound on-ramp merge to SR 520, increased traffic volumes would result in a change from LOS D to E during the AM peak hour for about 3 years of construction.

Construction Truck Volumes

Construction trucks would use designated truck routes and arterial streets to access work sites and construction staging areas. Direct access to work sites from SR 520 and the ramps would be provided where possible. Construction truck traffic would be necessary on City of Seattle streets in the project vicinity. Some local streets on the Eastside would also need to be used on a limited basis during construction of the Evergreen Point Bridge and Eastside transition area; however, most trucks would access the SR 520, Medina to SR 202 work site directly from the freeway and would leave the site through a direct access back to the freeway.

During typical construction days, the daily volume of project construction trucks on local streets would be less than 1 percent of total vehicle volumes on the streets. The existing daily volumes of trucks and buses on local streets range from about 1 to 4 percent of total vehicle volumes, with most locations just over 2 percent. On typical construction days, the project would not substantially increase truck activity on local streets.

On days when peak construction activities occur, the volume of project trucks added to local streets would be similar to the existing volumes of trucks and buses at most locations. The additional trucks would typically range from 2 to 4 percent of existing vehicle volumes, with only East Roanoke Street beyond that range at 6 percent. At the Eastside locations, additional trucks during peak construction would be less than 3 percent of existing vehicle volumes.

The existing total vehicle volumes, including trucks and buses on freeways, are much greater than on arterial streets; therefore, the additional project trucks would not have a substantial effect. Most construction trucks would travel during off-peak traffic conditions because road congestion would delay arrivals and reduce construction productivity. On average construction days, the trucks added to freeway traffic due to project activities would be negligible at all locations. During peak construction days, the estimated additional trucks would amount to 0.5 percent, or less, of total vehicles.

Transit

Construction would affect bus stops and operations on local streets in the study area, and could affect transit stations and associated bus operations along SR 520. Much like general traffic operations, most transit effects would be on the local streets rather than the freeway.

The most substantial change to transit during construction would be the closure of the Montlake Freeway Transit Station. When the station is closed, some transit riders would need to use different routes and bus stops as follows:

- People traveling to Montlake/UW from the east side of Lake Washington would need to transfer to University District buses at one of the Eastside freeway transit stations.
- People traveling to the east side of Lake Washington would need to board a University District bus on NE Pacific Street or on Montlake Boulevard East instead of using the freeway transit stop.
- People who use the Montlake Freeway Transit Station to travel between Montlake and downtown Seattle would need to ride a different local bus during the construction period.

Some riders could require an additional transfer to reach their destination. Additional bus service between the University District and the Eastside, such as Sound Transit Route 542, would accommodate the passengers affected by the closure of the Montlake Freeway Transit Station. During construction of the Preferred Alternative, the

Evergreen Point Road Freeway Transit Station would remain open to allow passengers to transfer between buses bound for Seattle and the University District.

The existing bus stops on Montlake Boulevard at SR 520 would be moved to nearby locations beginning at about year 3 of construction. Users transferring to and from SR 520 buses could transfer at the Montlake Triangle or East Shelby Street instead. The existing local bus stop on southbound 10th Avenue East would remain open during construction, but would require a minor relocation while the 10th Avenue East bridge is reconstructed.

Transit operations and facilities would be affected by temporary lane alignments and reconstruction of the bridges over SR 520 at 10th Avenue East and Montlake Boulevard East. Metro operates electric trolley buses in both locations. These buses are powered by fixed aerial wires above the travel lanes. When the lane alignments are changed, temporary overhead trolley wires would need to be installed or other transit facility provisions would be required to maintain service on the routes served by trolley buses.

Transit operations during construction would be affected by the same conditions that affect overall local street operations. Travel times are not expected to change substantially through year 4 of construction. Travel times would improve during year 5 due to temporary roadway improvements along Montlake Boulevard. In year 6, the Montlake Boulevard East bridge would be reconstructed. Southbound routes to SR 520 on Montlake Boulevard could incur travel time increases of 2 to 4 minutes. During year 7, the eastbound SR 520 loop ramp would be closed for construction. The resulting temporary road configurations would improve travel times for some routes and reduce travel times for others. Routes with reduced travel times would be the southbound Montlake Boulevard routes going to SR 520 and the northbound local routes on Montlake Boulevard.

Nonmotorized Facilities

The presence of construction activities in the Montlake area would affect bicycle and pedestrian access, particularly for north-south travel. The Bill Dawson Trail and the 24th Avenue East bridge would be closed for most of the construction period. Bicyclists and pedestrians would be detoured to Montlake Boulevard, which would remain open for non-motorized travel throughout construction.

The Bill Dawson Trail would be occupied by a construction access road during construction of the Portage Bay Bridge and portions of the Montlake lid. The trail would be rebuilt near the end of the construction period. The 24th Avenue East bridge would be demolished in year 2 of construction. Although the bridge would reopen within 2 years, access north of the bridge and the westbound SR 520 off-ramp would not be available due to construction activities.

During construction of the west transition span, the portion of the Foster Island Trail currently under the bridge would be closed. The trail would remain open at other times during construction. Access to the Foster Island Trail from East Montlake Park would not be affected.

Parking

Construction would affect parking at six locations in the study area. Four of the locations would not be substantially affected by the reductions in parking because utilization is low or the remaining parking supply would be sufficient to meet demand. These locations include Bagley Viewpoint, MOHAI/East Montlake Park, 24th Avenue East near MOHAI, Husky Stadium lot E11, and the WSDOT Public Lot on Lake Washington Boulevard.

The on-street parking along Lake Washington Boulevard, east of Montlake Boulevard would be unavailable during construction of the Montlake Lid. This area accommodates parking for about 35 vehicles.

The remaining parking area, at NOAA Northwest Fisheries Science Center, utilizes 38 spaces located on WSDOT right-of-way under Portage Bay Bridge. These spaces would not be available during construction and an additional 15 spaces on NOAA property are estimated to be occupied by construction activities. Alternative parking would be needed for approximately 40 vehicles at this site.

What are the key findings for cumulative effects?

This analysis determines the effects of the Preferred Alternative in combination with other improvements to regional transportation facilities that were not included in the direct effects analyses described in Chapters 5 through 10. Because the analysis year for direct effects was 2030, the results included effects of projects that were planned and programmed (funded) to be completed by that time. The cumulative effects analysis also includes projects that are planned to be completed by 2030, but were not programmed or funded at the time of the direct effects analysis. This analysis includes the evaluation of reasonably foreseeable regional pricing strategies by the year 2030 for the I-90, I-405, and SR 99 corridors, as well as the SR 520 toll included in the Preferred Alternative.

WSDOT drew the following conclusions about travel demand in the cumulative effects scenario of the project:

- Total traffic crossing the SR 520 corridor is forecasted to increase by 7 percent in the cumulative effects scenario compared to the Preferred Alternative. This is a 1 percent increase in total traffic compared to the No Build Alternative. All of the increase in volume compared to the No Build Alternative would occur in the HOV lanes. The SR 520 corridor HOV lane would have adequate capacity to accommodate this level of increase. This means that if the regional projects assumed in the cumulative effects scenario are implemented in conjunction with the SR 520, I-5 to Medina project, more person trips would likely be made across Lake Washington using SR 520. In addition, traffic conditions within the SR 520 corridor may fall somewhere between what has been estimated with the No Build and Preferred Alternatives in the Final EIS.

- Because the SR 520 Program completes the HOV lane system between Redmond and Seattle, and assuming carpools and transit would not be required to pay a toll, a considerable increase in HOV demand would occur along SR 520 with the Preferred Alternative compared to the No Build Alternative. The combination of reduced travel time and cost avoidance is a powerful incentive for carpool and transit use. An additional, but smaller, increase in carpool demand is also projected in the cumulative effects scenario compared to the Preferred Alternative, which introduces a toll on I-90.

- Total net peak and daily cross-lake vehicle travel under the cumulative effects scenario would be lower when compared with the No Build Alternative and Preferred Alternative. However, the number of peak and daily cross-lake HOV vehicle trips is expected to increase while the number of cross-lake, general-purpose trips would decrease.

- Cross-lake vehicle trips would decrease at a higher rate than person trips. This means that more people would be moved by fewer vehicles under the cumulative effects scenario than with the No Build Alternative and Preferred Alternative.
- Total cross-lake HOV travel would increase under the cumulative effects scenario compared to the No Build Alternative and Preferred Alternative. This increase is due to the increasing shift to HOV travel that would result from the implementation of tolls on both SR 520 and I-90.

Internal traffic circulation on the Eastside would improve and more trips would likely remain on the Eastside. These effects would be due to the introduction of tolls on SR 99 and I-90, as well as capacity improvements along regional corridors such as I-405 and SR 167. Therefore, the volume across the cross-lake screenline is expected to decrease, while volumes across screenlines on the Eastside are projected to increase under the cumulative effects scenario.

Chapter 3—Travel Demand Modeling

What is in this chapter?

This chapter provides a general overview of travel demand models, how these models estimate future traffic volumes, why there can be multiple versions, and when the most opportune time is to change models during a project's life time. It also documents the history of the SR 520 demand models and the strategy for potential future changes to travel demand modeling efforts. Chapter 4 describes travel demand modeling assumptions used in the analysis for the SR 520, I-5 to Medina project.

What is travel demand?

Travel demand refers to the number of people who want to go from one location to another by each mode of travel. Travel demand is based on a theory of how land use, people, and the transportation network interact. It is estimated using the *4-Step Process,* which is shown in Exhibit 3-1 and described below.

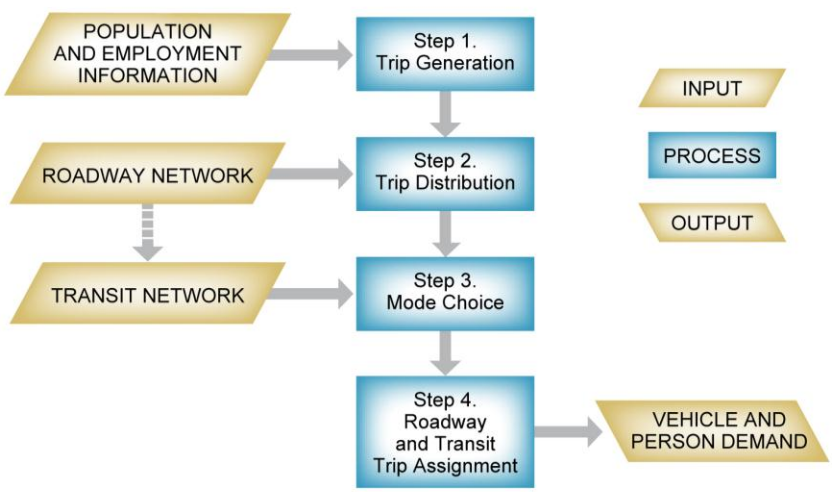


Exhibit 3-1. **4-Step Process for Estimating Travel Demand**

Trip generation – The first step in the *4-Step Process* estimates the number of trips that result from a particular place, such as a shopping mall, a residential neighborhood, a business district, and many others.

Trip distribution – The trips generated by each place go to a variety of different areas. This second step estimates the proportion of trips from a given area that goes to each of the other areas in the region. Specific routes and travel modes are not yet determined. Put simply, the number of people who want to go from place to place is determined, but not how they will travel.

Did you know?

Travel "mode" refers to the type of transportation vehicle or means of moving from one point to another. For example, cars, buses, trains, bicycles, and walking are different travel modes.

Mode choice – The third step estimates the proportion of trips that will use each travel mode. For example, while steps 1 and 2 estimate the number of people that will travel from one area to another, mode choice estimates the percentage of people who decide to drive alone, take the bus, or ride their bicycles. The mode choice is based on different factors that people consider when choosing how they want to travel for a particular trip. These factors include the cost of parking, travel time, and comfort of the trip.

Trip assignment – The last step determines the specific routes that trips will take through the transportation network from one area to another. The routes are usually freeways and arterial roadways, but may include other alternatives such as railways and passenger ferries.

What is a regional travel demand model?

A regional travel demand model is a software tool that applies the *4-Step Process* to large, complex networks of neighborhoods and transportation facilities. These types of models are used by transportation planners to estimate how people are likely to travel throughout a region and how travel patterns in the region would change as a result of different planning actions under consideration. These actions can include changes such as:

- Adding roadway capacity (lanes)
- Adding or changing transit service
- Tolling roadways
- Closing roadways
- Increasing parking rates
- Providing incentives for transit use (e.g., bus passes)
- Changing land development conditions

A regional travel demand model has three primary components: land use data, transportation network, and a variety of mathematical formulas (or algorithms) that determine the amount of interaction among the transportation network elements.

Land use data consist of population and employment forecasts for any given region. The forecasts are prepared at levels of geographic detail that can be further broken down to perform model analysis for specific purposes.

The transportation network includes freeways, highways, arterials, and bus/rail/ferry transit routes. Local roadways, specific intersection design, and traffic signal operations are not generally included in regional travel demand models.

The mathematical algorithms are formulas or rules that determine how travel demand will be distributed among the various destinations, modes, and routes that people can use to complete their trips.

Who creates this regional travel demand model?

PSRC is the Metropolitan Planning Organization (MPO) for the four-county region of Snohomish, King, Kitsap, and Pierce counties. PSRC works with the state, ports, transit agencies, tribes, local governments, businesses, and citizens to create a long-term vision for the region with respect to land use, economic development, and transportation.

PSRC is responsible for distributing federal transportation funding, developing policies, and making decisions on regional issues. Among other planning activities, PSRC develops and updates a region-wide transportation plan and a regional travel demand model.

The regional travel demand model covers PSRC's four-county jurisdiction and includes broad information about land use (population and employment data) and primary roadways in the region's transportation network. Because of the geographic expanse of the model, localized land use data and roadways are excluded.

Did you know?

Metropolitan Planning Organizations (MPOs) are required by federal regulation for urban areas, with a population larger than 50,000, which receive federal transportation funds. Each MPO has a board that represents local agencies and a staff of planners and other professionals who develop the regional transportation plan.

Can there be more than one version of a regional travel demand model?

There are a variety of reasons to have different models depending upon the scope of analysis, geography of interest, and the level of detail required in outputs. The goal of every analysis is to answer a specific set of questions that are unique to the situation being examined. Depending on the questions that are being asked, a variety of different tools can be used.

At the core, a model is a complex set of calculations that help estimate the differences resulting between proposed alternatives. As long as the same tools are used to estimate results among a set of alternatives, these alternatives can be compared to each other in a valid way. Thus, it is important to ensure that there is a consistent set of assumptions for the general demographic forecast—the foundation of the model.

Why do models change?

Regional travel demand models can change over time for a variety of reasons. Some are as simple as updates to the model networks and population and employment forecasts. Other changes can be more complicated and involve the overall model structure, including changes to functions that estimate how many people will travel between certain locations and how they will choose modes of travel. One example is the addition of tolling into the model, which would affect a person's decision to drive or take transit as a mode of travel.

Yet another potential reason for multiple versions of a travel demand model is a change in the type of model, such as transitioning from a traditional gravity-based model to a next generation activity-based model. Many metropolitan agencies, including PSRC, are changing to activity-based models, which allow them to answer more detailed questions about changes in land use and transportation.

The process of transitioning to a new type of model can take several years to complete due to the volume of data involved and the complexity of the testing process. This lengthy process requires that two travel demand models be used by different projects in the region at the same time so that valid analyses can be performed using the previous model while the new model is being tested and validated.

Did you know?

Traditional gravity models analyze aggregate, or grouped, trips from one area to another. The number of trips between areas is based on distance between areas, the cost of the trip, and the "weight" of each area. Weight refers to density of population or employment in an area.

Activity-based models estimate the behavior of people based on the activities that typical individuals engage in throughout the day. These models use complex sets of economic data describing how people make decisions about how they will travel based on the value of trips.

Because there can be multiple versions of a regional travel demand model at one time, a public agency or project could have a variety of versions from which to choose. The selection of a demand model version depends on the consistency of the demand model inputs and structure with the assumptions and purpose of the project. Every travel demand model is validated and calibrated for a specific project, at a specific time, and for a specific purpose.

What are project-level models?

Individual projects that focus on a specific area of the region use the PSRC regional travel demand model as a base model or starting point. Details are then added to develop a *project-specific* travel demand model. Examples of these details include local roads and intersections, interchange ramps, additional elements of the transit system, and adjustments to reflect how people access the transportation network.

This project-level analysis is the most common reason why multiple versions of a travel demand model are used. Regional travel demand models are built to test long-range plans and transportation policies at the broader four-county scale. As such, they are generally validated to a set of regional measures. This is sufficient for analysis that reports details at the county or regional level; however, further analysis and validation are required at a much finer scale to understand how the model works for localized, project-level improvements.

Corridor projects generally focus on a much smaller subsection of the region. As an example, even though the Evergreen Point Bridge has an effect on regional traffic movements, it is still only one small piece of the overall transportation network. The effects of SR 520 corridor changes on parallel facilities and smaller roadways that connect to it need to be understood, but the emphasis at the project level is on the effects of changes near the study area itself.

The scope of every project is different, and it is likely that every project will have some variation in its model. The key component that makes all the models consistent with one another is the long-range demographic forecast.

Can the project travel demand models change during the life of the project?

The project travel demand model can change during the course of the project. When the duration of a project spans several years, modeling information and assumptions become outdated. In these cases, making changes to update the project travel demand model is considered appropriate and desirable.

It is necessary to make changes to the project travel demand model at a specific point or points on the planning timeline. These points occur between phases of the project, after the results of one analysis are complete, and before a new analysis begins. For example, on the SR 520, I-5 to Medina project, a logical time to update the travel demand model occurred between the release of the Draft EIS and the analysis of project design options included in the SDEIS. The timing of these changes is important because of the way the model results are used.

The primary result provided by travel demand models is the *change* in demand associated with a particular action. Travel demand models are not intended to provide an absolute traffic volume forecast. This is because travel demand models include only major roadways and exclude minor roadways that carry traffic as well. Thus, although travel demand models can provide an approximate estimate of future travel demand, the emphasis should be placed on the *relative difference* between planning alternatives that are being compared. This difference is the *effect* of implementing an alternative.

Because the conclusions of an analysis are based on the *relative difference* between alternatives, different versions of the travel demand model can yield slightly different results for a single alternative. Therefore, it is important to use the same version of the model when comparing each alternative to accurately identify its effects.

How has the SR 520 travel demand model changed and how do the versions relate to each other?

Several travel demand models for the SR 520, I-5 to Medina project have been created to answer questions at different stages of the planning process. The first SR 520, I-5 to Medina project demand model was based on the 1998 PSRC regional travel demand model and was used for the Draft EIS. The primary purpose of this model was to estimate the change of travel demand on the SR 520 corridor given the completion of a 4-lane, 6-lane, or 8-lane Alternative. Each alternative included a toll on the SR 520 corridor as part of its definition.

Prior to analysis for the SR 520, I-5 to Medina SDEIS, the project demand model was updated to represent the most current transportation network, tolling assumption, land use, and transit data. The SR 520 demand model used for the SDEIS was the same version as the Draft EIS, but with the updates that were developed after publication of the Draft EIS. Several other planning efforts involving travel demand modeling have been completed for the SR 520 corridor. These planning efforts include the HCT Plan, the SR 520 Finance Plan, the Lake Washington Congestion Management Project, and the Tolling Implementation Committee (TIC). The common element in all these versions is that, even though the math may be slightly different among models, the basic inputs are the same. The same land use forecasts as well as local and regional highway and base transit assumptions are internally consistent among the analyses.

> Did you know?
>
> **A Tolling Implementation Committee (TIC)** was required by state legislation to evaluate the regional effects of various tolling alternatives on SR 520 and I-90 crossing Lake Washington.

The HCT planning effort used the SR 520, I-5 to Medina project travel demand model as a base to conduct transit forecasting. The HCT travel demand model included modifications and infrastructure changes that were assumed to be in place if high capacity transit is added to SR 520 in the future.

> Did you know?
>
> **The Urban Partnership Agreement** is part of a federal program to study and evaluate congestion management strategies for SR 520, including tolling. It may result in federal funding for congestion relief elements on SR 520.

The SR 520 Finance Plan was released in January 2008 to inform legislators about possible funding that could result from several sources, including tolling. A different version of the SR 520 demand model was developed for that effort to estimate the effects of several tolling scenarios on SR 520 travel patterns. This version of the SR 520 demand model minimized the estimated travel demand on SR 520 to avoid over-estimating revenue.

> Did you know?
>
> **The PRSC Version 1.0a model**, released in early 2008, was an interim release of the new PSRC Version 2.0 demand model. It included fundamental changes to address prior limitations in evaluating the effects of tolling projects.

A related study was completed for the TIC in 2008 to answer questions regarding the effects of tolling cross-lake travel. Transportation data generated by the TIC were used in the Environmental Assessment produced for the Urban Partnership Agreement. The TIC focused on the differences between several cost structures for tolls. The models used in these studies were based on PSRC's Version 1.0a travel demand model.

Although several versions of the SR 520 demand model exist, each version was appropriate at the time of the analysis and for its intended purpose. They allowed a sound comparison of the relative differences among alternatives to identify the effects of a particular action.

Which model version is being used for the Final Environmental Impact Statement?

For the SR 520, I-5 to Medina project Final EIS, the decision was made to update PSRC's Version 1.0a travel demand model (also known as Version 1bb). This model was selected, in part, because it was the current version available for use at the time the Final EIS transportation analysis was initiated; moreover, it is the same version used to support the 2008–2009 SR 520 Finance Plan, Lake Washington Congestion Management Project, and TIC planning efforts described above.

For this model, both highway and transit networks were updated again to reflect base year (2006) conditions. In addition, a detailed model update, refinement, and validation process was applied to the primary travel corridors, including and surrounding the SR 520 corridor, to enhance the model's performance for base year (2006) conditions. This update included a sensitivity test and comparison of actual and estimated trip ends between 2006 and 2010. The validated 2006 model was refined and enhanced to ensure that a solid foundation had been laid for developing future forecasts to support the Final EIS transportation analysis.

What is the strategy for future SR 520 travel demand model efforts?

WSDOT will continue to coordinate with all other planning efforts that use travel demand modeling to answer questions about the SR 520 corridor. Examples of such efforts could include an update to the SR 520 Finance Plan and selection of future toll rates for SR 520. Project administrators will communicate with PSRC, King County, Sound Transit, and the City of Seattle to ensure that modeling assumptions for SR 520 are compatible with current regional planning assumptions.

These agencies will help identify and establish the base PSRC model version and any other data updates, including transportation network changes. If another new PSRC version is adopted in the future, these agencies will help to assess the potential need to replace the travel demand model.

Chapter 4—Transportation Forecasts and Operations Analysis Methodology

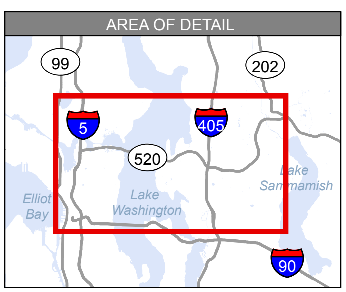
What is in this chapter?

This chapter describes the methodologies used in the project's transportation analysis. The first part of the chapter describes the methods for forecasting *freeway* traffic volumes and analyzing freeway operations in year 2030 without and with the project. The second part describes the methods for forecasting year 2030 *local street* volumes and analyzing intersection operations without and with the project.

Study Area

Although the project itself is limited to replacing SR 520 between I-5 and Medina, the transportation study area extends beyond project construction boundaries onto I-5 and I-405 to account for traffic interactions between the freeways. Exhibit 4-1 illustrates the difference between the project limits and study area. Traffic volumes and congestion are discussed for SR 520, I-5, and I-405 because SR 520 is affected by how the other two highways operate. The study area for this analysis included the following freeway segments and associated ramps and interchanges:

- SR 520 between I-5 in Seattle and SR 202 in Redmond
- I-5 in Seattle between NE 45th Street and south of the I-90 collector-distributor north connection to the main line
- I-5 express lanes between Northgate and 5th Avenue/ Columbia Street in Seattle
- I-405 between NE 70th Street in Kirkland and NE 4th Street in Bellevue



- Analyzed Interchange Area
- I-5 to Medina Project Limits
- Medina to SR 202 Project Limits
- Transportation Study Area in addition to Project Limits
- Interchange Influence Area

N

0 0.5 1 2 Miles

Source: King County (2008) GIS Data (Streams, Streets and Waterbodies) and CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 4-1. **Transportation Analysis Study Area**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

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Analysis Process

The process of forecasting travel and analyzing traffic operations consists of a series of steps in which each one builds upon information from the previous step. A simple depiction of this process is shown in Exhibit 4-2. The following sections provide an overview of data collection, travel demand modeling, traffic forecasting, and traffic operations analysis. This process of forecasting and analysis culminates in the documentation of freeway and local street transportation effects contained in Chapters 5 and 6 of the Transportation Discipline Report.

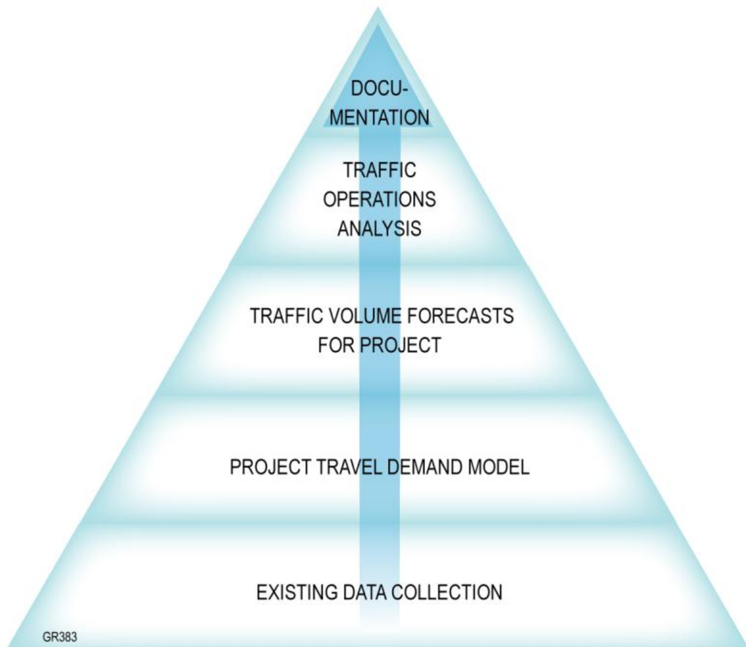

Exhibit 4-2. **Forecast and Operations Analysis Process**

How were travel demand and traffic patterns determined?

As described in Chapter 3, the project travel demand model was used to forecast year 2030 freeway traffic volumes without and with the project. These forecasts were used to assess the potential project effects on roadway operations throughout the study area. Travel demand models consider changes to the transportation network as well as changes in population and employment.

The SR 520 Bridge Replacement and HOV Project Base Year Validation Analysis Technical Memorandum (WSDOT 2010b) describes the attributes that were updated and refined specifically for this project, such as ramp connections, numbers of lanes, and roadway speeds.

The project travel demand model was used to forecast future traffic volumes and patterns. Existing travel usage must be well understood and represented by the model before future travel can be forecasted.

WSDOT collected existing traffic volume data for the study area freeways and major local streets for use in the travel demand modeling and traffic volume forecasting. The existing data was first used to verify that the regional travel demand model correctly represented existing regional traffic volumes and patterns—a process known as validation. The travel demand model output was calibrated to within 10 percent of existing traffic count data across select checkpoints (screenlines), which is considered standard practice for this type of analysis.

After the model was calibrated for existing conditions, it was updated to represent year 2030 No Build Alternative conditions. The No Build Alternative includes regional roadway and transit network improvements that were planned and programmed (funded) at the time of analysis. Projects that were proposed but not programmed at the time of analysis are included in the transportation cumulative effects analysis described in Chapter 11. The year 2030 No Build Alternative for the SR 520, I-5 to Medina project is based on the assumption that the following key transportation projects will be completed as planned:

Freeway

- SR 520—SR 520, Medina to SR 202 project, which will expand the HOV system, improve transit time and reliability, and enhance public safety
- SR 520—West Lake Sammamish Parkway to SR 202 Project, which will widen SR 520 in Redmond from two to four lanes in each direction
- I-90—Two–Way Transit and HOV Operations Project, which will add HOV lanes to the I-90 outer roadway between Seattle and Bellevue
- I-405—Widening and interchange improvements as funded by the Nickel funding package (enacted by the 2003 State Legislature) and the Transportation Partnership Act package (enacted by the 2005 State Legislature)

- SR 99—Alaskan Way Viaduct Replacement Project, which would replace the current elevated structure with a bored tunnel beneath downtown Seattle

Local Projects

- Mercer Corridor Improvement—Phase 1
- Spokane Street Viaduct
- Northup Way—120th to 124th Avenue NE eastbound widening project

Transit

- Light rail between Federal Way and Lynnwood
- Light rail station at Husky Stadium
- Light rail between Seattle and Overlake
- Tacoma Light Rail
- Seattle Streetcar
- Sounder Commuter Rail between Everett and Seattle
- Sounder Commuter Rail between Lakewood and Seattle
- King County Transit Now

The Final EIS Year 2030 Cumulative Effects Definition Technical Memorandum (WSDOT 2010c) contains detailed information about these travel demand model assumptions. They include all projects that were assumed to be complete by 2030, planned transit service, and other assumptions coded into the project's travel demand model for the No Build Alternative.

Adjustments were also made to reflect expected changes in inflation and land use,[1] specifically future population and employment growth forecasts, for the year 2030. These elements are major factors that influence travel behavior and patterns.

[1] Land use information was developed and provided by PSRC.

The project's travel demand model was then used to estimate changes in regional traffic demand volumes and patterns between now and the year 2030 with the No Build Alternative. Traffic demand volumes were forecasted at several "checkpoints" (screenline locations) along the freeway and at interchange influence areas. Interchange influence areas include the local streets and intersections surrounding an interchange that could be affected by changes to SR 520.

> **Did you know?**
>
> A **screenline** is an imaginary line across a section of freeway or arterials. Screenlines are often used in traffic analyses to determine how much volume is entering or exiting a particular area based on how much traffic crosses the screenline.
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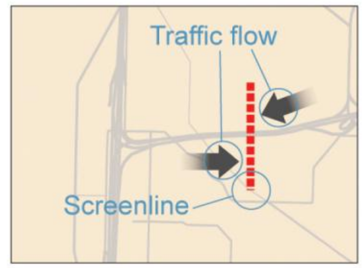
> 
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The percent growth in traffic demand between now and the year 2030 was then applied to existing traffic count data to forecast detailed traffic volumes within the study area. Existing traffic count data were used as a baseline so that forecasts were built on actual volumes and travel patterns.

After forecasting travel demand for the year 2030 No Build Alternative, the transportation network for the Preferred Alternative was coded into the travel demand model. The *network* for the Preferred Alternative describes the features of the roadways such as numbers and types of lanes (general-purpose and HOV), intersections, and interchange ramp configurations. In addition to the transportation networks, the following operational assumptions were included in the Preferred Alternative:

- Electronic tolling on SR 520 between I-5 and I-405
- Toll rates vary by time of day on a fixed schedule
- Transit and carpools (3+ persons) exempt from tolling
- No change in transit service compared to the No Build Alternative

Complete details about the travel demand modeling for the Preferred Alternative are published in the No Build and Preferred Alternatives Technical Memorandum (WSDOT 2010d).

After the networks and assumptions were coded, the process described for the No Build Alternative was then repeated to determine how the Preferred Alternative would affect traffic demand compared to the No Build Alternative.

Identifying Freeway Screenline Locations

Screenlines were selected to determine key travel patterns adjacent to and within the project limits. Screenlines on SR 520 between I-5 and I-405 represent the locations where traffic enters and exits the study area. Screenlines adjacent to the I-405 and I-5 interchanges with SR 520 were necessary to determine travel patterns to and from the adjacent freeways. A screenline at the middle of Lake Washington on SR 520 was chosen to determine vehicle demand crossing the lake. Screenlines on I-405 and I-5 provide information about the effects that changes on SR 520 might have on adjacent travel routes.

Identifying Interchange Area Boundaries

Interchange influence areas were identified as areas where similar growth in traffic was expected. Each influence area includes one or more interchanges. Some interchanges were grouped because of their similarities in serving traffic to and from adjacent neighborhoods.

The following interchange influence areas near SR 520 and I-5 were identified:

- SR 520/Montlake Boulevard. Traffic on SR 520 destined to the University District, Madison Park, Capitol Hill, Central District, and Madrona may take either Lake Washington Boulevard or Montlake Boulevard; therefore, these interchanges were grouped together.
- I-5/NE 45th Street. This is a single interchange area, and the growth patterns were assigned based solely on information from this location.
- SR 520/I-5/East Roanoke Street. This interchange area serves the neighborhoods adjacent to I-5, north Capitol Hill, and Eastlake. Traffic growth in these areas is similar, and they were combined to assess an overall local growth rate for this area.
- I-5/Mercer Street. This interchange serves neighborhoods north of downtown Seattle, including Queen Anne, and the growing South Lake Union neighborhood.
- I-5/Stewart Street. This interchange serves traffic to downtown Seattle and has connections to the I-5 main line and express lanes.

What time periods were evaluated and why?

Traffic volumes were forecasted for three time periods: daily, morning, and afternoon. Daily volumes were forecasted for one location on SR 520, I-90, and SR 522 to provide information on overall cross-lake travel changes without and with the project. Morning and afternoon commute period forecasts were completed for the SR 520 main line, ramps, and adjacent arterials to use in the operations models. Comparing the relationship between daily and peak period traffic volumes helps define how people might react to increases in congestion (longer travel times) and changes in travel costs (tolling).

Morning and afternoon traffic forecasts were prepared for two 5-hour periods: 5 a.m. to 10 a.m. and 2:30 p.m. to 7:30 p.m. Congestion currently occurs along SR 520 for several hours during both the morning and afternoon commutes. Because traffic volumes are expected to increase over the next 30 years, a 5-hour peak period was selected for traffic volume forecasting and analysis. This selection allowed WSDOT to determine how the peak period might change with traffic volume increases by the year 2030. Traffic forecasts and operational analysis results are reported here for the peak 3 hours (6:00 to 9:00 a.m. and 3:00 to 6:00 p.m.).

In what terms do we discuss traffic volumes and patterns?

Traffic forecast volumes are generally described in terms of vehicle demand, person demand, and mode choice. The purpose and need statement for the SR 520 Bridge Replacement and HOV Project states: "…the purpose of the project is to improve mobility for people and goods across Lake Washington." The best way to measure the improvement of mobility is two-fold. First, assess the person demand associated with any specific action on the corridor; second, measure how many of those people are actually served during a specified time period.

The process of forecasting traffic volumes estimates person demand with the year 2030 No Build Alternative and Preferred Alternative, while the freeway operations analysis measures how many people are served, or throughput. Demand is discussed below and throughput is discussed in more detail later in this chapter.

Demand

Demand refers to the number of vehicles or people that want to use the freeway during a given time period. Traffic demand volumes are based on the project's travel demand model. Person-trip demand was calculated based on the HOV (carpool and bus) and general-purpose vehicle demand and throughput, including the assumed average vehicle occupancy (AVO) that was consistent with the project travel demand model.

Mode Choice

Mode choice refers to the type of transportation a person chooses to use, such as driving alone (general-purpose), taking a bus, or carpooling. Person demand and vehicle demand can both be described by mode (i.e., the number of people taking the bus or the number of vehicles that can be classified as carpools). The mode choices used in the traffic forecasts include general-purpose, carpool (3+), and bus.

Did you know?

AVO (average vehicle occupancy) is a term used to describe the average number of persons per vehicle.

The following AVO assumptions were made for the operations analyses:

1.33 persons per general-purpose vehicle

3.15 persons per HOV vehicle

65 persons per bus

How was transit demand estimated?

Vehicle- and person-trip forecasts for buses were based on the travel demand model forecasts. The number of buses was estimated using the following information provided by the transit agencies:

- For Metro, it was assumed that the increase in transit service planned for the Transit Now program will account for growth between 2006 and 2016, and a 1 percent per year increase in service hours between the year 2016 and 2030.
- For Sound Transit, it was assumed there would be an approximate 14 percent increase in total service hours between the base year (2006) and 2013 (or about 1/2 percent per year), but no increase after 2013.

The transit person demand forecasts were not constrained by transit volume and service forecasts. In other words, the transit demand volumes represent how many people would choose transit regardless of how many buses were forecasted to be on the roadway. This provides data for the local transit agencies to use when determining future bus service, such as route changes (additions, deletions, extensions in routes), improved frequencies, or bus type (standard or articulated).

How were freeway traffic operations analyzed?

Travel demand forecasts help to determine how many vehicles and people would like to use the roadway. These volumes are input into a traffic simulation model to help engineers determine how much of the vehicle and person demand may actually be served by the proposed roadway design. The amount of traffic served is referred to as throughput. While the travel demand model uses planning level roadway capacity to estimate route travel time information (two of the biggest factors that influence corridor demand), it does not consider the more detailed throughput effects of roadway operations such as lane changes, grades, merges, and shoulder widths.

The freeway operations analysis in the Final EIS and SDEIS used the same methodology as in the Draft EIS, with the exception of the following two elements:

1. In the Draft EIS, the CORSIM software model included I-5 south to Spokane Street. However, in the Final EIS and SDEIS, the analysis ended at the northern terminus of the collector-distributor lanes, just south of the Convention Center. The operations analysis leading into the Draft EIS included the 8-Lane Alternative, which affected traffic volumes on I-5 near I-90 when compared to the No Build Alternative. The 8-Lane Alternative is not being considered further in the Final EIS or SDEIS. The 6-Lane Build Alternative had similar volumes as the No Build Alternative south of downtown Seattle and north of the I-90 collector-distributor ramps, so the additional travel demand modeling was not necessary.
2. The Final EIS and SDEIS include the 6th Street HOV ramps in downtown Bellevue, which were constructed following the Draft EIS analysis.

The CORSIM software program was used, which is a micro-simulation package developed by FHWA to simulate traffic operations on the SR 520 corridor as well as sections of the I-5 and I-405 corridors. CORSIM provides detailed simulation output, including animation and performance data, for freeway, ramp, and HOV operations. This information was used to evaluate operational differences between the No Build Alternative and the Preferred Alternative. Exhibit 4-3 shows an example of the CORSIM model animation screen.

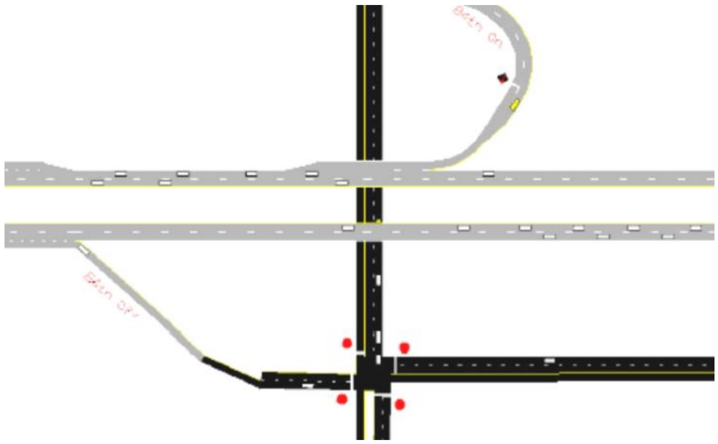


Exhibit 4-3. **CORSIM Micro-Simulation Model Animation Screen**

Exhibit 4-4 outlines the process used to analyze the alternatives. The first step in the process was to verify that the simulation model correctly represented existing freeway operations—a process known as calibration. The CORSIM model was calibrated against existing WSDOT freeway count data to ensure that the model's output for the morning and afternoon peak periods was accurately representing current volumes and operations of the freeway main line and ramps. Most locations were calibrated to within 5 percent of actual volumes. Congestion and travel times verified from the model reasonably matched field observations and data from WSDOT loop detectors. Existing data from October 2008 were used in the calibration effort.

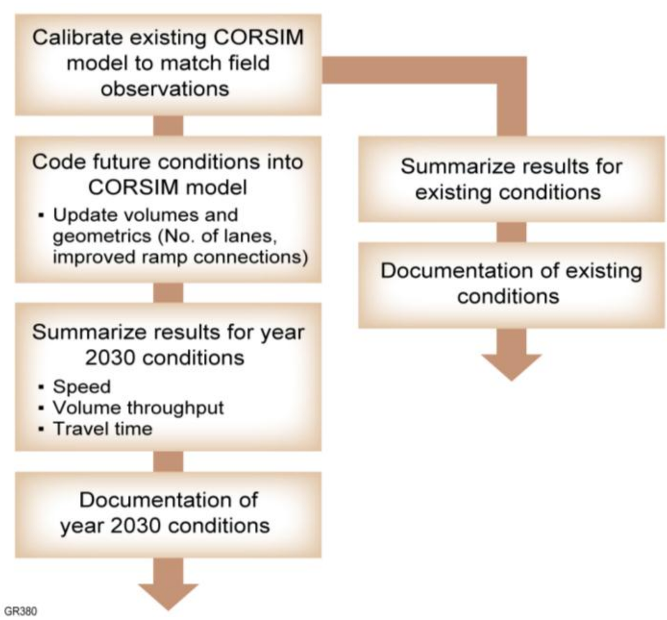


Exhibit 4-4. **Alternatives Analysis Process**

What are the measures of effectiveness for the freeway operational analysis?

WSDOT developed the following five measures of effectiveness (MOEs):

1. Congestion (queuing)
2. Speed
3. Travel times
4. Vehicles served (or vehicle throughput)
5. Persons served (or person throughput)

These MOEs were used to evaluate and compare traffic operations between the No Build Alternative and Preferred Alternative. Exhibit 4-5 shows how the MOEs were used to define freeway congestion. Each MOE is described in greater detail below.

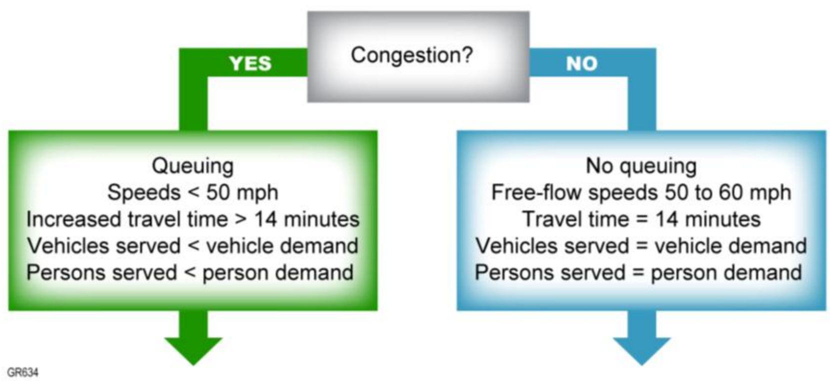


Exhibit 4-5. **Understanding Congestion and Measures of Effectiveness**

Congestion

Congestion and backups occur at locations where traffic demand exceeds the capacity of the roadway, limiting how many vehicles and people can be served. Congestion is defined as taking place in freeway sections that operate at speeds of less than 50 mph. Congestion may occur at on- or off-ramps because of weaving activity or changes in the number of lanes, lane widths, grades, or other physical characteristics.

Congestion is measured by its duration (minutes or hours) and its length (in feet or miles). Congestion locations were identified for the

No Build Alternative and Preferred Alternative based on CORSIM model results.

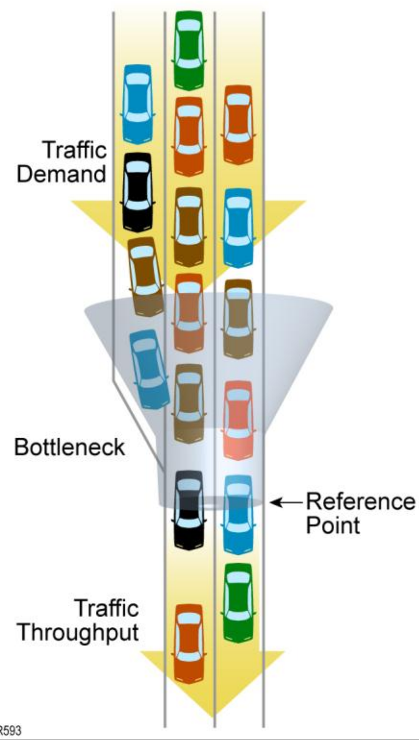
Speed

Travel speeds are a function of congestion and roadway design. Freeway traffic operating at speeds exceeding 50 mph is considered a free-flow condition. Traffic operating at speeds between 30 and 50 mph indicates moderate congestion, while speeds below 30 mph indicate a highly congested condition. Traffic operations along the freeways are summarized in 10-mph intervals between zero and 50+ mph.

The CORSIM model provided speed data in 15-minute intervals at each location along the SR 520 corridor. The data were then plotted on charts at various locations to provide a three-dimensional perspective of corridor operations, including time, space, and speed. These charts are called congestion diagrams and are shown for SR 520 in Chapter 5, which also presents the results of the CORSIM analysis.

Did you know?

A congestion point is similar to a funnel. If you pour in more liquid (demand) than can exit (traffic served, or throughput), then the funnel overflows (congestion occurs).



Travel Time

The team calculated travel time for the No Build Alternative and Preferred Alternative to measure the delay that drivers would experience on the corridor. Travel time is directly related to corridor speed, which was calculated using the CORSIM model corridor speed data. Travel time was calculated between I-5 and SR 202, which extends beyond the project limits. The study area was extended to SR 202 because some of the benefits of the Preferred Alternative would be realized outside of the project limits. Comparing the travel times between SR 202 and I-5 is an effective way to identify those benefits.

Throughput

Throughput refers to the number of vehicles or people that are moving beyond a point of reference during a given time period. This number is compared to the forecasted vehicle and person demand, which helps determine the effectiveness of the Preferred Alternative compared to the No Build Alternative.

Vehicle throughput is controlled by the roadway capacity, which is determined by several factors, including number of lanes, roadway geometry, and traffic control devices. For uncongested locations, vehicle demand equals vehicle throughput. For congested locations, demand is always higher than throughput because of over-capacity conditions. Demand that cannot "get through" is not served and backs up, creating congestion. These vehicles are eventually served during later time periods. A funnel analogy showing the relationship between traffic demand and throughput is illustrated in the right-hand column.

Person throughput is controlled by two factors: vehicle throughput and vehicle occupancy. Vehicle occupancy refers to the average number of people traveling in a vehicle. If more people travel in each vehicle, person throughput increases. The capacity for person throughput may be thought of as the number of available "seats" in vehicles. This is why transit is very effective at moving people—because transit vehicles have many seats, they have the capacity for high occupancy per vehicle. When HOVs are included in the transportation system, an analysis of mode choice is performed to estimate how many people are likely to choose alternative modes of travel, such as buses. When people choose to travel by high-occupancy modes, the people-moving capacity of the roadway is increased.

How were local traffic volumes forecasted?

Using the same methodology as the Draft EIS and SDEIS, the following steps were taken:

1. Identify growth rates for interchange influence areas. Growth in local traffic volumes was calculated using an area-wide growth rate that encompassed major arterials within an interchange influence area.

2. Identify interchange peak hour. Future traffic volumes were forecasted on local streets for one morning and one afternoon peak hour within the peak periods identified for the freeway.

3. Distribute freeway ramp traffic. Future freeway volumes were distributed through the local roadway system during the morning and afternoon peak hours using existing intersection turning movement ratios.

4. Forecast local traffic. After ramp traffic was distributed through the system, local traffic volumes not associated with the freeway ramps (e.g., people traveling between their home and a local shopping area) were increased to reach the growth rate identified in the influence area.

How did we apply our methodology to local traffic forecasts?

Growth in local traffic volumes was calculated using an area-wide growth rate that encompassed many local roads within each interchange influence area. The interchange area boundaries were drawn where the influence of the freeway ramp volumes on the local street system is the same between the No Build Alternative and the Preferred Alternative. This process is discussed further later in this chapter.

Identifying the Interchange Peak Hour

The volume of traffic on local streets not accessing the freeway can peak at different times in different areas regardless of when the adjacent freeway is peaking. Generally, local arterials peak for a single hour in the morning and in the afternoon.

Exhibit 4-6 depicts the relationship between the peak period and peak hour.

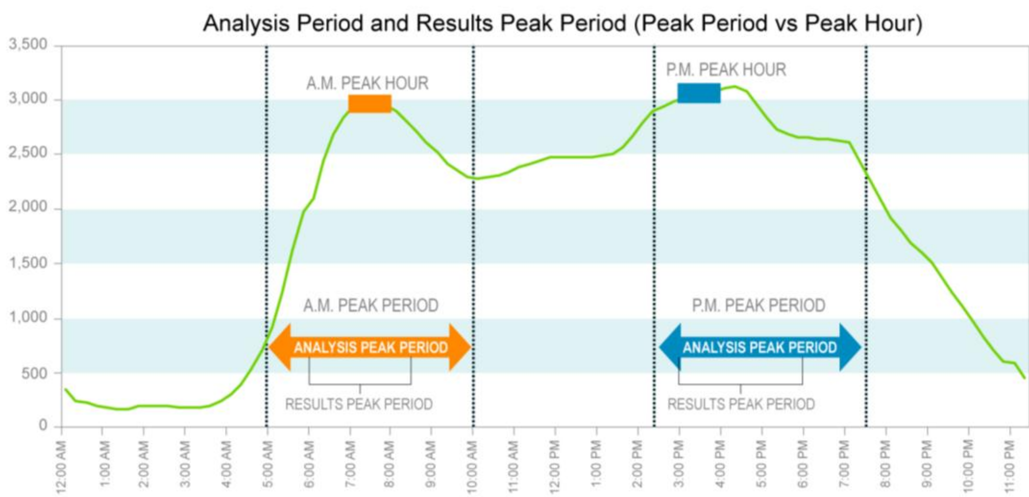


Exhibit 4-6. **Peak Hour Versus Peak Period**

Distributing Freeway Ramp Traffic

Traffic on local streets consists of two types: 1) traffic using local streets to primarily access the freeway, and 2) traffic using local streets to access other local locations. Traffic patterns were identified for both types by reviewing existing travel patterns and traffic volumes, and by considering the effect of new road connections and facilities.

Once the interchange peak hour and travel patterns were identified, freeway-related traffic volumes were distributed through the local network based on existing turning movement ratios observed at the intersections. For example, under existing conditions, if 10 percent of vehicles turn left at a given freeway ramp intersection, 60 percent go through, and the remaining 30 percent turn right, it was assumed that these ratios would be similar in the future.

Forecasting Local Street Traffic

After freeway traffic was distributed through the system, the target growth rate for the local area was applied to the local access traffic volumes. Local access traffic volumes were assumed to follow patterns similar to existing conditions, meaning that the turning movement ratios would not change substantially in the future except for where project options change the roadway network. For options that change the local roadway network, turning movement ratios were adjusted to reflect the new travel patterns based on changes to local traffic volumes throughout the interchange area.

Forecasting Pedestrian Volumes

Future pedestrian volumes were forecasted based on the North Link Final SEIS Addendum: Technical Memorandum on Traffic Operations Analysis and Construction Transportation Analysis (Sound Transit 2010a). This forecast includes pedestrian activity related to the Husky Stadium light rail station.

How were local traffic operations analyzed?

Traffic operations analyses were performed at intersections where the total approaching traffic is forecasted to increase by 5 percent or more for the Preferred Alternative compared to the No Build Alternative. The forecasts for the Preferred Alternative indicated that traffic volumes changed less than 1 percent with the Preferred Alternative at several intersections analyzed for the SDEIS. The intersections located in the following interchange areas were not analyzed for the Final EIS: SR 520/I-5/East Roanoke Street, I-5/NE 45th Street, I-5/Mercer Street, and I-5/Stewart Street.

The forecasted year 2030 traffic volumes were input into a model that analyzed intersection operations. Project engineers studied traffic operations at each ramp terminal intersection in the study area.

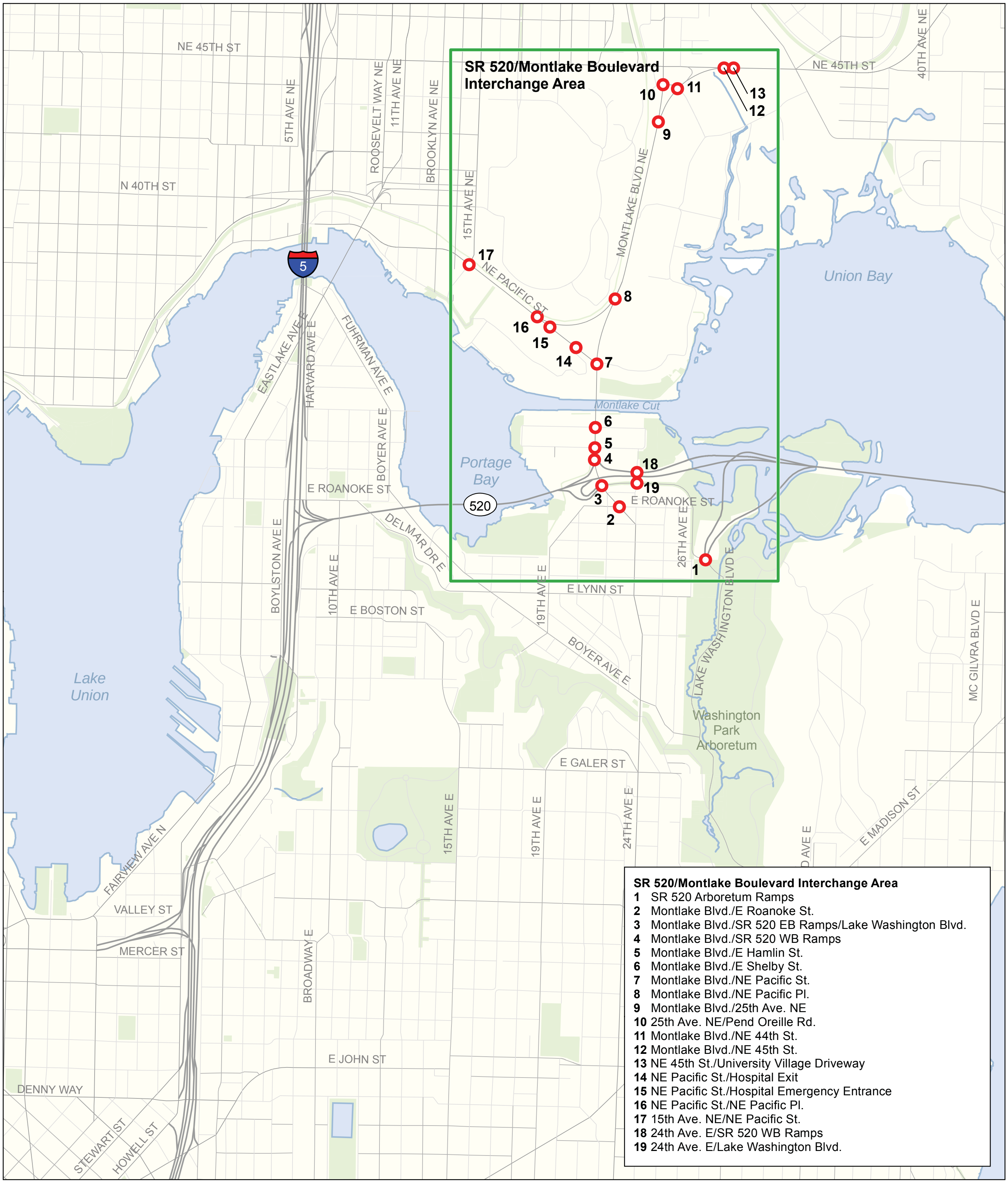
Exhibit 4-7 shows the interchange areas and intersections that were included in the traffic analysis for the Final EIS. The engineers also studied intersections adjacent to the ramp terminal intersections that would be affected by the project alternatives.

Current local street traffic operations were analyzed to provide a point of comparison to estimated future operations. The analysis results will enable local jurisdictions to know if, and to what degree, each alternative would meet their established standards for traffic operations.

A traffic modeling software package called Synchro was used to analyze local street traffic operations. Intersection operations were also evaluated because intersections control the capacity of the local street network. The evaluation used the forecasted traffic volumes during peak commute periods (specifically morning and late afternoon) for conditions in the base year (2008) and the design year (2030). Peak-hour traffic volumes were collected from the City of Seattle. WSDOT conducted traffic counts for those areas where traffic volume data were not readily available.

Traffic conditions for street systems are typically measured for a single peak hour during the longer morning and afternoon weekday commute peak periods. During the morning commute period, traffic volumes in the study area generally peak from 7:15 to 8:15 a.m.; during the afternoon commute period they peak from 5:00 to 6:00 p.m. Peak-hour local traffic volumes were compared with peak-hour freeway ramp volumes to ensure that the operations analysis included data that would represent the most conservative conditions (when both local street and freeway ramp volumes are at their highest).

The analysis of existing intersection operations used current signal timing and phasing information obtained from local jurisdictions. All operational analyses for future conditions used optimized signal and network settings (except phasing) to provide a similar comparison of operations for the alternatives. Signal phasing was also revised and optimized at a few freeway ramp intersections to improve operations. Intersection level of service was used to compare traffic operations between the No Build Alternative and the Preferred Alternative. At locations where the operations fell to LOS F, critical volume-to-capacity (V/C) ratios and queue spillback locations were used to compare traffic operations between the alternatives. LOS, V/C ratio, and queue spillback are defined and described below.



Intersection

Interchange Area

N

0 500 1,000 2,000 Feet

Source: King County (2008) GIS Data (Streams, Streets and Waterbodies) and CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 4-7. **Interchange Areas and Intersections Included in the Local Operations Analysis**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

Using the Level-of-service Rating

The LOS scale rates the quality of traffic operations on a given transportation facility. This rating scale uses letter grades A through F (Exhibit 4-8). The letter grades are based on the levels of delay that drivers experience at an intersection, with the letter A representing the least-delayed conditions and the letter F representing the most delayed.

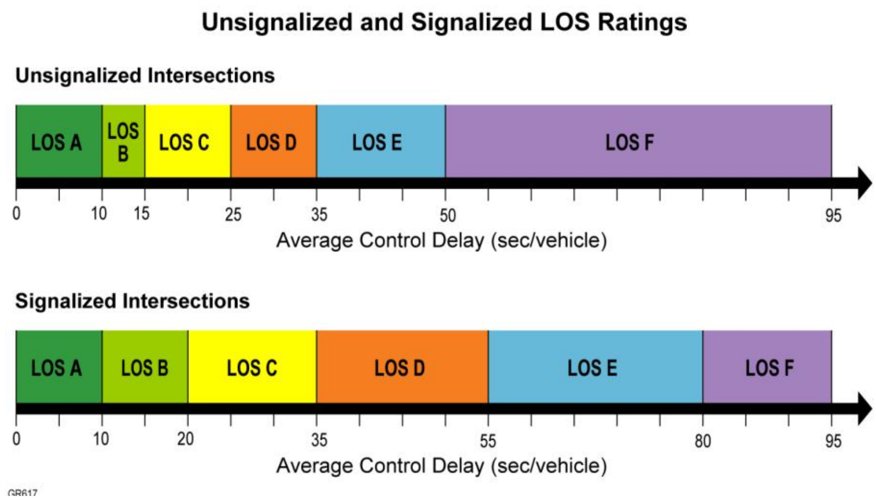


Exhibit 4-8. **Delay Ranges Associated with LOS Rating**

For intersections controlled by signals and all-way stops, LOS represents an average delay for the entire intersection. LOS is what is reported for the SR 520 local traffic analysis.

For two-way, stop-controlled intersections, LOS is typically reported for the most delayed leg of the intersection. For this report, the overall intersection LOS is reported for all unsignalized intersections, regardless of the type of intersection (four-way, two-way, or uncontrolled ramp termini where left turns yield to oncoming traffic). For two-way, stop-controlled, and uncontrolled yield intersections, Synchro provides an average delay (in seconds per vehicle) for the overall intersection, and a letter LOS only for the approach that must either stop or yield. The average intersection delay range (Exhibit 4-8) was used to apply an overall intersection LOS and provide a relative comparison between stop or yield intersections and other types of intersections (signalized, all-way, and stop-controlled).

Comparing the Volume-to-capacity Ratio

The V/C ratio compares the amount of traffic on a roadway (traffic volume) to the roadway's available capacity. If the V/C ratio is greater than 1.0, it means that the traffic volumes exceed the roadway capacity. Conversely, if the V/C ratio is less than 1.0, it means the roadway is carrying less than its full capacity. For instance, a V/C ratio of 1.07 means that traffic volumes exceed the roadway capacity by 7 percent.

At intersections, the capacity of a single lane depends on its physical layout (width, uphill/downhill grade, etc.) as well as the type and duration of traffic control (stop sign, signal, cycle length, and other factors). For instance, the longer a signal is set for green in a given intersection, the more vehicles can move through the intersection and thus the greater its capacity.

Identifying the Queue Spillback

A queue spillback occurs in an area where vehicles cannot proceed through an intersection because vehicles ahead are backed up from the next intersection. As shown in Exhibit 4-9, the location at which a vehicle is blocked from moving through an intersection is referred to as the queue spillback location. Queue spillback also happens when vehicles exiting via off-ramps back onto the freeway. This latter type of queue spillback was identified on this project.

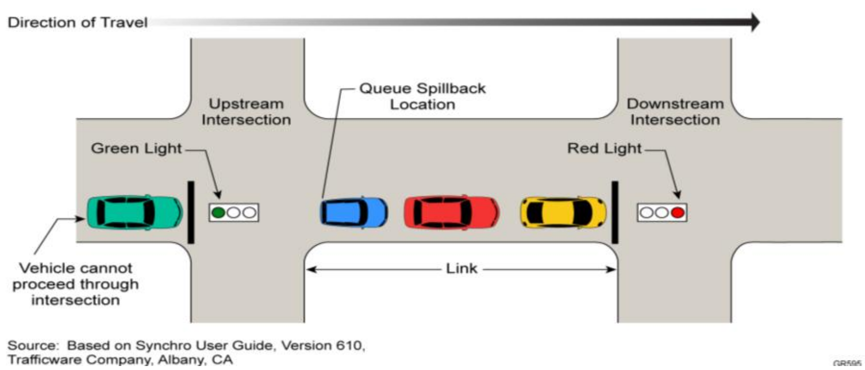


Exhibit 4-9. **Queue Spillback Location**

How were transit operations analyzed?

Transit operations through the Montlake interchange area were analyzed using the VISSIM software program—a micro-simulation packaged developed by PTV. This program was used to simulate traffic operations on SR 520 as well as Montlake Boulevard between NE Pacific Place to the north and East Roanoke Street to the south. The model also included NE Pacific Street between NE Pacific Place and Montlake Boulevard.

Transit operations were analyzed by measuring travel time differences between existing conditions and the No Build and Preferred Alternatives. The analysis examined conditions through the Montlake interchange during the peak hour (5:00 to 6:00 p.m.) and the off-peak hour (3:00 to 4:00 p.m.). The off-peak period included a simulated 5-minute bridge opening that prevented vehicles from crossing the Montlake Bridge. The opening was simulated at 3:25 p.m., which is the latest time the bridge can open.

Chapter 5—Freeway Volumes and Operations

What is in this chapter?

This chapter presents WSDOT's findings for the Final EIS freeway analysis. It describes freeway traffic volumes and operations on the SR 520 freeway main line and ramps during morning (AM) and afternoon (PM) peak (highest use) periods. The chapter also discusses the results of the freeway traffic volume forecasts and operations analysis of the No Build Alternative and the Preferred (Build) Alternative.

Did you know?

Freeway traffic volume refers to how many vehicles and/or people use or would like to use a freeway.

Freeway traffic operation refers to how traffic is moving or flowing, and is discussed in terms of speeds, travel times, and congestion.

What is traffic currently like on SR 520?

The existing configuration of SR 520 does not meet current WSDOT design guidelines, which affects the freeway's capacity to provide reliable and safe travel for buses and carpools (HOV) and general-purpose traffic. Roadway capacity in the SR 520 corridor is constrained by:

- Narrow shoulders and lanes on the corridor and across the bridge
- Short acceleration lane lengths at the SR 520/Montlake interchange and Lake Washington Boulevard on-ramps
- Poor sight distance at roadway curves, resulting in slower speeds

These constraints, coupled with high traffic volumes on SR 520, result in regular congestion at the following locations:

- Westbound approaching the floating bridge (near the HOV lane termination in Medina)
- Westbound on the Portage Bay Bridge between I-5 and the SR 520/Montlake interchange
- Eastbound approaching the west approach span of the Evergreen Point Bridge

Did you know?

Reliability is defined by how travel times vary over time. On any given day, unusual circumstances such as crashes can dramatically change the performance of the roadway, affecting both travel speeds and throughput volumes. Commuters who take congested highways to and from work are well aware of this. When asked about their commute they will say, "It takes me 45 minutes on a good day, but an hour and 15 minutes on a bad day."

Unreliable traffic conditions affect how and when people choose to travel. For example, if a road is known to have highly variable traffic conditions, a traveler using that road to catch an airplane routinely leaves "extra" time to get to the airport. In other words, the "reliability" of this traveler's trip is directly related to the variability in the performance of the route he or she takes.

Reliability, or the ability to predict trip travel time with some certainty, is important. If a commuter has a routine activity that must occur every day—such as picking up children from day care—he or she must plan an extra amount of trip time just to prevent a late arrival. The same goes for local trucking firms engaged in pickup and delivery of goods.

Several bottlenecks along the I-5 and I-405 corridors limit the amount of traffic that can access SR 520. In Seattle, these areas include northbound and southbound I-5 across the Ship Canal Bridge and through downtown Seattle. The capacity of the I-405/SR 520 interchange and I-405 main line through downtown Bellevue also limits the amount of traffic that can enter or exit the SR 520 corridor. Traffic volumes and congestion at these locations are discussed in more detail later in this chapter.

What are the current safety concerns along SR 520?

WSDOT evaluated historical crash data for the entire SR 520 corridor, including the main line and ramps, to identify safety concerns. Crash data were obtained for a recent 3 full years of data (January 2006 through December 2008). Crash data provide information about the frequency, severity, and type of crashes for a given section of the corridor. This section summarizes the crash data for the SR 520, I-5 to Medina study area.

SR 520 Main Line

Exhibit 5-1 shows eastbound and westbound crash rates, including the nature of the crash, along the SR 520 main line between I-5 and Medina. The highest crash rates from the project analysis were between I-5 and the 24th Avenue East overcrossing of SR 520 (in both directions). This section of SR 520 had higher crash rates than the SR 520 corridor average of 1.11 crashes/ mvmt in both the eastbound and westbound directions. This result is likely due to the congested conditions because 83 percent of the eastbound crashes and 86 percent of the westbound crashes are related to congestion (rear-end and side-swipe incidents) along this section.

Fixed-object crashes can result from drivers losing control because of roadway conditions or excessive speed, the proximity of roadside barriers to moving traffic, narrow shoulders, and the avoidance of other traffic. Roadside barriers help to avert more serious crashes and injuries. The placement of roadside barriers close to the roadway is necessary due to the limited width of the SR 520 corridor.

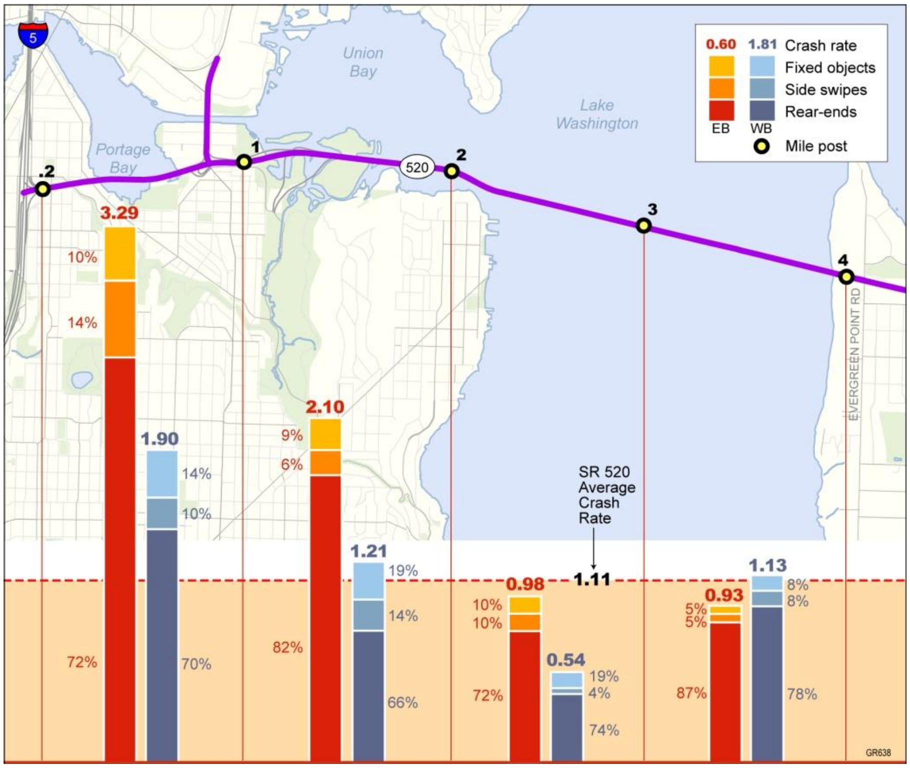


Exhibit 5-1. **Distribution and Type of Eastbound and Westbound Crash Rates along SR 520**

SR 520 crashes are attributed to traffic congestion and narrow roadway design. In most cases, safety could be improved by improving traffic flow and designing the freeway to meet current state and federal standards. In many cases, improved design could reduce the potential for crashes along the SR 520 main line and ramps. This is especially true in areas where current design limitations could be updated to improve the roadway and/or reduce areas of severe congestion through a more efficient design.

SR 520 Ramps

WSDOT also reviewed crash data for the interchange ramps between I-5 and Evergreen Point Road/76th Avenue NE. Several ramps with higher concentrations of crashes are discussed below.

SR 520 Eastbound Off-Ramp to Montlake Boulevard

Of the 11 crashes that occurred on this off-ramp in a 3-year period, 55 percent were intersection-related (versus ramp-related). These crashes occurred at the off-ramp intersection with Montlake Boulevard, including two accidents involving pedestrians.

SR 520 Eastbound On-Ramp from Montlake Boulevard

Twenty-seven crashes occurred on this on-ramp in a 3-year period. The majority of the rear-end crashes (64 percent) occurred at the beginning of the ramp where traffic from both directions of Montlake Boulevard merges. Possible causes include congestion, inadequate signing, driver inattention, and/or driver expectancy.

SR 520 Eastbound On-Ramp from Lake Washington Boulevard

Fourteen crashes occurred on this on-ramp from 2006 to 2008, of which 29 percent were rear-end crashes and 64 percent were fixed-object crashes. The majority of the fixed-object crashes (78 percent) occurred in the curve near the merge end of the ramp. Possible contributing circumstances for these fixed-object crashes are roadway design (super-elevation, shoulder width, signing, etc.), pavement condition, and/or driver inattention.

SR 520 Westbound Off-Ramp to Lake Washington Boulevard

All of the 12 crashes occurring on this off-ramp were fixed-object crashes, and 92 percent of those occurred on wet pavement. The majority of the crashes on this ramp (67 percent) occurred in the sharp horizontal curve at milepost 0.2. Possible contributing circumstances for these fixed-object crashes are roadway design (super-elevation, drainage, shoulder width, signing, etc.), pavement condition, and/or driver inattention.

SR 520 Westbound On-Ramp from Montlake Boulevard

Twenty-three crashes occurred on this on-ramp from 2006 to 2008, of which 87 percent were rear-end and 13 percent were fixed-object accidents. The majority of the rear-end crashes (75 percent) occurred after the merge point with the SR 520 main line, which is indicative of issues likely caused by the short merge distance, the congested mainline conditions, or a combination of both.

What are the safety benefits of this project?

This project will improve the ramp designs in the SR 520 study area to current design guidelines, which will result in improvements to current safety issues.

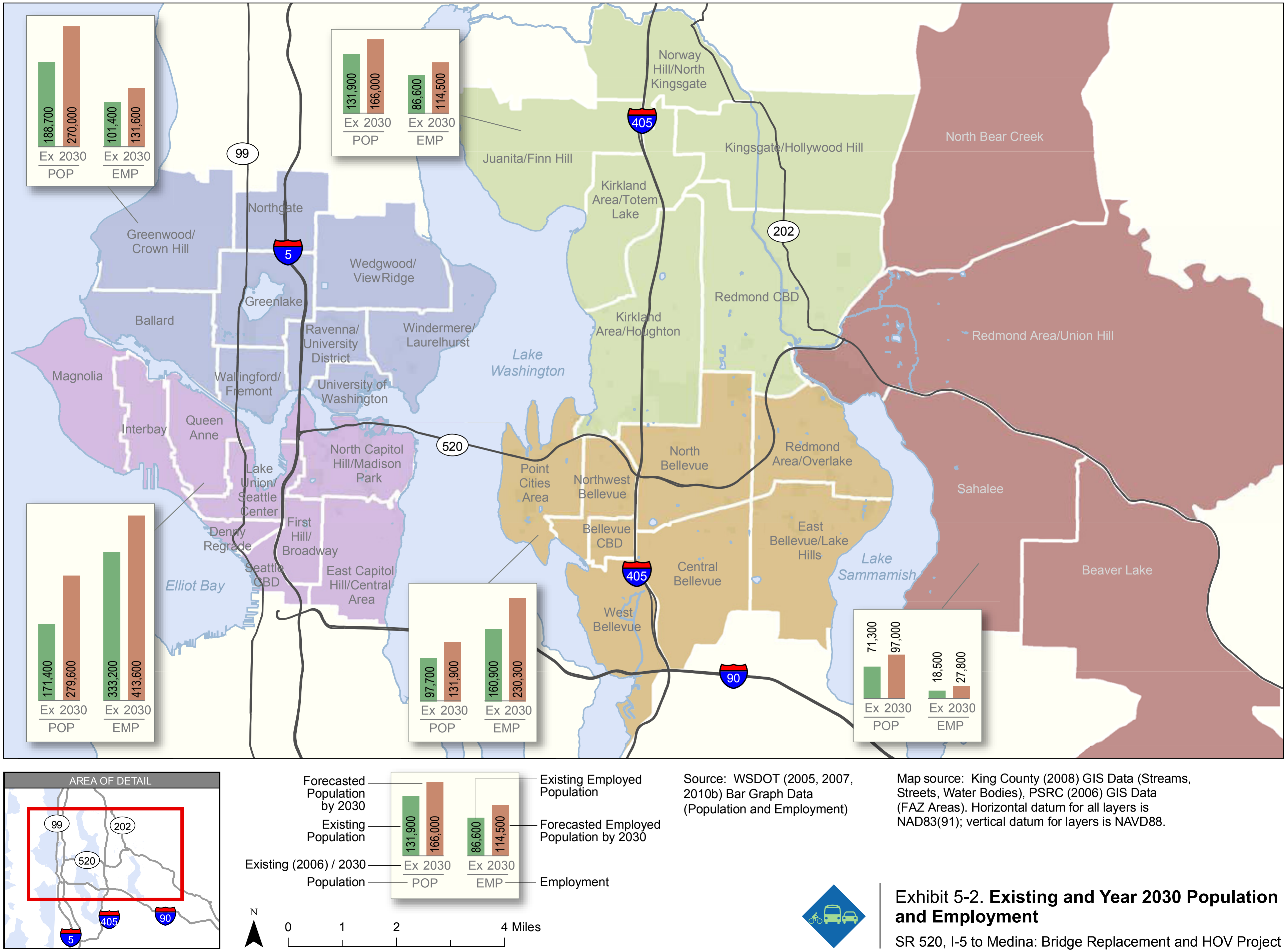
The main safety benefits of this project are summarized below. The improved traffic flow and reduced congestion may have other minor benefits as well.

- A decrease in overall crash frequencies and crash rates as a result of widening the roadway and improving traffic operations
- A decrease in fixed-object crashes as a result of widened shoulders, which will provide increased recovery area for errant vehicles
- A decrease in some ramp crashes as a result of improved designs that more closely meet current design guidelines

How are population and employment expected to change by the year 2030?

Between today and the year 2030, the population of the region will grow by 1 million people, add over 640,000 new jobs, and need to accommodate close to 40 percent more traffic (PSRC 2006). Exhibit 5-2 shows the projected population and employment growth for selected Seattle and Eastside areas. Both Eastside and Seattle forecasts are shown because regional travel patterns, including traffic across SR 520, are influenced by population and employment changes on both sides of Lake Washington.

The largest increases in population and employment in Seattle are forecasted in the South Lake Union, Denny Regrade/Triangle, and downtown Seattle areas. The largest forecasted increases on the Eastside are downtown Redmond, the Redmond/Overlake area, downtown Bellevue, and the Beaver Lake area.



Source: WSDOT (2005, 2007, 2010b) Bar Graph Data (Population and Employment)

Map source: King County (2008) GIS Data (Streams, Streets, Water Bodies), PSRC (2006) GIS Data (FAZ Areas). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 5-2. **Existing and Year 2030 Population and Employment**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

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How would cross-lake travel change?

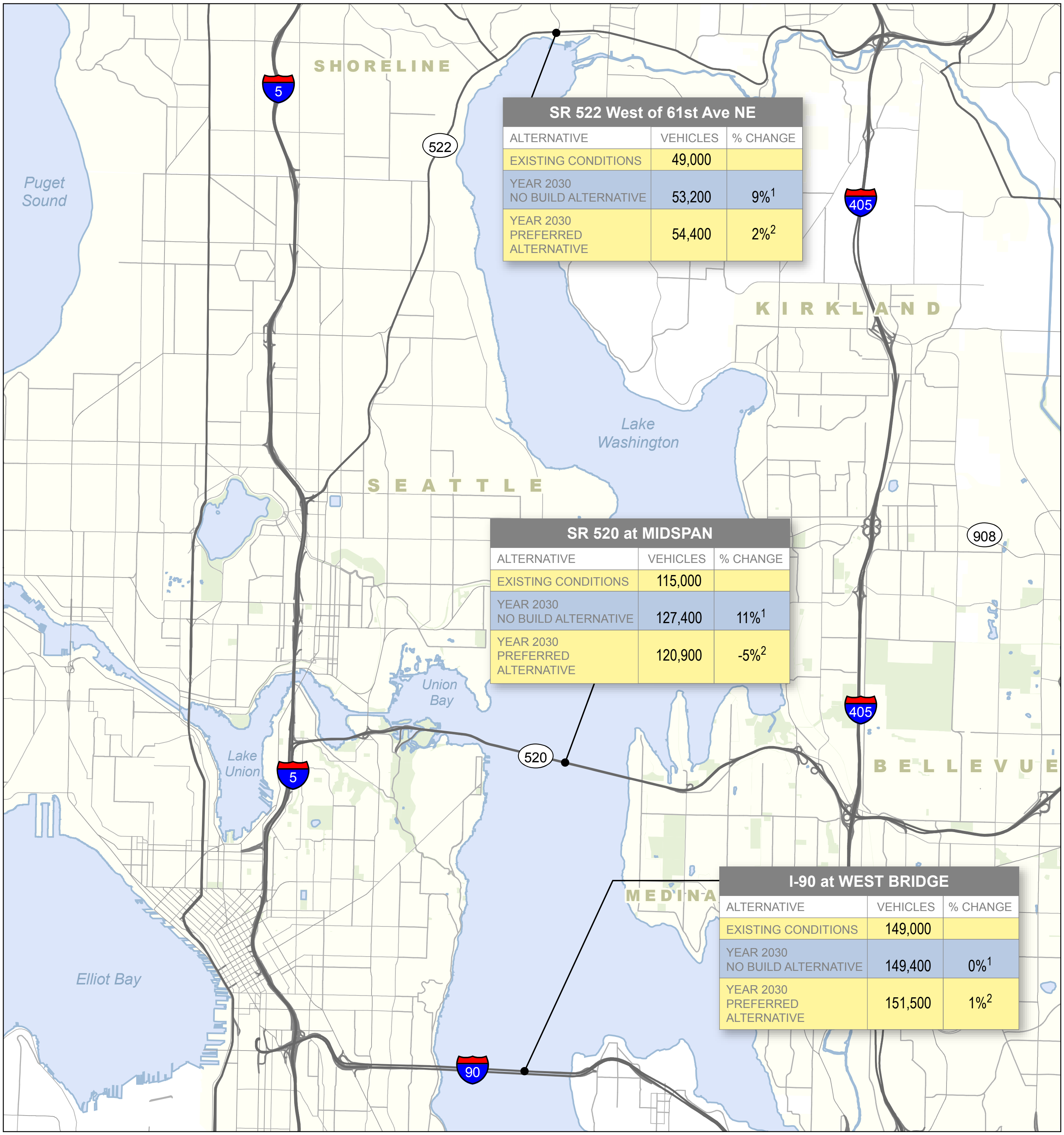
Daily Travel

With the forecasted increases in population and employment, traffic volumes would also increase on major transportation facilities. Exhibit 5-3 shows the forecasted changes in daily vehicle demand volumes on SR 522, SR 520, and I-90 for the No Build Alternative and the Preferred Alternative. Person demand at all cross-lake roadways would increase substantially more than vehicle demand, indicating a growth in HOV travel (carpools and buses) in the year 2030 compared to today. Year 2030 forecasts assume HOV occupancy of 3 or more persons.

With the Preferred Alternative, daily vehicle demand on SR 520 would decrease 5 percent, SR 522 would increase 2 percent, and I-90 would increase 1 percent compared to the No Build Alternative. Traffic demand on SR 520 would primarily decrease during the off-peak periods when alternative routes are less congested, making drivers more likely to use those routes to avoid a toll.

Exhibit 5-4 provides more detail regarding changes in daily vehicle and person demand by mode across the Evergreen Point Bridge for both the No Build Alternative and the Preferred Alternative.

With the Preferred Alternative, the person demand for HOV (carpool and bus) would increase by approximately 19,000 (39 percent) compared to the No Build Alternative. General-purpose vehicle demand would decrease approximately 11,000 vehicles per day (10 percent) for the Preferred Alternative compared to the No Build Alternative. This decrease would occur because the toll, improved HOV reliability, and reduced HOV travel times would increase the incentive to carpool or take the bus.



SR 522 West of 61st Ave NE

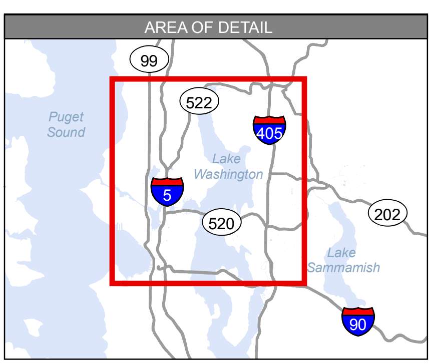
ALTERNATIVE	VEHICLES	% CHANGE
EXISTING CONDITIONS	49,000	
YEAR 2030 NO BUILD ALTERNATIVE	53,200	9%[1]
YEAR 2030 PREFERRED ALTERNATIVE	54,400	2%[2]

SR 520 at MIDSPAN

ALTERNATIVE	VEHICLES	% CHANGE
EXISTING CONDITIONS	115,000	
YEAR 2030 NO BUILD ALTERNATIVE	127,400	11%[1]
YEAR 2030 PREFERRED ALTERNATIVE	120,900	-5%[2]

I-90 at WEST BRIDGE

ALTERNATIVE	VEHICLES	% CHANGE
EXISTING CONDITIONS	149,000	
YEAR 2030 NO BUILD ALTERNATIVE	149,400	0%[1]
YEAR 2030 PREFERRED ALTERNATIVE	151,500	1%[2]



[1]Compared to Existing Conditions
[2]Compared to Year 2030 No Build Alternative

Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N 0 0.5 1 2 Miles

Exhibit 5-3. **Daily Vehicle Demand Volumes on SR 522, SR 520, and I-90**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

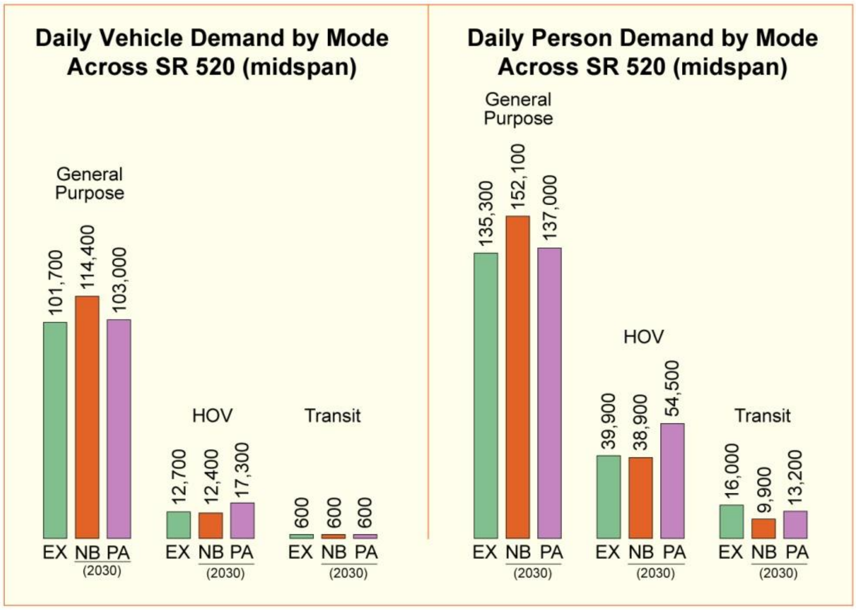
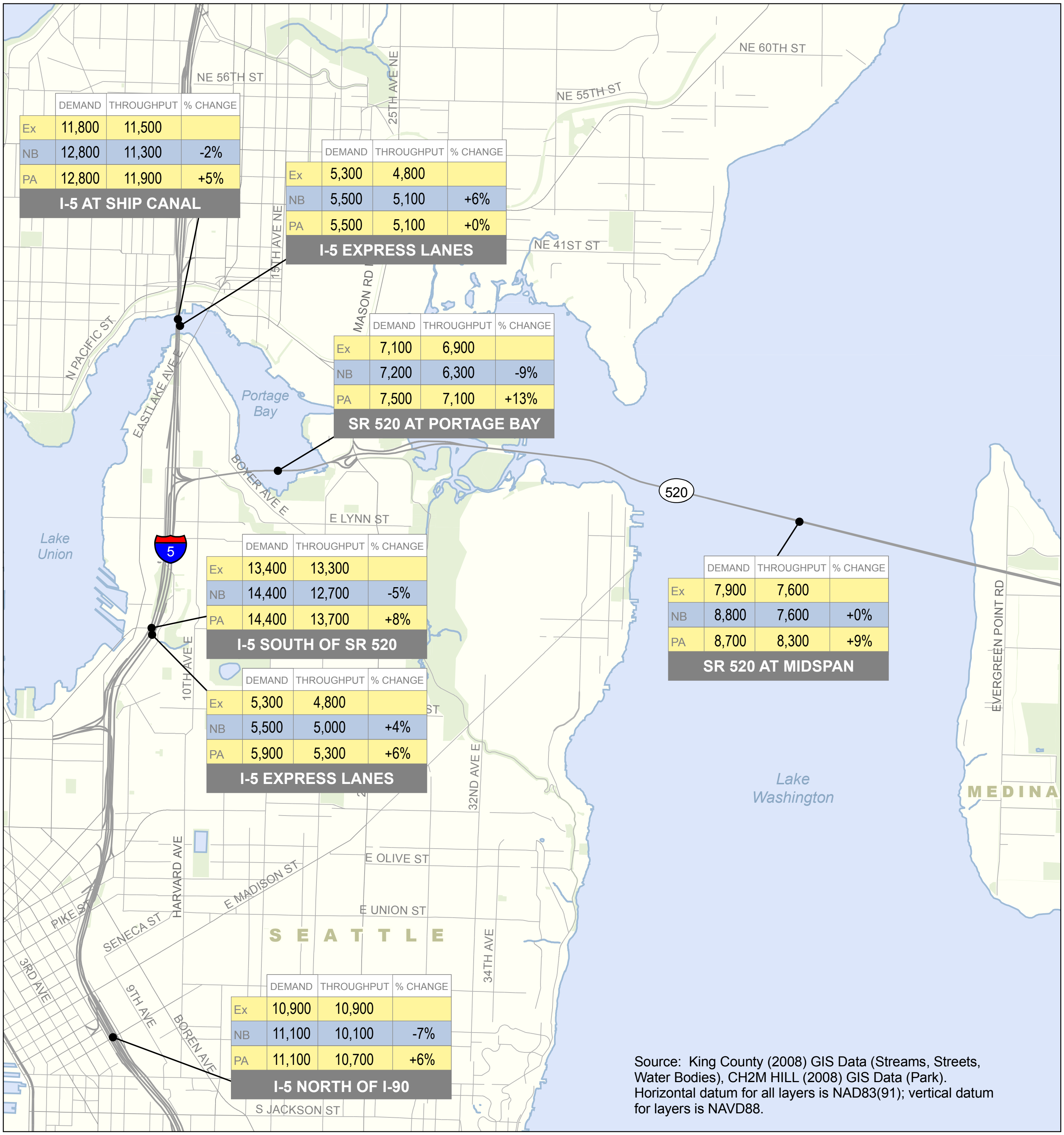


Exhibit 5-4. **Daily Vehicle and Person Demand by Mode across SR 520 (midspan)**

Peak Period Travel

In the year 2030 (No Build Alternative), peak period traffic demand would increase compared to today on SR 520 by 11 percent in the morning and 9 percent in the evening. In the morning, however, due to existing congestion on the SR 520 corridor and I-5 or I-405, no additional trips would be served. This means that the increase in traffic would add to existing congestion. In the evening, about half of the increase in cross-lake traffic would be served (4 percent increase in throughput, 9 percent increase in demand).

During the morning and afternoon commute periods, total vehicle trip demand across SR 520 (eastbound and westbound combined) in the year 2030 for the Preferred Alternative would be similar to the No Build Alternative (within 1 percent). Total traffic demand volumes would be similar with the Preferred Alternative during peak periods because congestion on the other two primary cross-lake routes (SR 522 and I-90) would make drivers just as likely to choose SR 520, especially if it is the most direct route. Vehicle trip demand and throughput for the morning and afternoon commutes are shown on Exhibits 5-5, 5-6, and 5-7.



I-5 AT SHIP CANAL

	DEMAND	THROUGHPUT	% CHANGE
Ex	11,800	11,500	
NB	12,800	11,300	-2%
PA	12,800	11,900	+5%

I-5 EXPRESS LANES

	DEMAND	THROUGHPUT	% CHANGE
Ex	5,300	4,800	
NB	5,500	5,100	+6%
PA	5,500	5,100	+0%

SR 520 AT PORTAGE BAY

	DEMAND	THROUGHPUT	% CHANGE
Ex	7,100	6,900	
NB	7,200	6,300	-9%
PA	7,500	7,100	+13%

SR 520 AT MIDSPAN

	DEMAND	THROUGHPUT	% CHANGE
Ex	7,900	7,600	
NB	8,800	7,600	+0%
PA	8,700	8,300	+9%

I-5 SOUTH OF SR 520

	DEMAND	THROUGHPUT	% CHANGE
Ex	13,400	13,300	
NB	14,400	12,700	-5%
PA	14,400	13,700	+8%

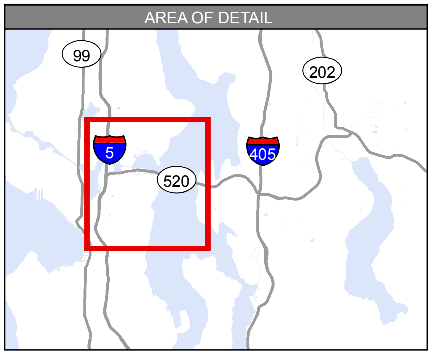
I-5 EXPRESS LANES

	DEMAND	THROUGHPUT	% CHANGE
Ex	5,300	4,800	
NB	5,500	5,000	+4%
PA	5,900	5,300	+6%

I-5 NORTH OF I-90

	DEMAND	THROUGHPUT	% CHANGE
Ex	10,900	10,900	
NB	11,100	10,100	-7%
PA	11,100	10,700	+6%

AREA OF DETAIL



Legend: Alternative; Vehicles Per Hour

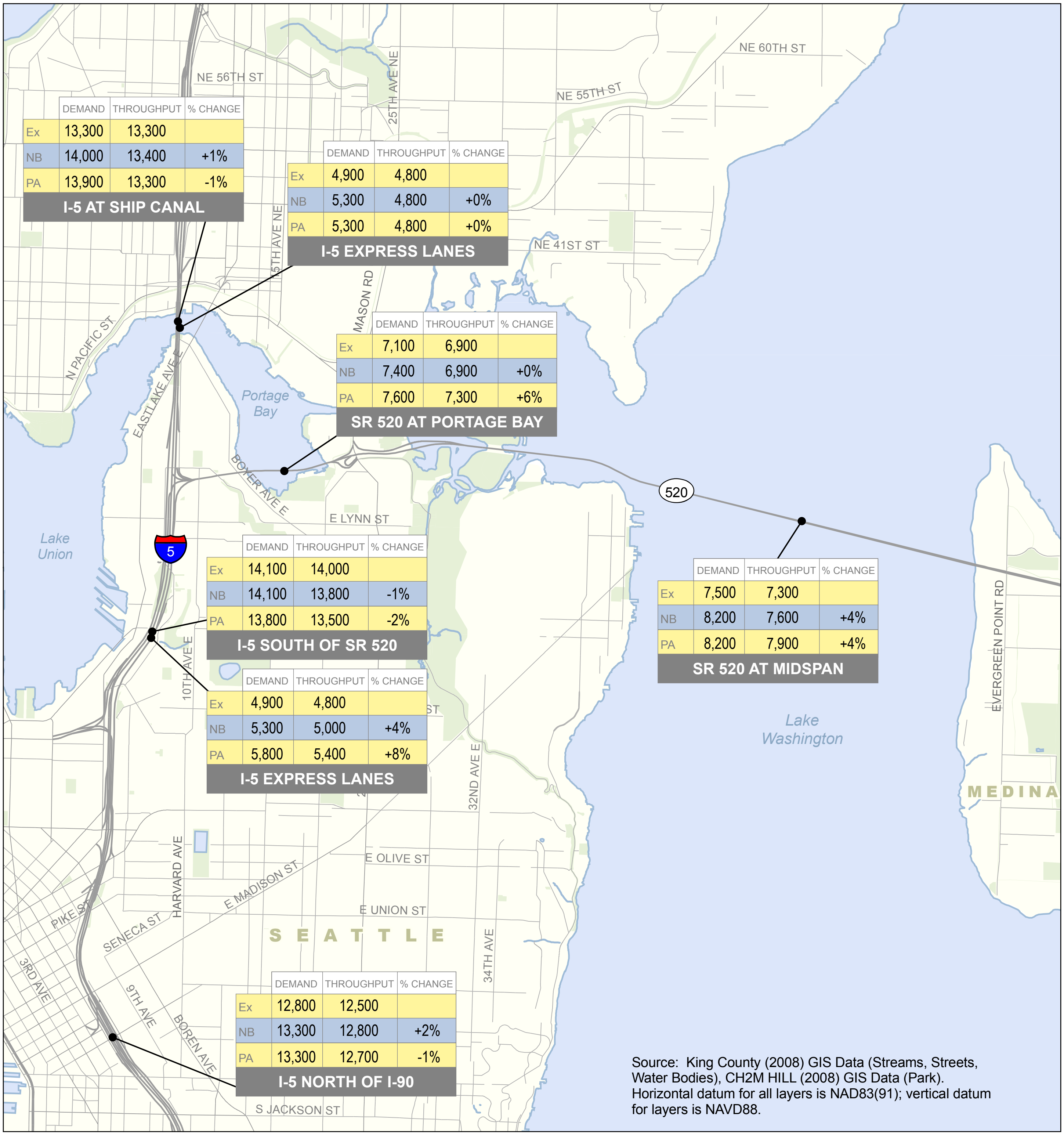
Year	Alternative		DEMAND	THROUGHPUT	% CHANGE	
	Existing	Ex	10,900	10,900		
2030	No Build	NB	11,100	10,100	-7%	± Change % vs. Existing (Throughput)
	Preferred Alternative	PA	11,100	10,700	+6%	± Change % vs. No Build (Throughput)
		LOCATION				

N

0 1,000 2,000 4,000 Feet

Exhibit 5-5. **Vehicle Trip Demand and Throughput – SR 520 and I-5 during the AM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project



I-5 AT SHIP CANAL

	DEMAND	THROUGHPUT	% CHANGE
Ex	13,300	13,300	
NB	14,000	13,400	+1%
PA	13,900	13,300	-1%

I-5 EXPRESS LANES

	DEMAND	THROUGHPUT	% CHANGE
Ex	4,900	4,800	
NB	5,300	4,800	+0%
PA	5,300	4,800	+0%

SR 520 AT PORTAGE BAY

	DEMAND	THROUGHPUT	% CHANGE
Ex	7,100	6,900	
NB	7,400	6,900	+0%
PA	7,600	7,300	+6%

I-5 SOUTH OF SR 520

	DEMAND	THROUGHPUT	% CHANGE
Ex	14,100	14,000	
NB	14,100	13,800	-1%
PA	13,800	13,500	-2%

SR 520 AT MIDSPAN

	DEMAND	THROUGHPUT	% CHANGE
Ex	7,500	7,300	
NB	8,200	7,600	+4%
PA	8,200	7,900	+4%

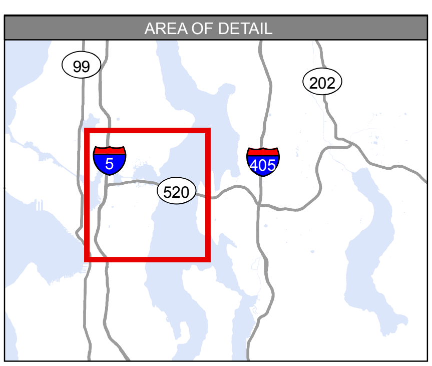
I-5 EXPRESS LANES

	DEMAND	THROUGHPUT	% CHANGE
Ex	4,900	4,800	
NB	5,300	5,000	+4%
PA	5,800	5,400	+8%

I-5 NORTH OF I-90

	DEMAND	THROUGHPUT	% CHANGE
Ex	12,800	12,500	
NB	13,300	12,800	+2%
PA	13,300	12,700	-1%

AREA OF DETAIL



Legend

Alternative — Vehicles Per Hour

Year 2030		DEMAND	THROUGHPUT	% CHANGE	
Existing	Ex	13,300	13,300		
No Build	NB	14,000	13,400	+1%	± Change % vs. Existing (Throughput)
Preferred Alternative	PA	13,900	13,300	-1%	± Change % vs. No Build (Throughput)
	LOCATION				

N

0 1,000 2,000 4,000 Feet

Exhibit 5-6. **Vehicle Trip Demand and Throughput – SR 520 and I-5 during the PM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

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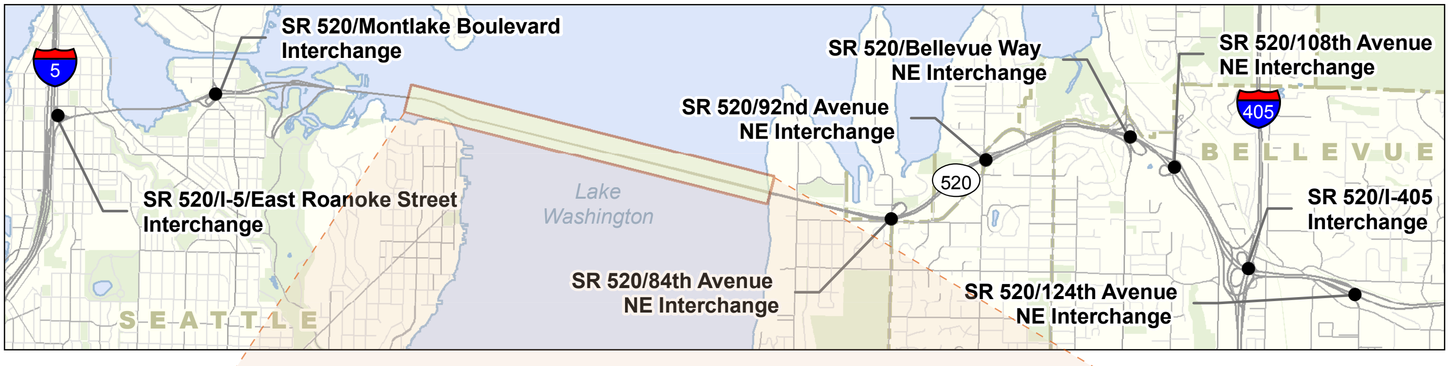


Bridge Midspan: Volume Trips per Hour

Westbound Demand · Westbound Throughput · Eastbound Demand · Eastbound Throughput

Alternative		AM Peak Hour Vehicle Trips	AM Peak Hour Person Trips		PM Peak Hour Vehicle Trips	PM Peak Hour Person Trips
Existing Conditions	Westbound	4,000	6,900	Westbound	4,000	6,700
		3,900	6,800		3,800	6,400
	Eastbound	3,900	6,900	Eastbound	3,500	6,700
		3,700	6,500		3,500	6,700
Year 2030 No Build Alternative	Westbound	4,400	6,900	Westbound	4,300	6,900
		3,900	6,100		3,800	6,000
	Eastbound	4,400	7,300	Eastbound	3,900	6,400
		3,700	6,300		3,800	6,300
Year 2030 Preferred Alternative	Westbound	4,500	8,000	Westbound	4,200	7,300
		4,300	7,400		4,000	6,800
	Eastbound	4,200	7,300	Eastbound	4,000	7,600
		4,000	7,100		3,900	7,500

N 0 0.5 1 Miles

Map Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 5-7. **Vehicle and Person Trip Demand and Throughput – SR 520 Cross-lake during the AM and PM Peak Periods**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

However, with the Preferred Alternative, the following changes in travel would occur:

- Less people would be stuck in congestion on SR 520 (similar demand, but higher throughput with the Preferred Alternative)
- More people would be traveling in higher occupancy modes, such as HOV 3+ or transit (less general-purpose trips)

As more people travel in higher modes such as HOV 3+ and transit, the Preferred Alternative can have similar total vehicle trips while serving more persons than the No Build Alternative. The Preferred Alternative serves 15 to 17 percent more persons than the No Build Alternative in the morning and evening peak periods, respectively, and serves 5 to 10 percent more vehicles. This increase would occur because the Preferred Alternative includes additional HOV capacity from Medina to I-5; moreover, by providing an HOV lane, the general-purpose lanes also operate with less congestion.

Effects on I-5

By reducing congestion or bottlenecks on SR 520 with the construction of the Preferred Alternative, as well as improving throughput, I-5 would operate differently as described in the following paragraphs.

In the morning, the year 2030 No Build Alternative would exhibit substantial congestion from the Montlake area on SR 520 back onto mainline I-5. As a result of the SR 520 congestion, on I-5 northbound between I-90 and SR 520 congestion would be present for over 3 hours of the morning commute with the No Build Alternative. Travel time from Seattle to Bellevue would be over 44 minutes at the peak of the commute.

Improvements made to the SR 520 corridor as part of the Preferred Alternative would result in near free-flow conditions on I-5 northbound during the morning. Travel times for this same trip between Seattle and Bellevue would be improved to 11 minutes—a savings of 33 minutes compared with the No Build Alternative.

Under the No Build Alternative, in the afternoon I-5 southbound is congested through downtown Seattle from the SR 520 interchange area to the I-90 collector-distributor roadway. Travel time from Bellevue to Seattle is up to 41 minutes during the worst congestion.

With the congestion relief on SR 520 provided by the Preferred Alternative, up to 200 vph more would be served on I-5 southbound. A 200-vph increase on I-5 is an increase in volume of about 3 percent in the downtown Seattle area. Because this section of roadway is operating at capacity today, this increase in trips would result in some increase in congestion on I-5 southbound with congestion lasting an hour longer than under the No Build Alternative. However, with the improvements to the SR 520 corridor, the travel time between Bellevue and Seattle would still improve to 28 minutes during the peak of the evening commute with the Preferred Alternative. This is a 13-minute improvement compared to the No Build Alternative.

This analysis assumes that by the year 2030, light rail would be constructed on I-90. Transit trips for the year 2030 No Build Alternative would decrease along SR 520 compared to today as riders shift to rail. When the SR 520, I-5 to Medina project is completed, some of these transit riders would shift back to the corridor to use the improved HOV system.

Did you know?

WSDOT's Traffic System Management Center (TSMC) collects traffic volume data along the state highways that can be used to create speed-flow diagrams (congestion diagrams) to visually determine areas of congestion. These surface plots, similar to a topographical map, plot average vehicle speeds against time and space and create speed contour plots.

These plots help engineers determine the intensity, duration, and length (queue) of congestion throughout the day. The SR 520 transportation team worked with WSDOT's NW Region traffic engineers to develop these diagrams. These speed-flow diagrams show that congestion occurs on SR 520, I-5, and I-405 for several hours each day at a number of locations.

How would westbound SR 520 operate during the morning commute?

Without the project, the SR 520 westbound general-purpose lanes would continue to be congested approaching Lake Washington and the end of the HOV lane. With the SR 520, I-5 to Medina project, this congestion would be substantially reduced because the HOV lanes would be completed across the bridge to the I-5 express lanes. As a result, vehicle and person throughput across the Evergreen Point Bridge would increase.

Volumes and Mode Share

As shown in Exhibit 5-8, the Preferred Alternative would serve up to approximately 1,300 more people than the No Build Alternative (a 20 percent increase) in only 400 more vehicles (a 9 percent increase). With both the No Build Alternative and Preferred Alternative, not all the forecasted traffic demand for SR 520 would be served because of congestion on I-5 and I-405.

Exhibit 5-8. **Westbound AM Vehicle and Person Trips**

The westbound HOV lane connection to the southbound I-5 express lanes in the morning would allow carpools and buses to bypass congestion on the I-5 main line. The SR 520 to I-5 express lane connection would serve 400 vph (transit and HOV), which equals approximately 2,000 persons per hour.

Congestion Points

WSDOT developed speed-flow diagrams using model output to provide a graphic representation of the congestion that would occur with and without the project. Exhibits 5-9 and 5-10 show where congestion would occur on the SR 520 corridor with the No Build Alternative and Preferred Alternative during the westbound morning commute. The worst of the congestion points shown in these diagrams (indicated by the red/orange areas) are discussed below, including a description of how the Preferred Alternative operates compared to the No Build Alternative.

Bridge Approach at the Eastern Lake Shore

As shown in Exhibit 5-9, today the most severe congestion on westbound SR 520 occurs between the east bridge approach, near the 84th Avenue NE on-ramp and the westbound HOV lane termination, and the SR 520/104th Avenue NE interchange area. This section of roadway remains congested for approximately 3-1/2 hours during the morning commute period, and limits the amount of traffic that can cross the bridge.

Congestion at the bridge approach would worsen in the year 2030 under the No Build Alternative with the increase in vehicle demand. Congestion would extend from I-405 to the lake shore and affect general-purpose operations. The No Build Alternative includes the SR 520, Medina to SR 202 project so the HOV lane would be moved to the inside. This configuration means the HOV trips would bypass this congestion and experience near free-flow conditions approaching the lake. After the HOV lane terminates, both general-purpose and HOV trips would experience some congestion across the lake.

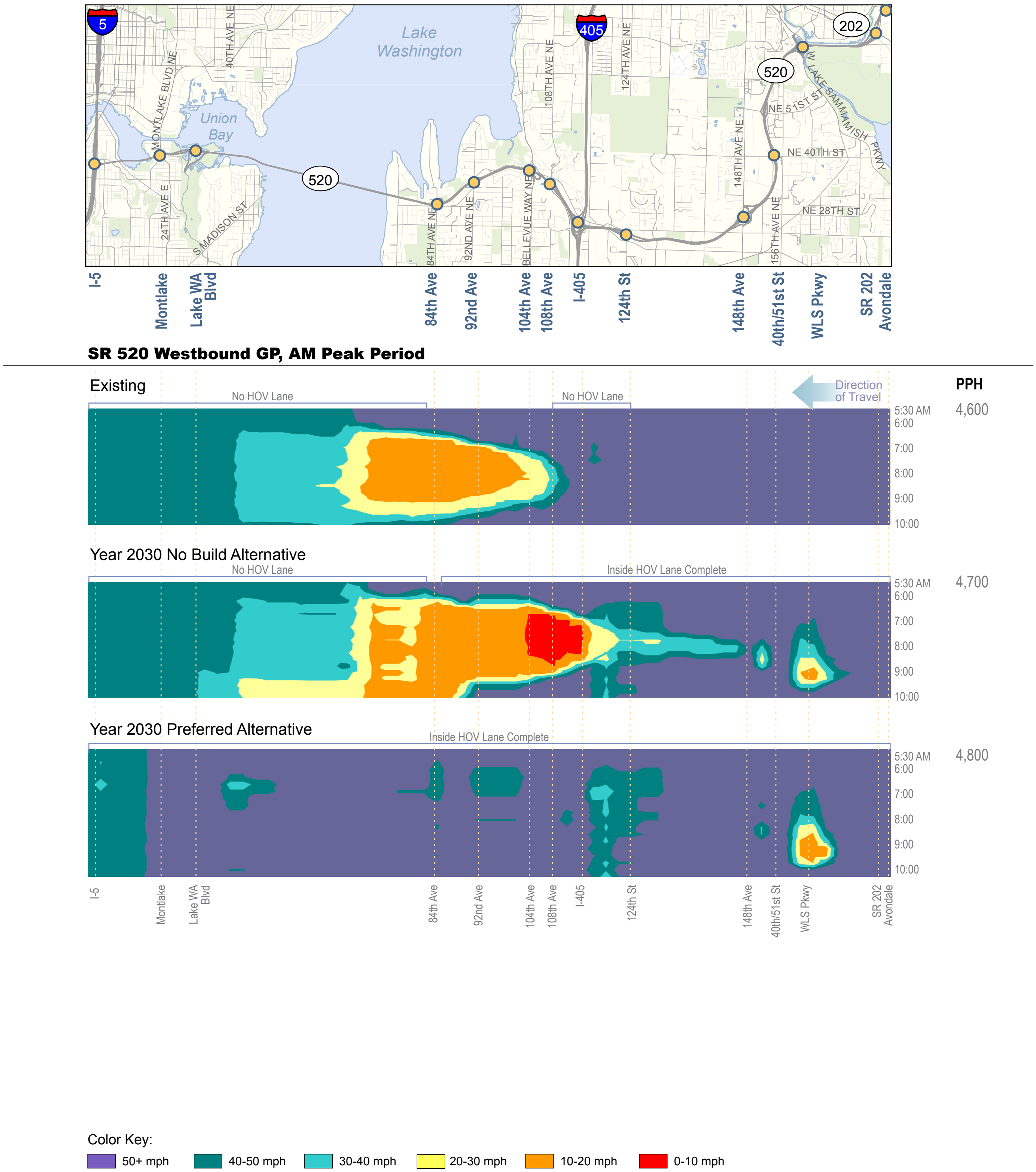
With the Preferred Alternative, the westbound HOV lane would be extended across the Evergreen Point Bridge to I-5, eliminating congestion at this point for both HOV and general-purpose traffic.

Did you know?

A travel time under 14 minutes indicates near free-flow speeds.

A travel time of 30 minutes indicates average speeds of 25 mph.

A travel time of over an hour indicates average speeds of less than 15 mph.

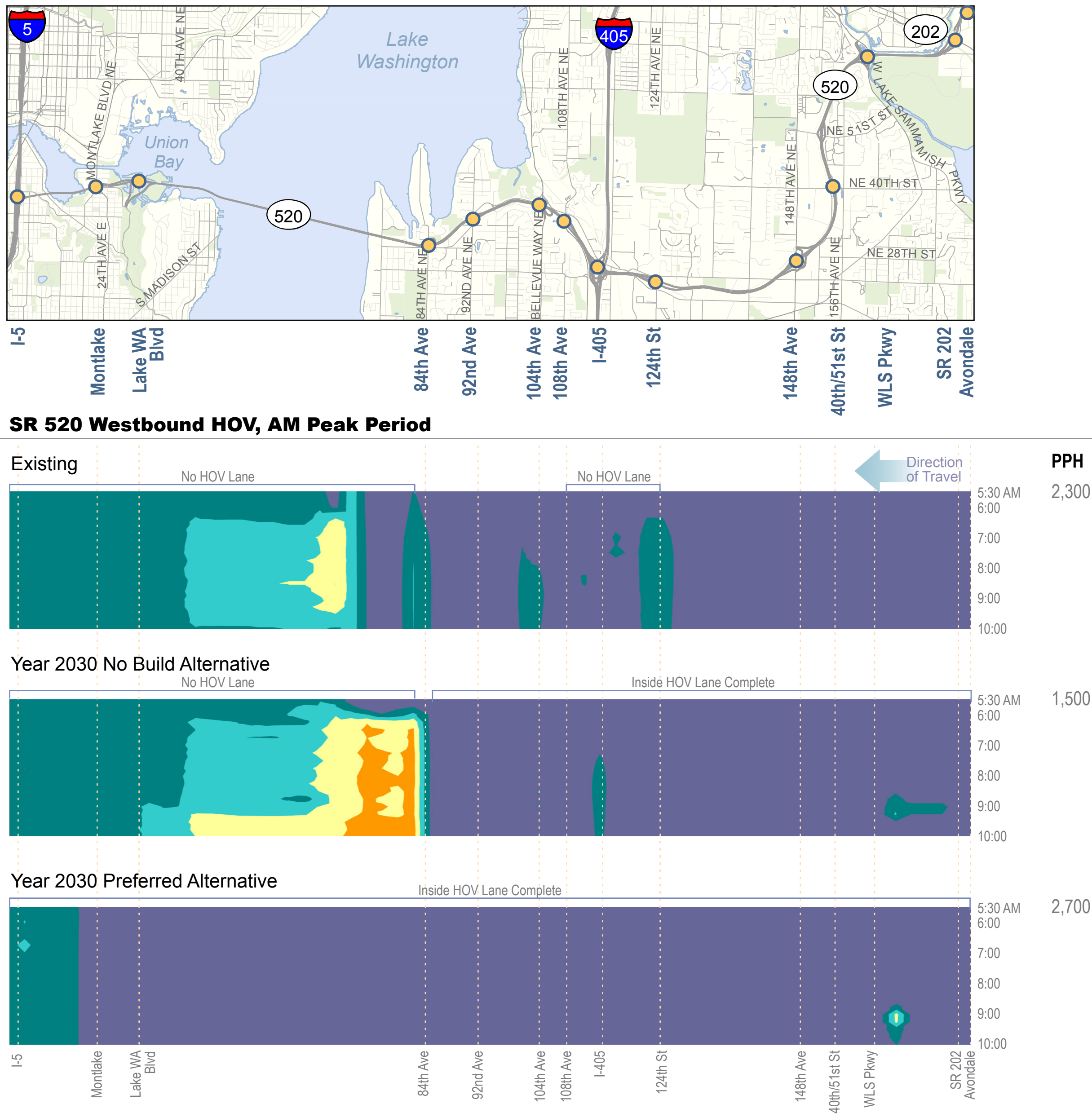


Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

PPH = Persons per hour
(average during the peak period)

Exhibit 5-9. **General-Purpose Travel Speeds – Westbound SR 520 during the AM Peak Period**
SR 520, I-5 to Medina: Bridge Replacement and HOV Project



Color Key:

50+ mph | 40-50 mph | 30-40 mph | 20-30 mph | 10-20 mph | 0-10 mph

Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

PPH = Persons per hour
(average during the peak period)

Exhibit 5-10. **HOV Travel Speeds – Westbound SR 520 during the AM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

Travel Time and Speed

The average travel time between SR 202 and I-5 is currently 16 to 22 minutes during the westbound morning commute (averaging 40 to 50 mph) for both general-purpose and HOV traffic (Exhibit 5-11). The floating span and Portage Bay section of the Evergreen Point Bridge have little to no congestion during the westbound morning commute. HOV travel is slightly faster than general-purpose travel (up to 6 minutes savings in travel time).

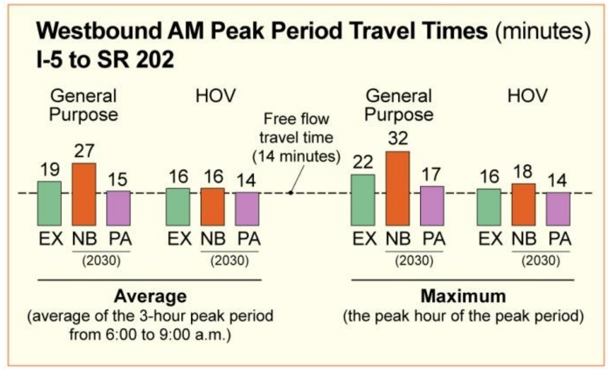


Exhibit 5-11. **Travel Time by Mode – Westbound SR 520 during the AM Peak Period**

As shown in Exhibit 5-11, travel times would increase under the No Build Alternative by the year 2030 for both general-purpose and HOV traffic. Travel time for general-purpose trips would increase to 27 minutes with a peak travel time of 32 minutes from SR 202 to I-5. Travel time for HOV trips would be about 10 minutes faster than general-purpose trips.

With the Preferred Alternative, general-purpose and HOV average travel time would improve, operating better than today's conditions or up to 15 minutes in savings compared to the year 2030 No Build Alternative.

Travel times on SR 520 outside of the study area are also reported because some of the benefits of the Preferred Alternative will be realized outside of the project limits. An effective way to capture these benefits is to compare the travel times between SR 202 and I-5.

How would eastbound SR 520 operate during the morning commute?

Without the project, SR 520 eastbound would continue to be congested between I-5 and the western approach to the Evergreen Point Bridge in Seattle. With the project, the SR 520 main line would be improved and an eastbound HOV lane would be added between I-5 and Medina. As a result, congestion at this location would be substantially reduced and vehicle and person throughput would increase.

Did you know?

Under stop-and-go conditions, 100 cars indicate about a half mile of congestion in one lane or a quarter mile of congestion in two lanes.

Volumes and Mode Share

The Preferred Alternative would serve 800 more people per hour (a 23 percent increase) and 300 more vehicles (an 8 percent increase) than the No Build Alternative (Exhibit 5-12). With the HOV lane improvements and the toll, 30 percent more people would be traveling by carpool and bus. None of the options would be able to serve all of the forecasted traffic demand because of congestion on I-5 and I-405.

Exhibit 5-12. **Vehicle and Person Trip Demand and Throughput—Eastbound SR 520 Cross-lake during the AM Peak Period**

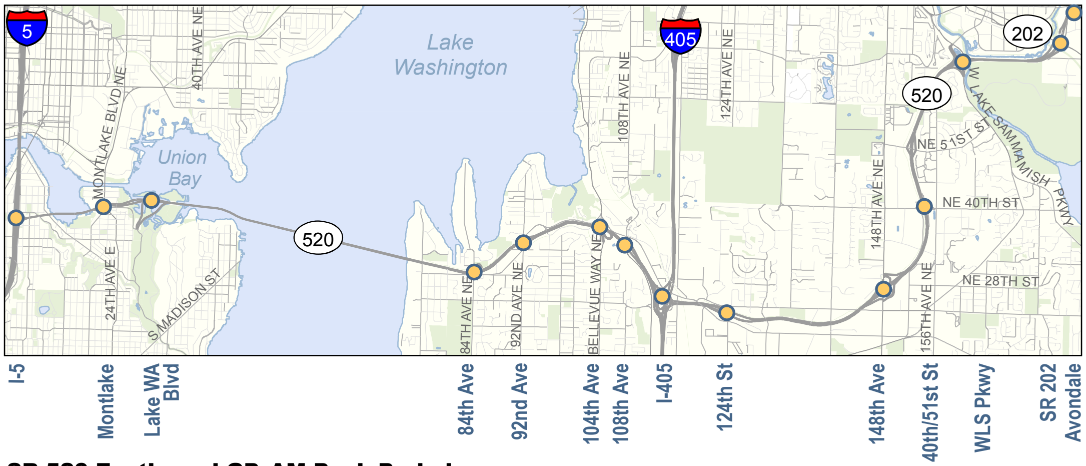
Congestion Points

The speed-flow diagrams displayed in Exhibits 5-13 and 5-14 provide a graphic representation of the congestion that occurs today, as well as with the No Build Alternative and Preferred Alternative during the eastbound morning commute. The worst of the congestion points shown in these diagrams (indicated by the red/orange areas) are discussed below, including a description of how the Preferred Alternative operates compared to the No Build Alternative.

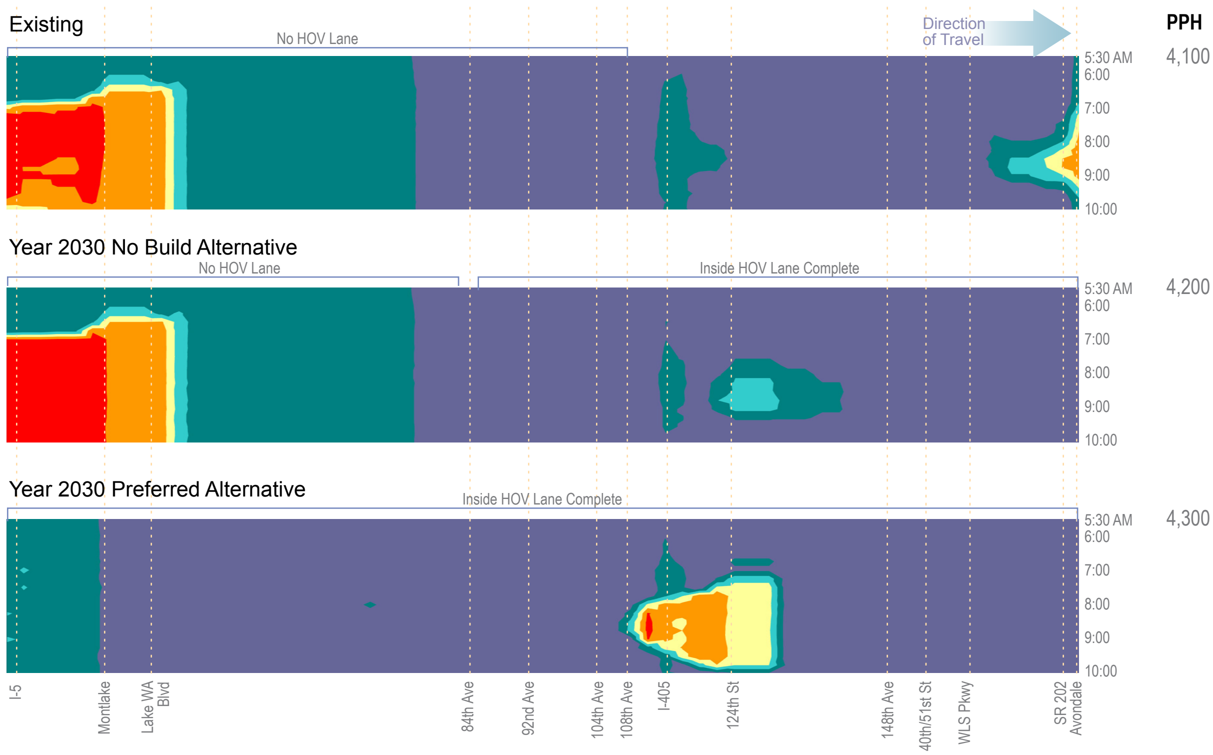
West Approach and Lake Washington Boulevard On-Ramp Merge

Congestion currently occurs approaching the west approach span of the Evergreen Point Bridge because of several reasons: the added volume and short acceleration lane for traffic merging from the Lake Washington Boulevard on-ramp, the mainline grade change approaching the western approach span, substandard shoulder widths, and visual distractions associated with the lake. The congestion at this location is present for approximately 3 hours of the morning commute period and extends back to I-5. Travel speeds are reduced to below 10 mph.

With the No Build Alternative, these conditions would remain and congestion would be worse than today. Traffic entering from the Lake Washington Boulevard on-ramp would increase by 30 percent from today to the year 2030 No Build Alternative. Congestion from SR 520 would spill back onto I-5 northbound, and operations between I-90 and SR 520 would be affected by congestion for over 3 hours during the morning commute period.



SR 520 Eastbound GP, AM Peak Period



Color Key:

50+ mph | 40-50 mph | 30-40 mph | 20-30 mph | 10-20 mph | 0-10 mph

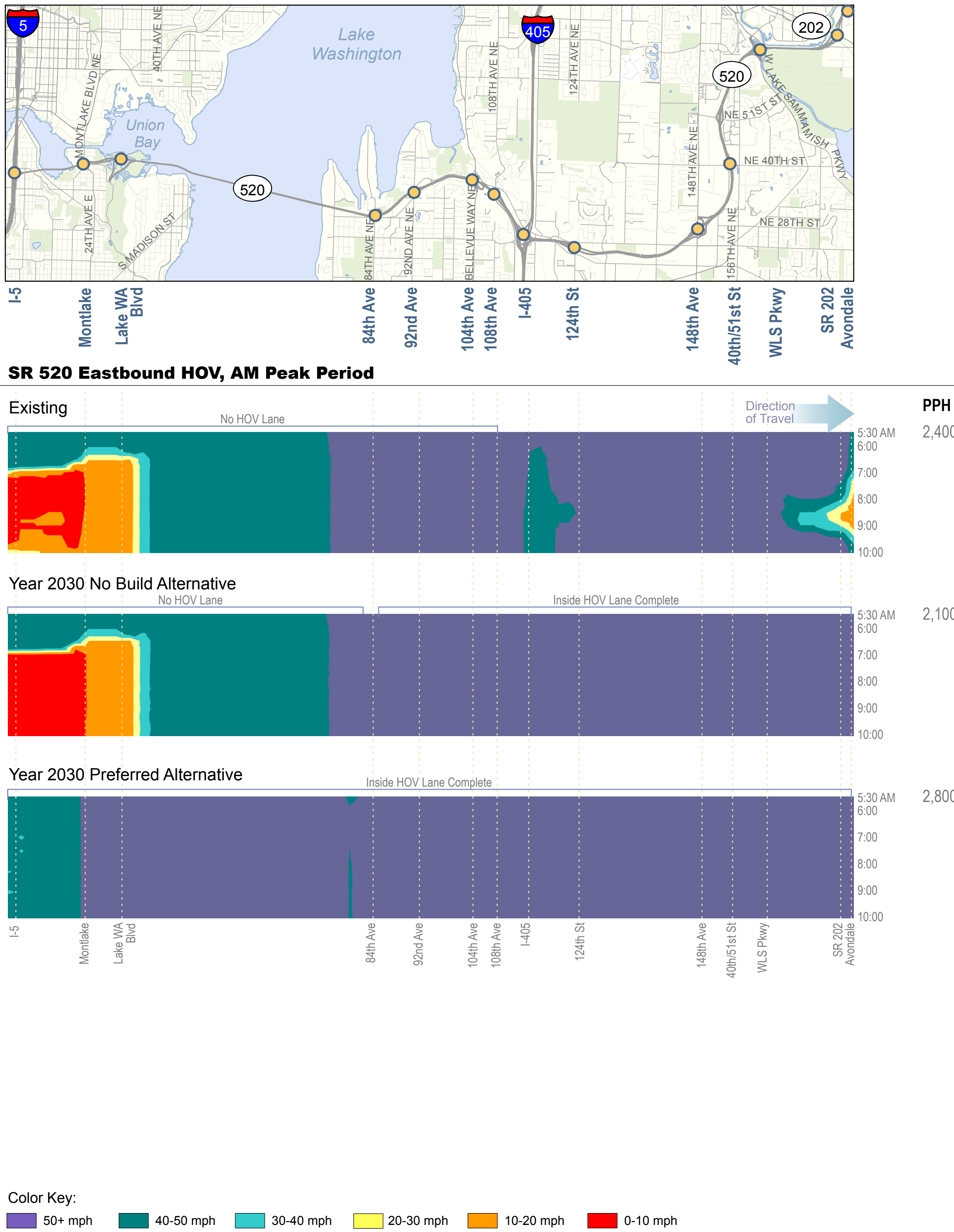
Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

PPH = Persons per hour
(average during the peak period)

Exhibit 5-13. **General-Purpose Travel Speeds – Eastbound SR 520 during the AM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project



Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

PPH = Persons per hour
(average during the peak period)

Exhibit 5-14. **HOV Travel Speeds – Eastbound SR 520 during the AM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

With the Preferred Alternative, improvements to the SR 520 main line and the removal of the Lake Washington Boulevard on-ramp, as well as the additional capacity provided by the HOV lane, would eliminate this congestion on SR 520 and its effects on I-5 operations.

I-405 Northbound Merge

In the year 2030, minor congestion would occur at the merge from I-405 northbound to SR 520 eastbound in the outside lanes with the No Build Alternative.

With the Preferred Alternative, congestion on the west side of the lake would be reduced, allowing more traffic to cross the bridge; however, this would increase congestion on SR 520 eastbound at the merge from northbound I-405. Congestion would be present at this location for approximately 2 1/2 hours during the morning commute period. As shown in Exhibit 5-14, HOV and transit traffic would be able to bypass this congestion because it occurs in the outside general-purpose lanes.

SR 520 Termination at SR 202/Avondale Road

Congestion currently occurs at the east end of the SR 520 corridor, but does not extend into the project limits (between I-5 and Medina). Congestion occurs at this location because freeway traffic volumes exceed the traffic signal's capacity at the NE Union Hill Road/SR 520/Avondale Road intersection. Congestion is present for approximately 2 hours during the morning commute period and extends back to near the SR 202 exit.

By the year 2030, congestion at this location would be substantially reduced due to completion of the SR 520, Medina to SR 202 project. The Preferred Alternative would not affect this area.

Travel Time and Speed

As shown in Exhibit 5-15, No Build Alternative travel times on SR 520 are expected to be similar to today.

With the Preferred Alternative, the additional capacity provided across the lake with the HOV lane would improve operations and travel time for both HOV and general-purpose traffic.

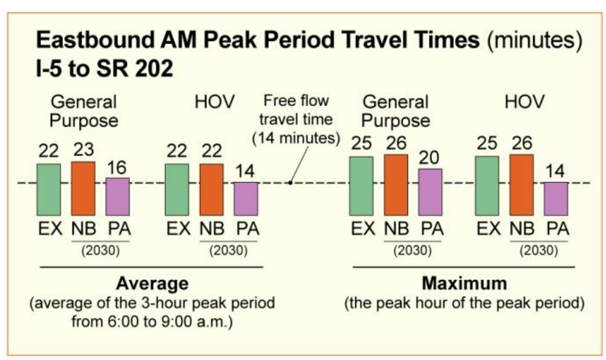


Exhibit 5-15. **No Build Alternative Travel Times on SR 520**

Average travel times would improve by up to 7 minutes for general-purpose trips and up to 12 minutes for HOV trips (with speeds above 50 mph) from I-5 to SR 202.

With the Preferred Alternative, improvements to SR 520 would substantially reduce spill back onto I-5 northbound. Travel time between Seattle and Bellevue would improve from 44 minutes at the peak of congestion with the No Build Alternative to 11 minutes with the Preferred Alternative.

How would southbound I-5 express lanes operate during the morning commute?

The reversible express lanes on I-5 operate southbound in the morning and northbound in the afternoon. The limits of the express lanes are between the Northgate area and downtown Seattle.

Today, in the morning commute, the express lane operates with congestion approaching the SR 522 on-ramp where the corridor is reduced from three lanes to two. Congestion also occurs in the central business district (CBD) in the two lanes open to general-purpose traffic. In the first lane from the outside (or right side), queues from the signals at Mercer Street and Stewart Street affect the express lanes. In the third lane, a significant queue forms for traffic exiting to the I-5 main line.

The second lane that exits to Pike Street and the fourth lane that exits to 5th Avenue and Columbia Street are HOV/transit lanes. The two HOV and transit lanes operate under free-flow conditions through this area.

By the year 2030, planned population and employment increases that are independent of the project would result in traffic demand volumes 5 percent higher than currently exists in the morning peak period. The increase in demand results in increased congestion at these bottlenecks. This increase in traffic demand is expected due to increases in employment and population in the region between now and the year 2030.

In the year 2030 No Build Alternative, congestion would be present for 4 hours of the morning commute period beginning north of SR 522, where the three-lane corridor narrows to two lanes. This congestion extends north to the express lane entrance at Northgate. The express lanes between the Ship Canal Bridge and the southern exit back to the

I-5 main line would operate similarly to today. This is because with the increased congestion at the northern SR 522 bottleneck, additional traffic would not be able to get through to the south.

In the HOV/transit lanes from the Ship Canal Bridge to the end of the express lanes, speeds would be free flow.

The Preferred Alternative includes an HOV/transit ramp connection between SR 520 and the I-5 express lanes. The Preferred Alternative would reduce the number of lanes from four to three in the express lanes across the Ship Canal Bridge to provide space for a single new HOV/transit ramp to and from SR 520. To reduce the section to three lanes to accommodate the SR 520 HOV/transit ramp, the 42nd Street NE on-ramp would be converted to a merge rather than an add lane.

In the year 2030 Preferred Alternative, the 42nd Street NE on-ramp is expected to carry up to 250 vph during the morning peak period. This is a low volume for an interstate ramp and vehicles can reasonably merge to the express lanes. Because of upstream congestion, the volume throughput across the Ship Canal Bridge is expected to be similar to today, which is a volume of traffic (5,000 vph) that can be served in the three lanes across the Ship Canal Bridge.

The SR 520/I-5 direct access ramp included in the project would add 400 buses and carpools per hour in the morning commute period. Because these additional trips are HOV and transit using the free-flow lanes, the resulting I-5 express lane operations with the SR 520/I-5 direct access ramp are similar to the No Build Alternative, as shown in Exhibit 5-16.

Exhibit 5-16. **I-5 Express Lanes, Morning Commute Peak Travel Times (minutes)**

	Existing	Year 2030 No Build Alternative	Year 2030 Preferred Alternative
General-Purpose Trips			
I-5 Express Lanes Southbound from Northgate to I-5 Main Line	26	31	31
HOV and Transit Travel			
I-5 Express Lanes Southbound from SR 520 Interchange to Stewart Street	NA	NA	1
I-5 Main Line Southbound from SR 520 Interchange to Stewart Street	2	5	5

How would I-5 main line operate during the morning commute?

In the No Build configuration, eastbound SR 520 traffic would back up from the Lake Washington Boulevard on-ramp onto I-5 where congestion would be present for over 3 hours during the morning peak period, which is similar to today. This backup limits throughput on the northbound I-5 main line and doubles the existing travel time from I-90 to NE 45th Street by year 2030. Westbound SR 520 congestion caused by the bottleneck at the Evergreen Point Bridge limits the throughput to the floating bridge and I-5 during the morning commute.

Removing the Lake Washington Boulevard access ramps and building a continuous 6-lane freeway section with inside HOV lanes will reduce congestion and increase throughput on SR 520 with the Preferred Alternative. These improvements to SR 520 will remove the eastbound congestion that backs up the northbound and southbound on-ramps from I-5. The Preferred Alternative also improves northbound and southbound I-5 main line by improving SR 520 conditions.

The Preferred Alternative will improve the Seattle to Bellevue travel time to 11 minutes. That is a 33-minute travel time savings (compared to the No Build Alternative) for Seattle to Bellevue traffic using eastbound SR 520. The average speed for travel from Seattle to Bellevue would improve from 15 mph under the No Build Alternative to 50 mph with the Preferred Alternative.

Improvements to westbound SR 520 would also allow over 200 more vehicles per hour to reach southbound I-5. The increase in westbound throughput (more vehicles) combined with the reduction in congestion from eastbound SR 520 backing onto I-5 southbound results in similar travel times between the No Build Alternative and Preferred Alternative, as shown in Exhibit 5-17. Travel between NE 45th Street to I-90 will decrease from 19 minutes under the No Build Alternative to 17 minutes with the Preferred Alternative (Exhibit 5-17).

Exhibit 5-17 also summarizes the existing and projected peak travel times on I-5 and between Seattle and Bellevue during the morning commute.

Exhibit 5-17. Morning Commute Peak Travel Times—General-Purpose Trips (minutes)

	Existing	Year 2030 No Build Alternative	Year 2030 Preferred Alternative
I-5 Northbound (Main Line) from I-90 to NE 45th Street	9	31	7
I-5 Southbound (Main Line) from NE 45th Street to I-90	11	19	17
Seattle to Bellevue (I-5 at University Street to I-405 at NE 4th/8th Streets)	25	44	11
Bellevue to Seattle (I-405 at NE 4th/8th Streets to I-5 at University Street)	19	25	13

How would westbound SR 520 operate during the afternoon commute?

In the year 2030 without the project, the SR 520 westbound general-purpose lanes would continue to be congested approaching the bridge on the east side because of the HOV lane merge near 84th Avenue NE in Medina. With the project, congestion at this location would be substantially reduced and vehicle and person throughput would increase.

Volumes and Mode Share

As shown in Exhibit 5-18, the Preferred Alternative would serve 800 more people per hour (a 13 percent increase) than the No Build Alternative with an increase of only 200 vehicles (5 percent). With the Preferred Alternative's HOV lane improvements and toll, up to 50 percent more people would be traveling by carpool and bus compared to the No Build Alternative. None of the alternatives would be able to serve all of the forecasted traffic demand because of congestion on I-5 and I-405.

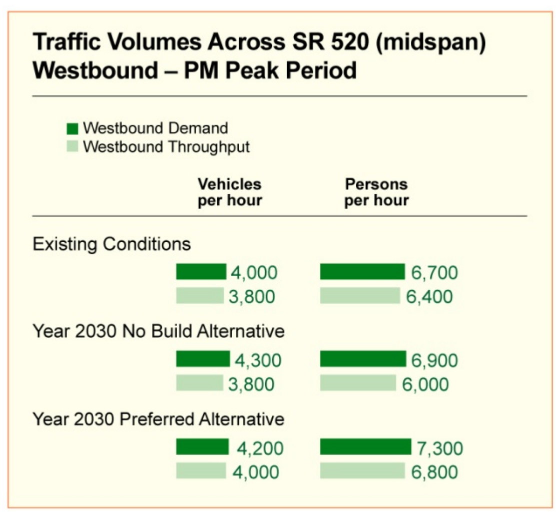


Exhibit 5-18. SR 520 Westbound Vehicle and Person Trips during the PM Peak Period

The northbound I-5 express lane connection to SR 520 eastbound in the afternoon would serve 550 vph (transit and HOV), which equals 2,500 persons per hour.

Congestion Points

WSDOT developed speed-flow diagrams using existing data and model output to provide a graphic representation of the congestion that occurs today and in the year 2030. Exhibits 5-19 and 5-20 show where congestion would occur on the SR 520 corridor with the No Build Alternative and Preferred Alternative during the westbound afternoon commute. The worst of the congestion points shown in these diagrams (indicated by the red\orange areas) are discussed below, including how the Preferred Alternative operates compared to the No Build Alternative.

Bridge Approach at the Eastern Lake Shore

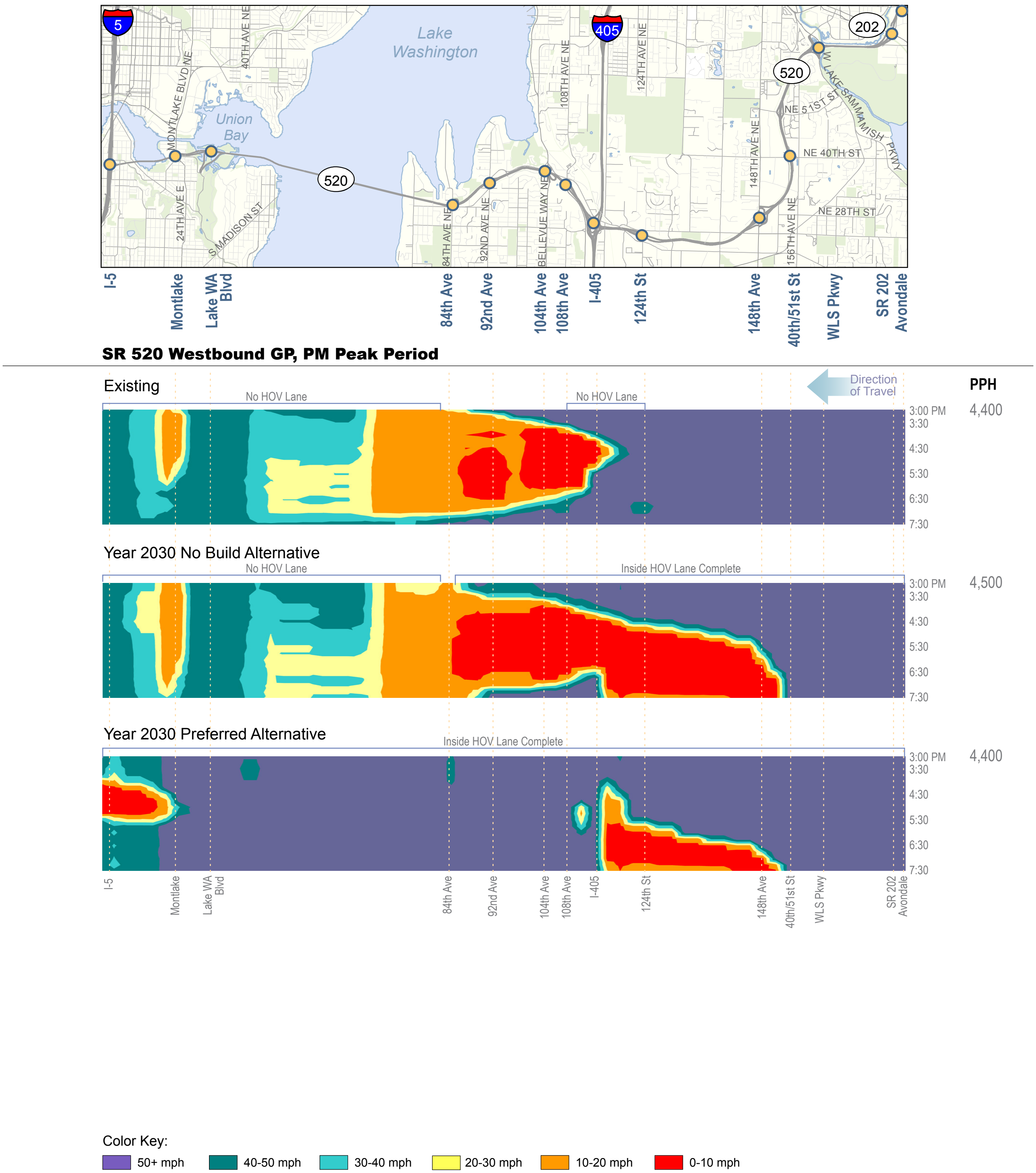
As shown in Exhibit 5-19, the most severe congestion on westbound SR 520 occurs between the east approach to the Evergreen Point Bridge, near the 84th Avenue NE on-ramp and the HOV lane termination, and the I-405 interchange. The congestion at this location is present for approximately 4 hours during the evening commute, and limits the amount of traffic that can cross the bridge.

This congestion would increase by the year 2030 with the No Build Alternative. With the SR 520, Medina to SR 202 project, the HOV lane would be relocated to the inside (compared to today). This action would allow the HOV trips to bypass some of the congestion.

With the Preferred Alternative, the HOV lane would be extended across the Evergreen Point Bridge to I-5, eliminating congestion at this point for both HOV and general-purpose traffic. This action would result in improved travel for both modes of transportation.

I-405 Northbound and Southbound

The I-405 northbound and southbound main lines are currently congested during the afternoon commute. I-405 congestion causes the I-405/SR 520 interchange ramps to back up onto SR 520 westbound, causing congestion that extends back to 124th Avenue NE. Congestion limits the amount of traffic that can exit from SR 520 to I-405, and also determines how much traffic can enter SR 520 from I-405.



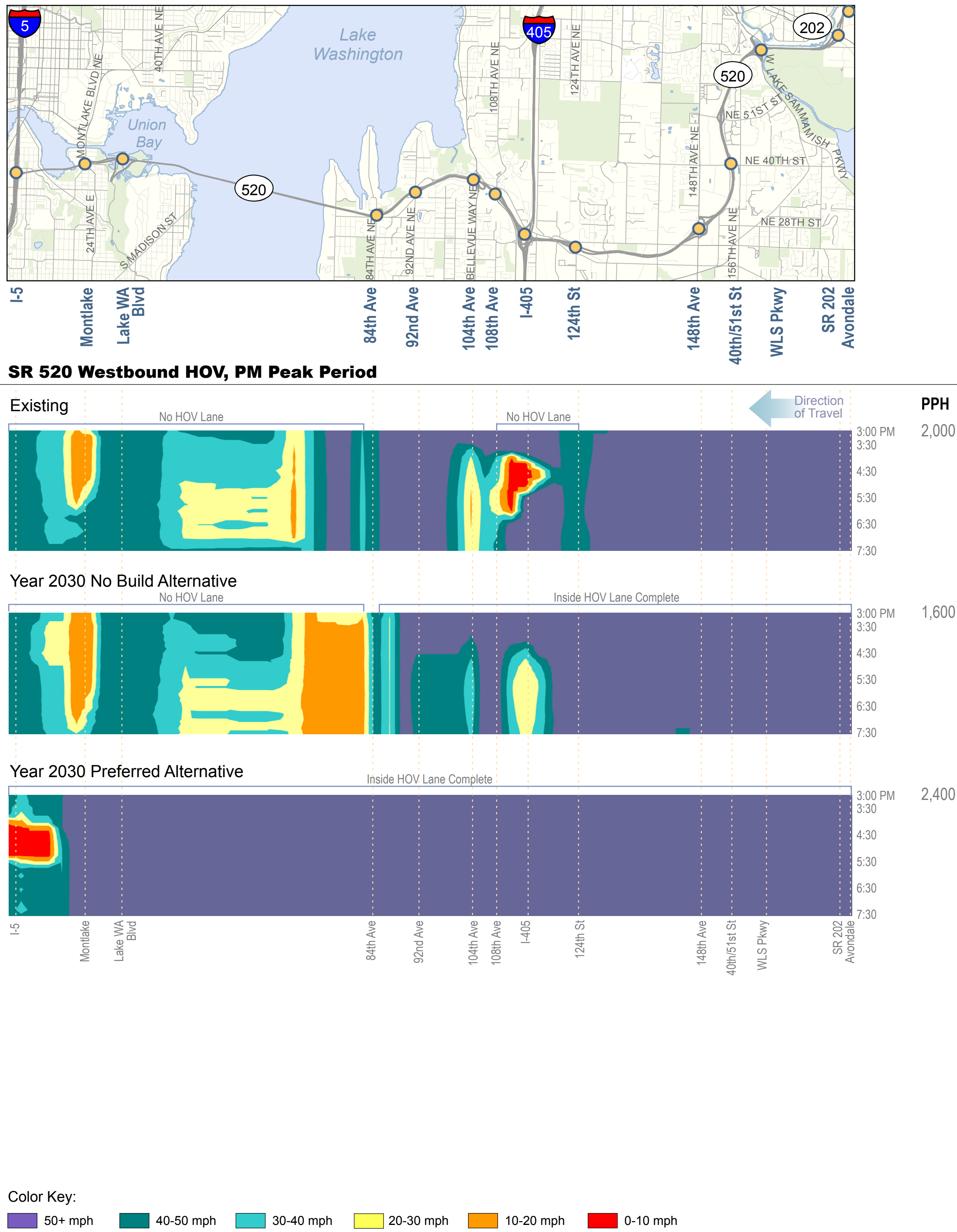
Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

PPH = Persons per hour (average during the peak period)

Exhibit 5-19. **General-Purpose Travel Speeds – Westbound SR 520 during the PM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project



Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

PPH = Persons per hour
(average during the peak period)

Exhibit 5-20. **HOV Travel Speeds – Westbound SR 520 during the PM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

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In the year 2030 No Build Alternative, queues that begin from the eastern lake shore would compound the congestion in this area. The resulting congestion would extend back to the NE 40th/51st Street interchange area and would be present for nearly 3 1/2 hours of the evening commute. Carpools and buses would be able to bypass this congestion in the inside HOV lane.

I-405 traffic would still back up onto SR 520 with the Preferred Alternative. However, because the congestion is eliminated at the eastern lake shore, the resulting queue would not be as extensive as under the No Build Alternative. With the Preferred Alternative, the congestion from I-405 would affect SR 520 operations between the 148th Avenue NE interchange area and I-405 and would be present for 3 1/2 hours during the evening commute.

Across Portage Bay Bridge

Today, there is moderate congestion on SR 520 between the Montlake Boulevard on-ramp merge point and I-5 due to the short acceleration lane. Drivers cannot get up to freeway speeds and drivers on the SR 520 main line must slow down to accommodate entering vehicles. Drivers changing lanes to access the I-5 off-ramps and congestion spilling back from I-5 also contribute to congestion in this area. Traffic speeds average 30 mph for approximately 2 to 3 hours (refer to Exhibits 5-17 and 5-19).

With the No Build Alternative, Portage Bay Bridge would operate similarly to its operation today (refer to Exhibits 5-17 and 5-19) with reduced speeds lasting for 3 hours during the evening commute. While traffic demand for this area increases, traffic volume throughput is significantly reduced by the congestion on the east side of the lake.

The Preferred Alternative includes a hard-shoulder-running auxiliary lane between Montlake and I-5, which would operate during the peak commute periods. The Preferred Alternative also improves the transit access points (transit can access the direct access ramp from the HOV lane rather than crossing the general-purpose lanes), and includes a ramp meter on the westbound on-ramp from Montlake. With these geometric capacity improvements between the western lake shore and I-5, the corridor would operate better overall in the shoulder periods (before 4 p.m. and after 6 p.m.). During the peak of the evening commute, however, enough traffic would be served across SR 520 to have the I-5 interchange ramps operating at over capacity. This means for about an hour and a half during the evening commute, congestion from I-5 would be present on SR 520.

Travel Time and Speed

The average travel time today between SR 202 and I-5 during the westbound afternoon commute is approximately 33 minutes for general-purpose trips and 23 minutes for HOV trips (Exhibit 5-21). The difference in travel times is due to the westbound congestion approaching the bridge in Medina, which HOVs can bypass. Typically, some congestion also occurs in the SR 520/Montlake Boulevard interchange/Portage Bay sections during the afternoon commute.

As shown in Exhibit 5-21, general-purpose travel times for the No Build Alternative are expected to increase to 60 minutes at the peak of congestion. The HOV lane, however, will operate better than today due to the SR 520, Medina to SR 202 project improvements. During the peak of congestion, HOV travel times would be 9 minutes faster than today.

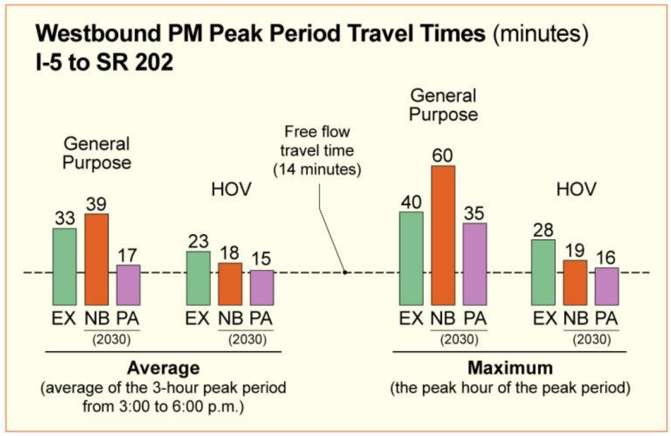


Exhibit 5-21. **Westbound PM Peak Period Travel Times—I-5 to SR 202**

The Preferred Alternative would have an improved operation compared to the No Build Alternative between SR 202 and I-5. When congestion is at its peak, the Preferred Alternative would provide a travel time savings for general-purpose travel of 25 minutes (compared to the No Build Alternative). HOV trips would be able to bypass most of the congestion in both the No Build Alternative and Preferred Alternative during the afternoon westbound commute.

How would eastbound SR 520 operate during the afternoon commute?

By the year 2030, traffic congestion on the I-405 main line would have some effects on the SR 520 eastbound afternoon commute. Congestion would occur near the Montlake Boulevard and Lake Washington Boulevard interchange areas. Improvements associated with the Preferred Alternative would result in better operation on the western side of Lake Washington.

Volumes and Mode Share

The Preferred Alternative would serve 1,200 more people (an 18 percent increase) than the No Build Alternative, with an increase of only 100 (3 percent) more vehicles (Exhibit 5-22). With the HOV lane improvements and toll, up to 75 percent more people would travel by carpool and bus.

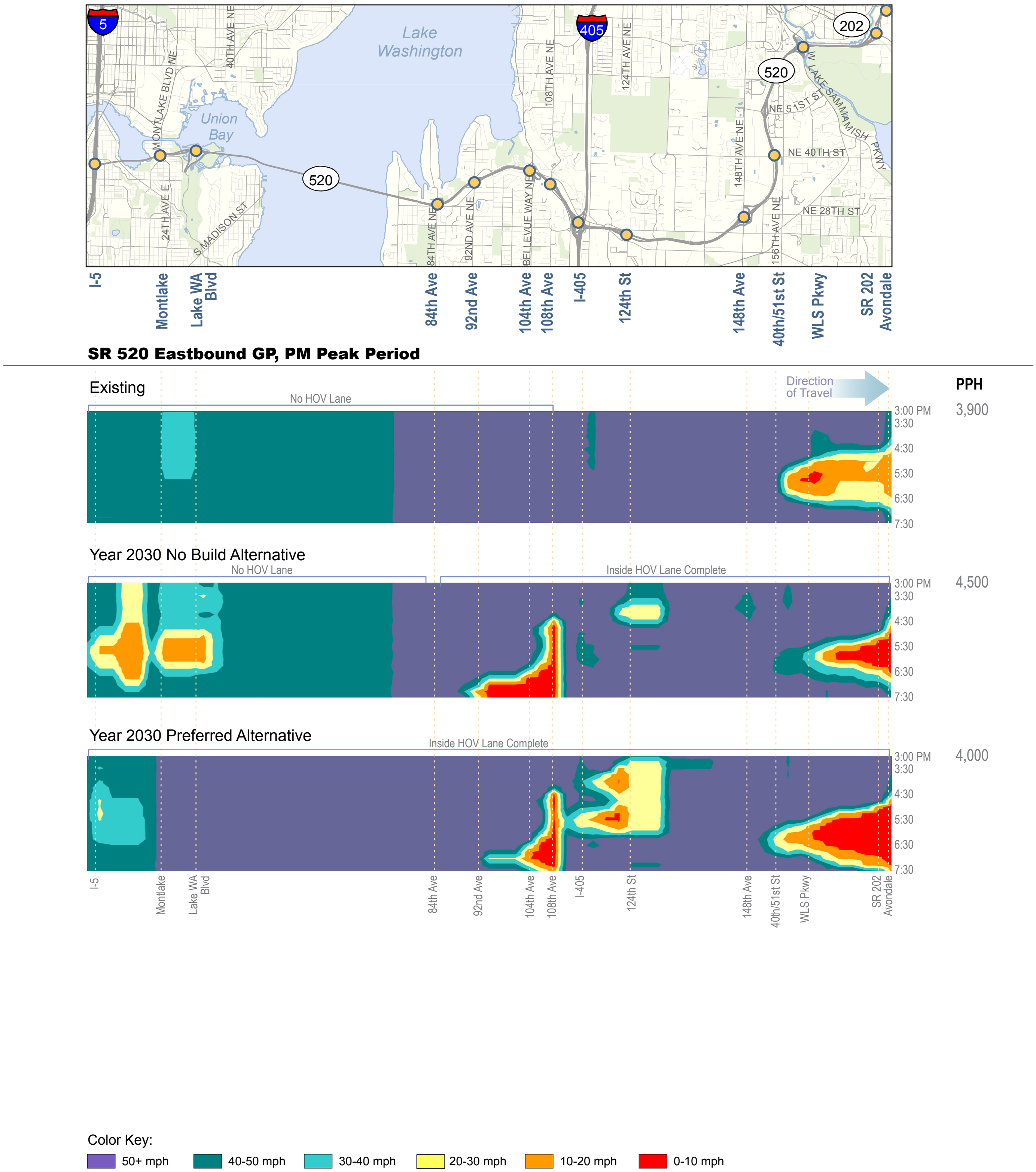
Exhibit 5-22. **Vehicle Demand and Throughput across Eastbound SR 520 (midspan) during the PM Peak Period**

Congestion Points

The speed-flow diagrams displayed in Exhibits 5-23 and 5-24 provide a graphic representation of the eastbound afternoon commute congestion that occurs today and in the year 2030 with the No Build Alternative and Preferred Alternative. These congestion points are discussed below, including a description of what causes the congestion at each location.

Portage Bay Bridge to West Approach

In the year 2030 with the No Build Alternative, congestion would occur from the Montlake interchange to the west approach span of the Evergreen Point Bridge. This congestion would occur because the off-ramp intersection at Montlake would operate over capacity and queue onto SR 520 eastbound. Additional factors causing congestion include the short acceleration lane for traffic merging from the Lake Washington Boulevard on-ramp, the mainline grade change approaching the western approach span, substandard shoulder widths, and visual distractions associated with the lake. Congestion would be present at this location for approximately 4 hours and would at times extend back to I-5. Travel speeds would be reduced to below 10 mph. The congestion would limit the amount of traffic that could cross the bridge, which would prevent some traffic congestion at points farther east on SR 520.



Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

PPH = Persons per hour
(average during the peak period)

Exhibit 5-23. **General-Purpose Travel Speeds – Eastbound SR 520 during the PM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

With the Preferred Alternative, improvements to the SR 520 main line, reduction in access points (closure of the Lake Washington Boulevard on-ramp), improvements to the Montlake interchange arterial operations, as well as the additional capacity provided by the HOV lane would decrease the congestion compared to the No Build Alternative. Traffic speeds for the No Build Alternative are between 10 and 20 mph for most of the peak period. With the Preferred Alternative, traffic speeds would be above 30 mph for the peak period.

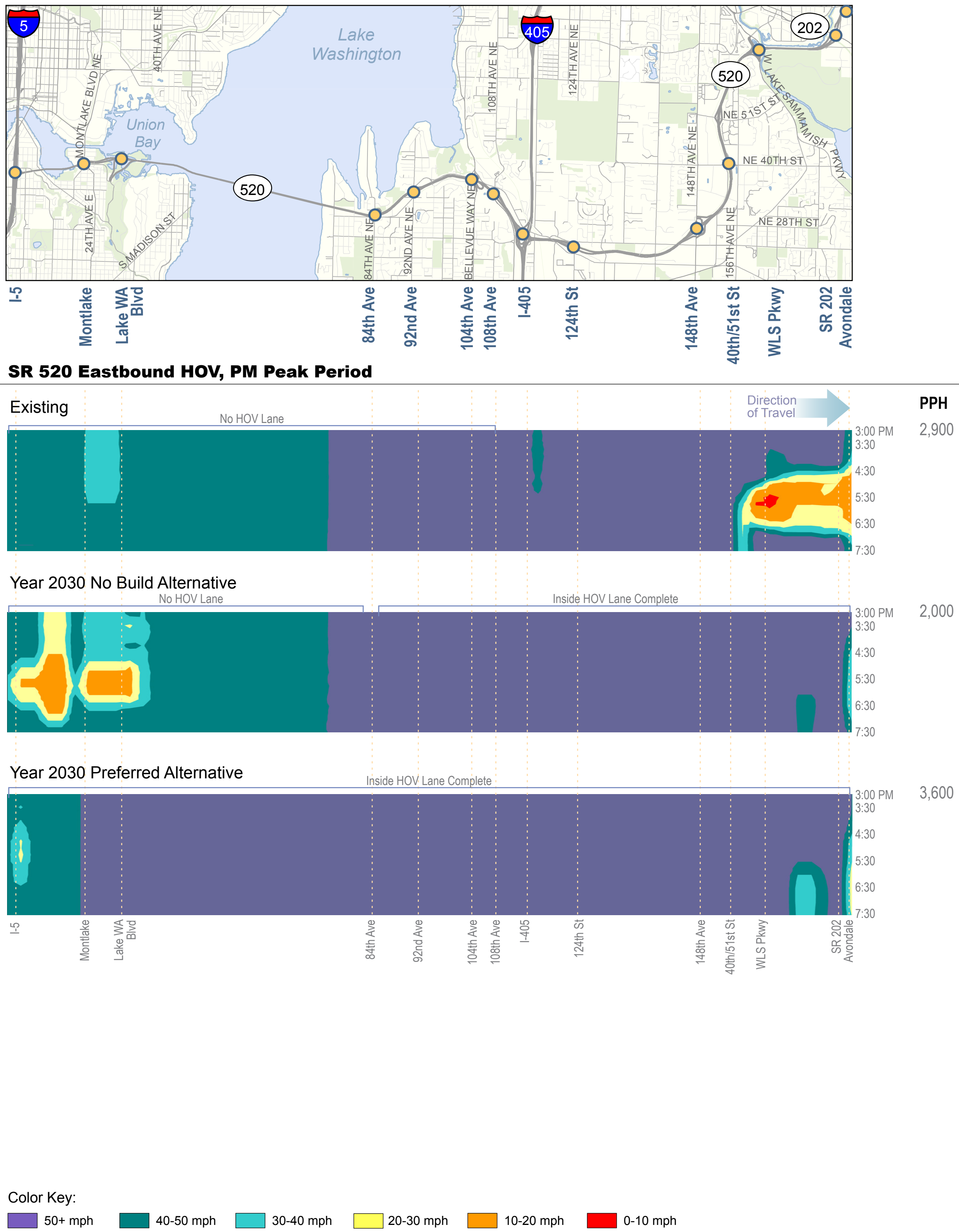
I-405 Northbound and Southbound

Traffic is currently congested on I-405 through downtown Bellevue during the afternoon commute period because traffic volumes exceed roadway capacity. Some moderate congestion occurs northbound on I-405 between NE 4th Street and the SR 520 off-ramps because the I-405 northbound-to-SR 520 eastbound ramp is over capacity. High traffic volumes and merging vehicles between the NE 8th Street on-ramp and the SR 520 off-ramps also contribute to congestion in this area. Although this congestion typically does not affect SR 520 operations, it likely reduces traffic able to access SR 520.

By the year 2030, congestion on SR 520 approaching the SR 520/I-405 interchange would be worse due to I-405 traffic backing up onto the SR 520 ramps. Under the No Build Alternative and the Preferred Alternative, congestion on the SR 520 off-ramp to northbound I-405 would spill back onto the SR 520 main line and cause congestion extending back to the 92nd Avenue NE on-ramp. For both alternatives, the HOV/transit trips would be able to bypass this congestion with the inside HOV lane (Exhibit 5-24).

SR 520 Termination at SR 202/Avondale Road

Congestion currently occurs at the east end of the SR 520 corridor, but does not extend into the project limits (between I-5 and Medina). Congestion occurs at this location because freeway traffic volumes exceed the traffic signal's capacity at the NE Union Hill Road/ SR 520/Avondale Road intersection. Congestion would be present at this location for up to 2 1/2 hours and extend back to the NE 40th Street interchange at its peak.



Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

PPH = Persons per hour
(average during the peak period)

Exhibit 5-24. **HOV Travel Speeds – Eastbound SR 520 during the PM Peak Period**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

\\simba\proj\Parametrix\180171\GRAPHICS\x_FEIS_Westside\TRAN\WS_FEIS_DR_TRAN_Ex05-24_GR500-6_PM-EB_HOV_22mar11.ai

By the year 2030, congestion at this location would be similar to today. There would be a large increase in traffic demand at the east end of the corridor due to land use changes; however, the effect of increased traffic would be offset with the completion of the SR 520, Medina to SR 202 project.

With the Preferred Alternative, up to an additional 100 vph would reach this area due to improvements on the western end of the corridor. Because the area is over capacity and queued up today, any additional trips would add to that congestion.

Travel Times and Speed

Today, the average travel time between I-5 and SR 202 for general-purpose and HOV traffic is approximately 18 minutes during the afternoon commute (Exhibit 5-25).

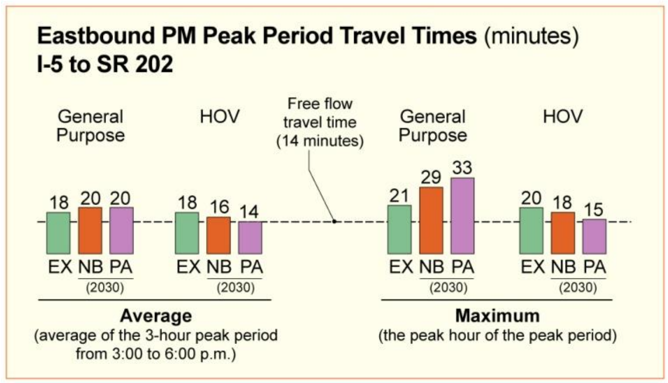


Exhibit 5-25. **SR 520 Eastbound PM Peak Period Travel Times – I-5 to SR 202**

By the year 2030 with the No Build Alternative, both general-purpose and HOV travel times would increase due to I-405 mainline congestion backing up onto SR 520. General-purpose travel times would range between 20 (average) and 29 minutes during the peak hour of travel. HOV average travel times would be 14 minutes.

With the Preferred Alternative, the average general-purpose trip would be similar to the No Build Alternative. The maximum travel time would increase to 33 minutes. However, the HOV travel times would decrease by a few minutes compared to the No Build Alternative.

How would northbound I-5 express lanes operate during the afternoon commute?

The reversible express lanes on I-5 operate southbound in the morning and northbound in the afternoon. The limits of the express lanes are the Northgate area and downtown Seattle.

In the evening today, congestion builds in the general-purpose lane at the exit near Northgate and spills back past the SR 522 off-ramp. The HOV lane designation northbound begins at the SR 522 off-ramp so HOV/transit is affected by this congestion. However, once north of the SR 522 off-ramp, HOV/transit operate at free-flow speed.
The remaining portions of the express lanes also operate in free-flow conditions.

By the year 2030, traffic volumes are expected to increase in the express lanes by 10 percent during the afternoon peak period. This increase in demand would result in increased congestion at the existing bottlenecks. This traffic increase is expected due to projected increases in employment and population in the region between now and the year 2030.

In the afternoon, northbound congestion from the I-5 main line at Northgate would affect operations on the express lanes for 4 hours during the evening commute with the peak of congestion extending to the Mercer Street interchange. South of SR 522, where there is no HOV designation, HOV and transit trips would operate with congestion. However, HOV/transit would operate at free-flow speed between SR 522 and Northgate. South of the Mercer Street interchange, operations would be near free flow.

The Preferred Alternative includes an HOV/transit ramp connection between SR 520 and the I-5 express lanes. The Preferred Alternative would reduce the number of lanes from four to three in the express lanes across the Ship Canal Bridge to provide space for a single new HOV/transit ramp to and from SR 520. To reduce the section to three lanes to accommodate the SR 520 HOV/transit ramp, the 42nd Street NE ramp would be converted to a diverge ramp northbound rather than a drop lane.

In year 2030, the 42nd Street NE ramp is expected to carry up to 600 vph during the PM peak hour. The volume throughput across the Ship Canal Bridge is expected to be similar to today, which is a volume of traffic (5,300 vph) that can be served in the three lanes across the Ship Canal Bridge.

In both the Preferred Alternative and No Build Alternative, congestion begins at the northern end and extends near the SR 520 interchange area. With the Preferred Alternative, traffic volumes would only be greater between downtown Seattle and the SR 520 interchange area. For year 2030 under the No Build Alternative and the Preferred Alternative, travel time is the same from the entrance to the I-5 main line in downtown Seattle to Northgate for both alternatives.

Travel for HOVs and transit trips destined to the SR 520 interchange ramp would be better than mainline operations. Mainline I-5 travel times for this same segment would be up to 5 minutes during the peak of congestion. I-5 express lanes would provide a 4-minute travel time savings for transit trips destined to SR 520.

General-purpose travel times in the express lanes and transit travel times between downtown Seattle and SR 520 are shown in Exhibit 5-26.

Exhibit 5-26. **Evening Commute Peak Travel Times**

	Existing	Year 2030 No Build Alternative	Year 2030 Preferred Alternative
General-Purpose Trips			
I-5 Express Lanes Northbound from I-5 Main Line to Northgate	13	34	34
Transit Travel			
I-5 Express Lanes Northbound from Stewart Street to SR 520 Interchange	NA	NA	1
I-5 Main Line Northbound from Olive Street to SR 520 Interchange	3	4	5

How would I-5 main line operate during the afternoon commute?

Under No Build conditions, evening congestion on westbound SR 520 restricts the volume of traffic that reaches the I-5 corridor. The SR 520 throughput to both northbound and southbound I-5 is expected to be noticeably lower than demand, improving conditions on I-5 southbound and northbound from SR 520. Eastbound congestion on SR 520 from the Lake Washington Boulevard on-ramp backs up the I-5 off-ramp to SR 520, slowing the northbound I-5 main line.

Consolidating the Lake Washington Boulevard access to the Montlake interchange, together with a continuous 6-lane freeway section with inside HOV lanes, would reduce congestion and increase throughput on SR 520 under the Preferred Alternative. As a result of this increased throughput during the evening commute, the same section of I-5 would be congested for about an hour longer than the No Build Alternative because more traffic is allowed to reach the I-5 corridor. This is an increase in volume throughput, not an increase in demand. The improvements to SR 520 allow about 200 more vehicles per hour to reach the already existing southbound I-5 congestion, thus extending the severity and duration of congestion.

Despite the increase in travel times during the evening commute, both I-5 and SR 520 would serve more vehicles and more people in these vital segments of the network. Exhibit 5-27 summarizes the peak travel times during the evening commute for existing conditions, No Build Alternative, and Preferred Alternative.

Exhibit 5-27. **Evening Commute Peak Travel Times—General-Purpose Trips (minutes)**

	Existing	Year 2030 No Build Alternative	Year 2030 Preferred Alternative
I-5 Northbound (Main Line) from I-90 to NE 45th Street	11	13	15
I-5 Southbound (Main Line) from NE 45th Street to I-90	22	20	29
Seattle to Bellevue (I-5 at University Street to I-405 at NE 4th/8th Streets)	15	23	19
Bellevue to Seattle (I-405 at NE 4th/8th Streets to I-5 at University Street)	43	41	28

Chapter 6—Local Volumes and Operations

What is in this chapter?

This chapter discusses the results of the SR 520 transportation team's traffic forecasts and operations analysis of local streets adjacent to SR 520. The analysis results were used to compare existing traffic conditions with the effects of the year 2030 No Build Alternative and Preferred Alternative. The No Build Alternative allowed the team to first determine what local street and intersection traffic operations would be like in the future if the project were not built. The Preferred (Build) Alternative was then compared to the No Build Alternative to determine effects on traffic conditions that would result from the project.

As described in Chapter 4, traffic operations were analyzed at intersections where the total approaching traffic is forecasted to increase by 5 percent or more compared to the No Build Alternative. This forecasted increase occurred at some locations in the Montlake interchange area. The Montlake interchange area includes the neighborhoods from north of the Montlake Boulevard/NE Pacific Street intersection to south of the SR 520/Montlake Boulevard interchange. The following detailed analysis documents the projected changes in local traffic operations with the Preferred Alternative compared to the No Build Alternative within this interchange area.

What is traffic like at the Montlake Boulevard interchange area today?

The SR 520/Montlake Boulevard interchange area, which provides access to and from SR 520, is congested during the morning and afternoon peak hours. This congestion is partially related to traffic flow on SR 520 (which can affect traffic flow on the local street network), and traffic flow on the local street network (which can affect traffic flow on SR 520).

Freeway traffic operations on SR 520 are managed by using the eastbound on-ramp meter to control the flow of traffic entering SR 520. On-ramp traffic volumes at this location exceed the storage capacity on the ramp and queue onto Montlake Boulevard. At times, congestion on

SR 520 exceeds a level that can be managed by the ramp meter, meaning congestion from SR 520 spills back through the merge point and past the ramp meter.

Traffic congestion associated with the eastbound SR 520 on-ramp can extend back across the Montlake Bridge. When traffic is backed up in the outside right lane, Montlake Boulevard southbound is constrained to one lane for drivers traveling to the south of SR 520.During the morning and afternoon commutes, traffic typically backs up on southbound Montlake Boulevard approaching the on-ramp to eastbound SR 520. Traffic congestion can extend across the Montlake Bridge to the Montlake Boulevard/NE Pacific Street intersection and as far back as 25th Avenue NE near University Village (approximately 1 mile). Congestion can also occur on NE Pacific Street eastbound, extending back through the NE Pacific Place intersection. The factors described in the following paragraphs contribute to the congestion in the SR 520/Montlake Boulevard interchange area.

Drivers traveling northbound on Montlake Boulevard NE to access SR 520 westbound must make a U-turn at the Montlake Boulevard/East Hamlin Street intersection. These vehicles often spill out of the U-turn pocket. This occurrence blocks the inside northbound lane on Montlake Boulevard, which constrains through traffic to a single lane. This, in turn, affects traffic exiting the eastbound off-ramp and other intersections to the south.

Some drivers who use the SR 520 westbound off-ramp want to travel southbound on Montlake Boulevard or reach the Shelby/Hamlin neighborhood west of Montlake Boulevard. These drivers stop at the end of the westbound off-ramp to wait for a gap in traffic to aggressively merge across the two northbound through lanes and access the U-turn at the East Hamlin intersection. Accommodating this movement can worsen northbound congestion and create backup on the westbound off-ramp.

Montlake Bridge openings can have long-lasting effects on traffic flow in this area. The bridge does not open during the morning and afternoon peak periods; however, if the bridge opens at the end of the midday period (3:30 p.m.), it can affect traffic operations throughout the afternoon commute. Bridge openings compound whatever congestion is present on the local street network and can cause congestion to spill back onto the SR 520 main line. When congestion reaches the SR 520 corridor, eastbound traffic can then become so congested that it affects traffic on I-5.

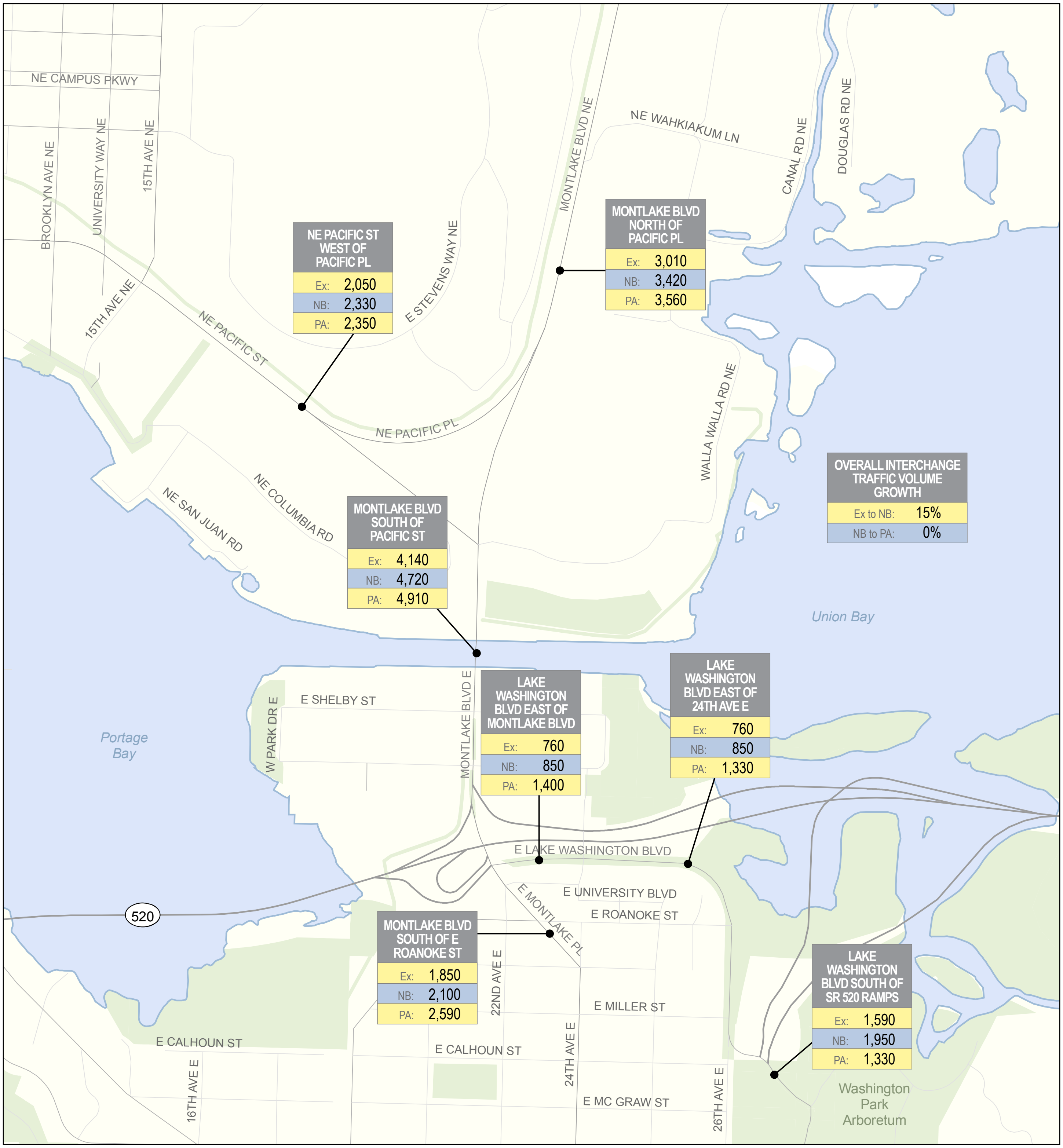
An average of 10 bridge openings occurs during a typical summer weekday (fewer openings occur during other times of the year). Bridge openings typically last 4 to 5 minutes, but can extend up to 6 minutes on occasion (WSDOT 2008a).

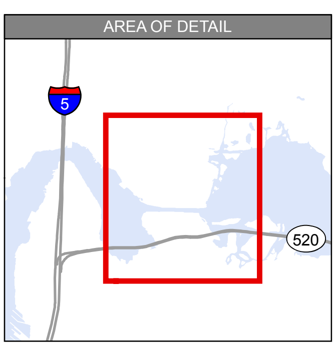
Montlake Bridge opening delays make it difficult for bus drivers to keep to their schedules, affecting bus travel times and reliability. Additional discussion on the effects on bus travel times is provided in Chapter 8.

Montlake Boulevard NE is an important transit corridor, serving both local and regional buses between the SR 520/Montlake interchange and the University District. Montlake Boulevard NE, NE Pacific Street, and 15th Avenue NE are considered Urban Village Transit Network corridors as identified in the Seattle Transit Plan (SDOT 2005). Today, minimal transit priority is provided along the Montlake corridor. A transit or HOV ramp meter bypass lane is provided at the eastbound on-ramp. Queue jumps are also provided for northbound transit after the bus stop at Montlake Boulevard/East Shelby Street and from the HOV lane along NE Pacific Street turning southbound at the Montlake Boulevard/NE Pacific Street intersection.

Morning and afternoon peak-hour traffic volumes on streets within the SR 520/Montlake Boulevard interchange area are shown in Exhibits 6-1 and 6-2.

WSDOT analyzes the study intersection operations and assigns a letter grade (as discussed in Chapter 4). This letter grade represents the operations of that intersection alone assuming all traffic demand can reach that intersection. The letter grade does not include congestion from adjacent intersections or from SR 520 that may spill into that intersection. This process allows engineers to design each intersection to provide sufficient capacity for the traffic demand rather than limit the operations due to external constraints that could or would be removed in the future.





LOCATION	
Existing — Ex:	Volume
No Build — NB:	Volume
Preferred Alternative — PA:	Volume

Volumes are totals for both directions

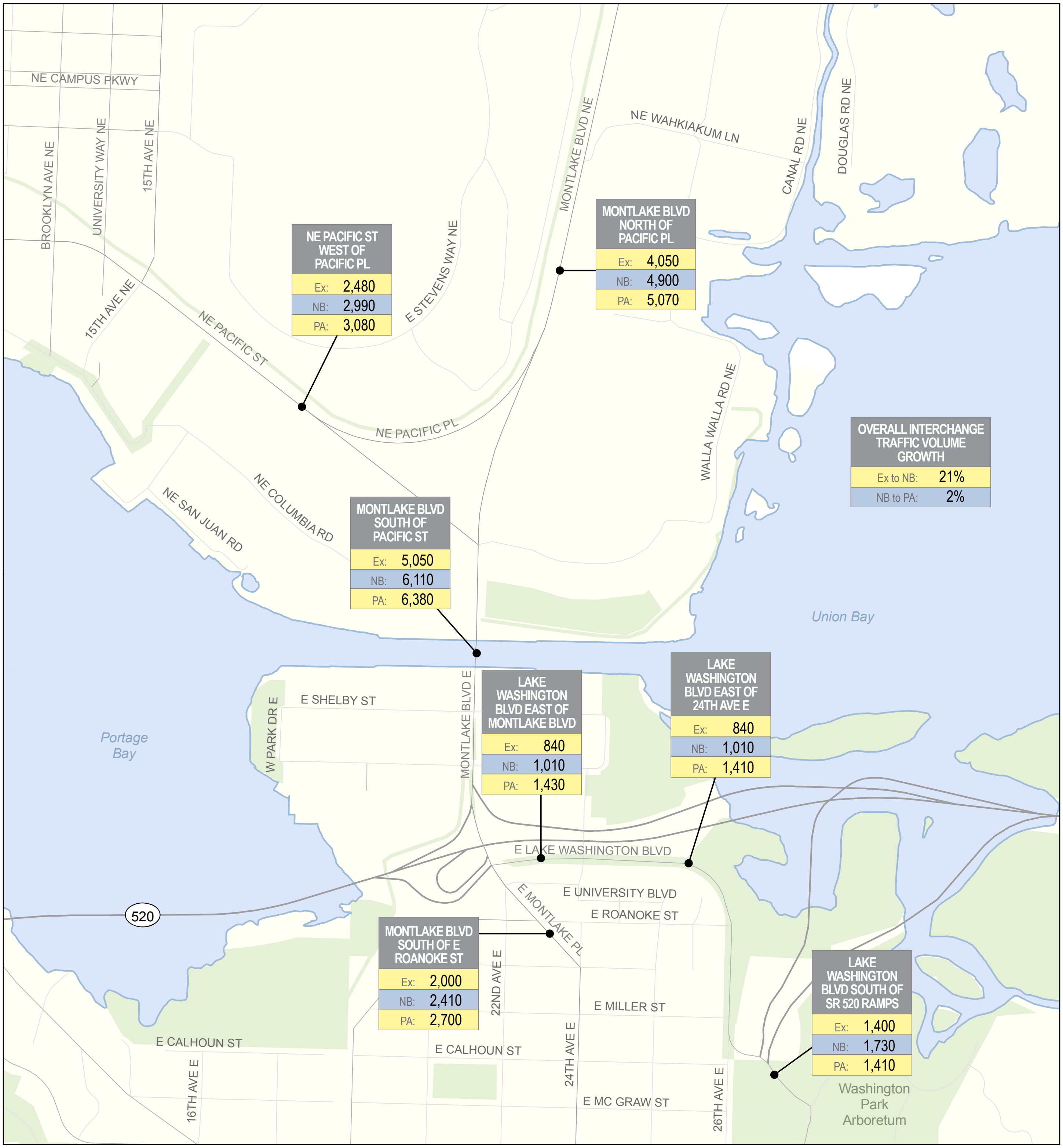
N

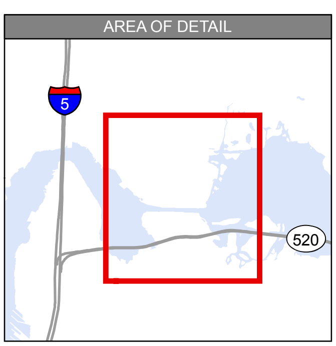
0 500 1,000 Feet

Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 6-1. **SR 520/Montlake Boulevard Interchange Area – AM Peak Hour Vehicle Volumes**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project





Source: King County (2008) GIS Data (Streams, Streets, Water Bodies), CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 6-2. **SR 520/Montlake Boulevard Interchange Area – PM Peak Hour Vehicle Volumes**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

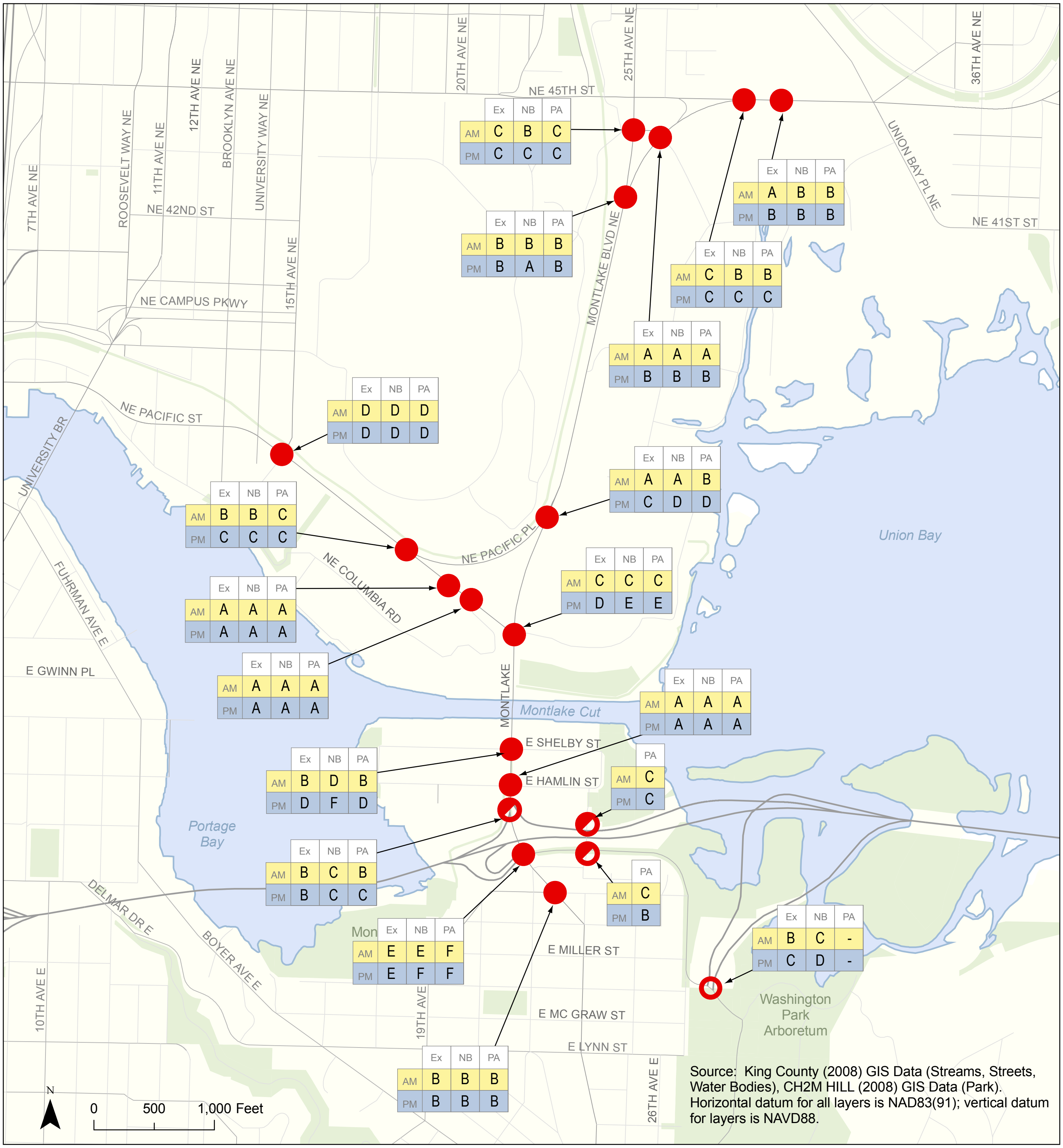
Exhibit 6-3 shows that most intersections in the SR 520/Montlake Boulevard interchange area currently operate at LOS D or better during the morning and afternoon peak hours (refer to Chapter 4 for a description of LOS). However, the Montlake Boulevard/Lake Washington Boulevard/SR 520 eastbound ramps intersection operates at LOS E during both the morning and afternoon peak hours, with legs of the intersection operating near or over capacity. Congestion from this traffic signal spills back into the off-ramp deceleration lane, which affects SR 520 mainline operations as drivers slow when approaching the off-ramp. Southbound queues, at times compounded by SR 520 congestion, extend back between East Hamlin Street and East Shelby Street. Northbound queues at times extend through the East Roanoke Street intersection.

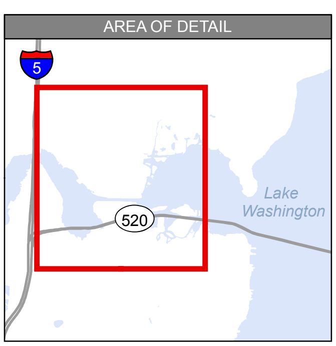
What would traffic be like at the Montlake interchange in 2030 without the project?

As discussed in Chapter 5, the region will grow by 1 million people by 2030, add over 640,000 new jobs, and need to accommodate close to 40 percent more traffic (PSRC 2006). Chapter 5 summarizes population and employment changes between now and the year 2030. Because of these increases, traffic volumes at the Montlake interchange area are forecasted to increase between 15 and 21 percent in the morning and afternoon, respectively, by the year 2030 independent of the SR 520, I-5 to Medina project.

The peak-hour volumes shown in Exhibits 6-1 and 6-2 for the SR 520/Montlake Boulevard interchange area show how traffic volume changes within the larger interchange area would affect specific streets.

With these increases, congestion is expected to worsen compared to today’s conditions. The following subsections describe areas where congestion occurs or where traffic volumes have been a concern to the communities. Intersections in the SR 520/Montlake Boulevard interchange area where traffic operations would degrade to worse than LOS D under the No Build Alternative are also described in detail below. Exhibit 6-3 shows the LOS designations for the intersections in the study area.





No Build
Existing
Preferred Alternative

	Ex	NB	PA
AM Peak Hour — AM	B	B	C
PM Peak Hour — PM	C	C	C

Alternatives Year 2030

LEVEL OF SERVICE

- A-C No/Little Congestion
- D Moderate Congestion
- E Heavy Congestion
- F Severe Congestion/Over Capacity

- Unsignalized Intersection
- Signalized Intersection
- Signalized Intersection with Project

Exhibit 6-3. **SR 520/Montlake Boulevard Interchange Area – AM and PM Peak Hour LOS**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

Lake Washington Boulevard through the Arboretum

Of the vehicles that travel through the Arboretum today and in the year 2030, about half the trips travel to and from SR 520. Today, the volume on Lake Washington Boulevard through the Arboretum is highest in the morning peak period, with about 1,590 trips per hour. Because of population and employment growth, this volume would increase by 23 percent to 1,950 vph in the year 2030. Today, in the afternoon peak period, there are 1,400 vph traveling through the Arboretum. This rate would increase to 1,730 vph in the year 2030 under the No Build Alternative. However, with this growth, the intersection of Lake Washington Boulevard with the SR 520 ramps would still operate at LOS D or better in the year 2030.

Montlake Boulevard/Lake Washington Boulevard/SR 520 Eastbound Ramps

As discussed in Chapter 5, eastbound SR 520 is congested for approximately 3 hours during the morning peak period. As a result, congestion backs up through the Montlake Boulevard/Lake Washington Boulevard/SR 520 eastbound ramps intersection and onto adjacent arterials. Congestion on Montlake Boulevard southbound can extend as far back as NE 45th Street.

During the morning peak hour, this intersection operates at LOS E today with an average delay of 60 seconds per vehicle. Today, the intersection receives an LOS E grade because the movements to and from the SR 520 ramps operate over capacity.

Between now and the year 2030 (No Build Alternative), traffic volumes would increase by 15 percent at this intersection. However, most of the growth would occur on the north-south movements. This means the overall intersection would still operate at LOS E in year 2030, but most of the approaches would operate over capacity with an overall delay of 72 seconds per vehicle. Northbound congestion would affect the Montlake Boulevard/East Roanoke Street intersection, and southbound congestion would limit the traffic that could access the westbound SR 520 on-ramp. Congestion on the eastbound off-ramp would not affect SR 520 mainline operations in the morning peak period.

At 55 seconds of delay per vehicle, an intersection earns a LOS E grade. At 80 seconds of delay per vehicle, an intersection earns a LOS F grade. Today's conditions of LOS E with 60 seconds of delay per vehicle is a better operating LOS E than the year 2030 No Build Alternative LOS E with 72 seconds, which is approaching a LOS F.

During the afternoon peak hour, intersection operations would worsen from LOS E today to LOS F (and 51 percent over capacity) in 2030 under the No Build Alternative. At its worst, congestion on the eastbound SR 520 off-ramp would extend back onto the eastbound SR 520 main line. Large queues would occur on all approaches and affect adjacent intersections.

Montlake Boulevard/NE Pacific Street

During the afternoon peak hour, intersection operations would worsen to LOS E with the No Build Alternative because of increases in traffic volumes expected between now and the year 2030. This intersection, which is currently at capacity, would be 20 percent over capacity in 2030 with the No Build Alternative. Congestion at this intersection would continue to affect adjacent intersections, with congestion extending as far north as 25th Avenue NE during the afternoon peak hour.

Traffic operations during the morning peak hour would not operate below a LOS D at this intersection.

Montlake Boulevard/East Shelby Street

During the afternoon peak hour, operations at this intersection would worsen from LOS D today to LOS F under the No Build Alternative. Congestion at this intersection would extend into adjacent intersections to the north and south. However, the effect of this congestion does not change the LOS grade at the adjacent intersections.

What would traffic be like at the Montlake interchange in 2030 with the project?

The Preferred Alternative would make the following changes to the transportation network within the Montlake Boulevard interchange area (Exhibits 6-4 and 6-5):

- Remove the Lake Washington Boulevard ramps that exist today.
- Improve the ramp merge areas on SR 520.
- Provide additional shoulder width on SR 520.
- Provide an inside HOV lane on SR 520.

- Add a new bascule bridge parallel to the existing Montlake Bridge that would add two lanes across the Montlake Cut and connect with the existing lanes on either side.
- Provide a northbound HOV lane on Montlake Boulevard between the SR 520 westbound ramps and the Montlake Cut.
- Provide a southbound HOV lane between Pacific Street and south of the Montlake cut.
- Add access from westbound SR 520 to south of the interchange area via 24th Avenue East.
- Add HOV direct access ramps that extend through 24th Avenue East to Montlake Boulevard from westbound SR 520 and to eastbound SR 520.
- Signalize the Montlake Boulevard/westbound SR 520 ramp intersection, and provide a northbound left turn from Montlake Boulevard to westbound SR 520.
- Add a second general-purpose lane on the westbound on-ramp and include a ramp meter.
- Convert the HOV bypass lane on the eastbound loop on-ramp to a general-purpose lane, resulting in a total of two general-purpose lanes that will be metered.

The design modifications for the SR 520 corridor in combination with the corridor toll would substantially reduce eastbound congestion through the interchange area. This reduction in SR 520 congestion would eliminate the highway-related congestion effects on Montlake Boulevard and improve traffic operations on the local street system.

The Preferred Alternative revises access for HOV/transit trips to and from SR 520 to the east, and for all trips to and from south of the interchange area.

For HOV trips, today the only priority they are provided is a queue bypass lane on the eastbound loop on-ramp. With the Preferred Alternative, trips destined to or from the east can use the direct access ramps.

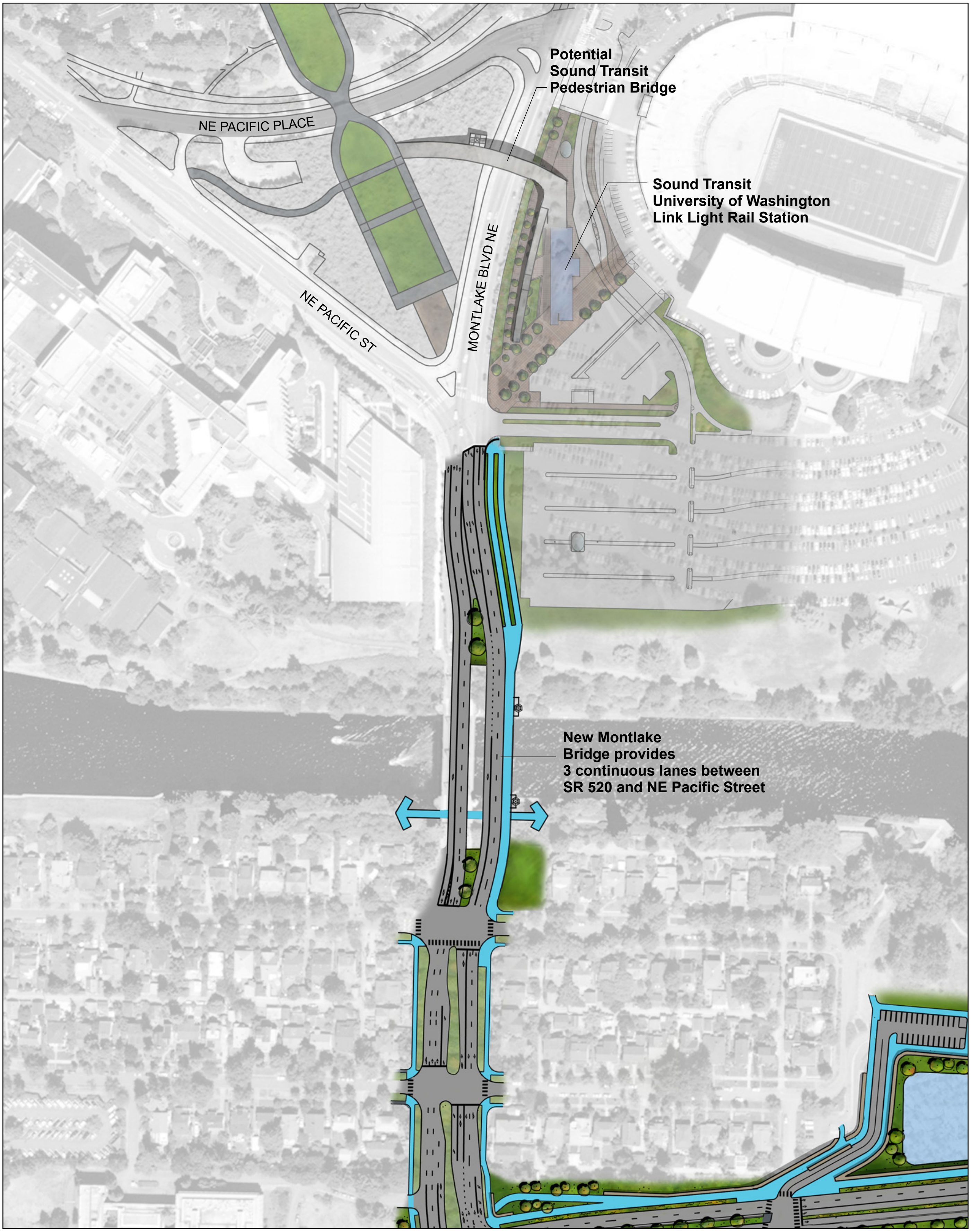


Exhibit 6-4. **Preferred Alternative Design, Montlake Boulevard from Pacific Street to SR 520**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

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Exhibit 6-5. **Preferred Alternative Design, Montlake Boulevard Interchange Area**

SR 520, I-5 to Medina: Bridge Replacement and HOV Project

For an HOV trip originating from east of Lake Washington to the Montlake area, the driver would stay in the HOV lane on SR 520, and exit from the left onto the direct access ramp. The ramp climbs over SR 520 onto the Montlake lid. The direct access ramp intersects with 24th Avenue East and terminates at Montlake Boulevard. If the trip had a south destination, the driver could turn left onto 24th Avenue East and travel south on either Lake Washington Boulevard or Montlake Boulevard. If the trip had a north destination, the driver would continue through the 24th Avenue East intersection and turn right at the Montlake Boulevard intersection. From here, the direct access ramp ties directly into an HOV lane that extends to the Montlake Cut.

For HOV trips starting in the Montlake area and destined to the Eastside, access directly into the HOV lane on SR 520 would also be provided. For trips traveling from north of SR 520, the driver could turn left from Montlake Boulevard directly onto the direct access ramps at the new Montlake Boulevard/SR 520 westbound ramp intersection. The driver would travel through the 24th Avenue East intersection and merge directly into the HOV lane on SR 520. For trips from the south, the vehicles would travel up Montlake Boulevard or Lake Washington Boulevard and access the direct access ramps from 24th Avenue East.

General-purpose access also changes with the Preferred Alternative for trips between south of SR 520 and east of Lake Washington. Today, those trips are served with the ramps to and from Lake Washington Boulevard. These ramps would be removed with the Preferred Alternative.

For trips south of SR 520 that are destined to the east, the drivers would travel up either Montlake Boulevard or Lake Washington Boulevard and use the loop ramp. For the return trip (westbound on SR 520 to south of SR 520), they would exit at the Montlake Boulevard off-ramp. This ramp climbs up to the lid where it intersects with 24th Avenue East. Trips heading south would then turn left onto 24th Avenue East and have the option to then travel southbound onto Lake Washington Boulevard or Montlake Boulevard.

In the Montlake area, year 2030 traffic forecasts show an overall growth of 15 percent and 23 percent in traffic during the morning and afternoon peak hours, respectively, which is similar to the No Build Alternative. The Preferred Alternative would not generate more regional traffic. However, travel patterns within the interchange area would change compared to the No Build Alternative due to the changes in access described above.

From the north, more trips from the University District to I-5 would travel along Montlake Boulevard southbound and across Portage Bay westbound than under the No Build Alternative. This is because travel along Montlake Boulevard would be improved with the additional capacity across the Montlake Cut, and congestion spilling back from SR 520 would be reduced.

With the Preferred Alternative, access to SR 520 from the south is provided at the Montlake loop ramp (for general-purpose trips) and at 24th Avenue East (for HOV trips). The ramp to SR 520 from Lake Washington Boulevard would be removed. Of the trips that do head north to travel eastbound on SR 520, more of them would use Montlake Boulevard rather than Lake Washington Boulevard to access SR 520. This change would result in less traffic using Lake Washington Boulevard through the Arboretum.

With these design changes, the Preferred Alternative would improve traffic operations at the following intersections compared with the No Build Alternative.

- In the No Build Alternative, significant congestion would spill back onto the Montlake Boulevard corridor, affecting operations at the intersections. This congestion is not quantified in the LOS letter grades. With the Preferred Alternative, this congestion would be removed, resulting in better operations. The effects of SR 520 congestion and its impacts on travel times are further discussed in Chapter 7.
- Montlake Boulevard/Lake Washington Boulevard/SR 520 eastbound ramps (operates at LOS F for both year 2030 scenarios, but improves from 50 percent over capacity with the No Build Alternative to 15 percent over capacity with the Preferred Alternative in the afternoon peak hour)
- Montlake Boulevard/East Shelby Street (improves from a LOS F with the No Build Alternative to a LOS D in the afternoon peak hour)
- Montlake Boulevard/NE Pacific Street (operates at LOS F for both year 2030 scenarios, but improves marginally from 20 percent over capacity to 15 percent over capacity with the Preferred Alternative in the afternoon peak hour)

Exhibit 6-3 summarizes LOS results for all SR 520/Montlake Boulevard interchange area intersections. The Preferred alternative would not degrade intersection operations during either peak hour compared to the No Build Alternative. The following subsections describe changes in traffic operations compared to the No Build Alternative. This description includes intersections that would operate worse than LOS D, which is considered to be below the threshold for acceptable peak period operations.

Lake Washington Boulevard through the Arboretum

Traffic volumes through the Arboretum with the Preferred Alternative in year 2030 would be lower than the No Build Alternative, but similar to today's conditions because the Lake Washington Boulevard ramps would be removed. About half of the trips that had used the Lake Washington Boulevard ramps from the south to head eastbound would move over to Montlake Boulevard. In the westbound direction, trips heading south would exit at 24th Avenue East and have the option to head south along Lake Washington Boulevard or Montlake Boulevard. Similar to the shift in travel for the eastbound trips, half the westbound trips would travel south along Montlake Boulevard and half on Lake Washington Boulevard. This pattern would be consistent in the morning and afternoon commute periods. The shift in travel to Montlake Boulevard occurs because the access that is provided at 24th Avenue East is fairly close to the Montlake corridor.

Today, the volume on Lake Washington Boulevard through the Arboretum is highest in the morning peak period, with about 1,590 trips per hour. Trips on Lake Washington Boulevard through the Arboretum would increase to 1,950 vph in the year 2030 without the project. Traffic volumes through the Arboretum would decrease to 1,330 vph in the morning, which is less than today's volumes with the Preferred Alternative that includes closing the Lake Washington Boulevard ramps.

Today, in the afternoon commute period, there are 1,400 vph traveling through the Arboretum. This rate would increase to 1,730 vph in the year 2030 with the No Build Alternative due to land use growth. With the Preferred Alternative, traffic volumes would be reduced to 1,410 vph in the afternoon peak hour, similar to today's conditions.

Montlake Boulevard/Lake Washington Boulevard/SR 520 Eastbound Ramps

With the Preferred Alternative, up to an additional 640 vph (Exhibit 6-6) would travel through this intersection with the closure of the ramps to/from SR 520 and Lake Washington Boulevard. The Preferred Alternative also includes additional capacity at this intersection to help serve those trips. The capacity improvements provided in this area were reviewed through the ESSB 6392 Workgroup process and limited by adjacent properties. The Preferred Alternative includes an additional northbound left lane and a westbound left-turn lane, and adds an eastbound left turn from the off-ramp.

Exhibit 6-6. **Volume Entering Montlake Boulevard/Lake Washington Boulevard/ SR 520 Eastbound Ramps Intersection, Year 2030 AM Peak Hour**

Alternative	AM Peak Hour	PM Peak Hour
Year 2030 No Build Alternative	4,550 vph	5,410 vph
Year 2030 Preferred Alternative	5,190 vph	5,760 vph
Preferred Alternative minus No Build Alternative	640 vph	350 vph

With this additional capacity, the Preferred Alternative would operate at LOS F and 10 percent over capacity in the morning peak period, and 20 percent over capacity in the afternoon peak period. The afternoon peak operations are a significant improvement compared to the No Build Alternative, which operates at 50 percent over capacity. The morning peak operations are similar to or slightly worse than the No Build Alternative (that operates at 5 percent over capacity) with the channelization reviewed in the ESSB 6392 Workgroup process. As described in Chapter 12, WSDOT may continue to work with the City of Seattle to manage the intersection such that SR 520 operations are not negatively affected.

With the improvements to the SR 520 main line and the addition of a second general-purpose lane on the on-ramp (by converting the HOV lane to general-purpose and shifting HOV to a dedicated ramp), congestion on the eastbound on-ramp would be reduced and would no longer back up onto Montlake Boulevard, substantially reducing the congestion on Montlake Boulevard southbound. However, because the intersection would operate at LOS F, there would still be congestion on the northbound, southbound, and westbound approaches to the intersection. Northbound congestion would queue through the

Montlake Boulevard/ East Roanoke Street intersection, and southbound congestion would affect the trips able to access the westbound SR 520 on-ramp intersection.

Montlake Bridge openings can have long-lasting effects on traffic flow in this area. The bridge does not open during the morning and afternoon peak periods; however, if the bridge opens at the end of the midday period (3:30 p.m.), it can affect traffic operations throughout the afternoon commute. Bridge openings compound whatever congestion is present on the local street network and can cause congestion to spill back onto the SR 520 main line. When congestion reaches the SR 520 corridor, eastbound traffic can then become so congested that it affects traffic on I-5.

An average of 8 to 9 bridge openings occurs during a typical summer weekday (fewer openings occur during other times of the year). Bridge openings typically last 4 to 5 minutes, but can extend up to 6 minutes on occasion (WSDOT 2008a).

Montlake Bridge opening delays make it difficult for bus drivers to keep to their schedules, which affect bus travel times and reliability. When the bridge opens during the weekday afternoon, southbound buses are delayed up to an additional 13 minutes (above their typical travel time without a bridge opening) and northbound buses are delayed up to an additional 7 minutes.

Today, it takes up to 40 minutes for northbound congestion to clear and recover to pre-bridge opening conditions. When the bridge opens at 3:30 p.m., the southbound congestion does not clear again before traffic volumes increase and additional congestion builds due to the evening commute.

In the year 2030 No Build Alternative, as traffic volumes increase due to land use changes, congestion and resulting delays due to bridge openings would increase.

With the Preferred Alternative, a parallel new bascule bridge would be constructed. The roadway capacity provided with the new bridge would allow for the Montlake Boulevard corridor to include an HOV lane in each direction and a widened pedestrian path. The two parallel bridges would open together as boats pass underneath. The typical opening would be 10 seconds longer with two parallel bridges compared to a single bridge to allow boats to clear both bridges. However, having two bridges would also allow the queue of traffic that builds during an opening to clear faster.

Travel time delays for today, year 2030 No Build Alternative, and the Preferred Alternative are shown below.

Maximum Delay due to Bridge Opening at 3:30 p.m. and Recovery Time

Proposed Trip	Existing Travel Delay	2030 No Build Alternative	2030 Preferred Alternative
Local southbound transit trip (from NE Pacific Street to south of SR 520)	13 minutes of delay; *congestion would continue through peak commute*	13 minutes of delay; *congestion would continue through peak commute*	7 minutes of delay; *congestion would continue through peak commute*
Local northbound transit trip (from south of SR 520 to NE Pacific Street)	4 minutes of delay; 40 minutes to recover	14 minutes of delay; *congestion would continue through peak commute*	11 minutes of delay; *congestion would continue through peak commute*
SR 520 transit trip (from southbound NE Pacific Street to eastbound SR 520)	12 minutes of delay; *congestion would continue through peak commute*	14 minutes of delay; *congestion would continue through peak commute*	7 minutes of delay; *congestion would continue through peak commute*
SR 520 transit trip (from westbound SR 520 to northbound NE Pacific Street)	7 minutes of delay; 40 minutes to recover	11 minutes of delay; *congestion would continue through peak commute*	4 minutes of delay; 20 minutes to recover
University Village to south of SR 520	3 minutes of delay; 10 minutes to recover	16 minutes of delay; *congestion would continue through peak commute*	15 minutes of delay; *congestion would continue through peak commute*
South of SR 520 to University Village	4 minutes of delay; 30 minutes to recover	13 minutes of delay; *congestion would continue through peak commute*	10 minutes of delay; *congestion would continue through peak commute*

* Delay shown is only the additional delay experienced with the bridge opening. Delay does not include other factors such as signal delay or delay from congestion prior to bridge opening.

Montlake Boulevard NE/NE Pacific Street

During the afternoon peak hour, the Montlake Boulevard NE/NE Pacific Street intersection would operate at LOS E and 21 percent over capacity under the No Build Alternative.

The Preferred Alternative would have similar volumes through this intersection as the No Build Alternative. However, with the Preferred Alternative, a southbound HOV receiving lane along Montlake Boulevard is provided. This configuration allows signal modifications, resulting in slightly better operations.

Montlake Boulevard/East Shelby Street

Intersection operations would improve from LOS F under the No Build Alternative to LOS D with the Preferred Alternative.

Today, north of the Montlake Boulevard/East Shelby Street intersection, the roadway is limited to two lanes in each direction. This requires traffic to narrow from three lanes to two northbound through this intersection. The Preferred Alternative includes additional capacity across the Montlake Cut with a new bascule bridge, resulting in three lanes in each direction. The increased capacity in and out of the Montlake Boulevard/East Shelby Street intersection to and from the north would result in less delay for traffic traveling through this intersection.